



Shell Australia

Browse Regional Oil Pollution Emergency Plan (OPEP)

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I. Initial response requirements

An overview of the initial response requirements for Facility spills (where Titleholder is the Control Agency) is provided in Table I-I-1 and vessel spills (where AMSA becomes the Control Agency) is provided in Table I-I-2.

Table I-I-1 and Table I-I-2 have been developed to guide response personnel through the key steps of this Browse Regional Oil Pollution Emergency Plan (BROPEP) during a Level 2 or Level 3 spill (defined in Section 2.1).

The tables contain cross-references to other sections of this BROPEP, which provide additional information to guide the response.



Table I-I-1 : Initial response requirements – facility spill (FLNG/Platform/CPF/FPSO/GEP/MODU, etc.)

Action by			Spill from a facility (SHELL Control Agency Scenario)		
Definitions for 'Action by' persons are as follows: CSSR – Contractor Senior Site Representative. SSR – Shell Senior Site Representative. IMT – Incident Management Team (Shell). CSSR includes: (Onboard facility – Contractor most senior representative), (Onboard MODU - Contractor OIM), (Onboard vessel conducting activity as a Facility/AOP – Vessel Master). SSR includes: (Onboard FLNG/CPF/FPSO –OIM), (Onboard MODU – Shell Drilling Supervisor), (Onboard vessel conducting activity as a Facility/AOP – Shell Client Site Representative).					
CSSR	SSR	IMT	Immediate Response Actions	Information/Resources	Comments
■	■		ALL - report the spill to relevant CSSR/SSR. If safe to do so - stop the source of the spill (CSSR from a Contractor operated facility, or SSR from an Shell operated facility).	Activate facility/vessel shipboard oil pollution emergency plan (SOPEP)/emergency response plans.	
■	■		CSSR to alert the SSR.	See Section 2.4.1 Internal notification.	
	■	■	SSR to notify Incident Management Team (IMT) Leader. IMT Leader notify SHELL Crisis Management Team (CMT) Leader. IMT Leader to activate IMT.	Activate via IMT via contact with IMT Leader. See Section 2.4.1 Internal notification. Table 2-2: Jurisdictional Boundaries, Jurisdictional Authority and Control Agencies. IMT W Weekly Contact List. IMT W Confidential Phone List	Titleholder is the Control Agency for spills from the Facility in Commonwealth Waters. Titleholder is required to coordinate the response to the spill in accordance with this BROPEP. 24-hour activation numbers are located in the IMT W Weekly Contact List and IMT W Confidential Phone List
	■	■	SSR and IMT Leader to classify the spill incident level.	See Section 2.1 Spill classification. See Table 2-1: Incident classification.	This BROPEP is only activated if the spill is a Level 2 or 3 spill. (NOPSEMA 2hr notification not required, if not a Level 2/3 spill.)
	■	■	SSR (or IMT Leader at request of SSR) to verbally notify the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) of Level 2 or Level 3 spills.	Section 2.4.2 External agencies notification Table 2-2: Jurisdictional Boundaries, Jurisdictional Authority and Control Agencies. IMT W L2 Emergency Response Plan	NOPSEMA is the Jurisdictional Authority for spills from Facilities in Commonwealth Waters. Complete verbal notification to NOPSEMA within two hours of spill occurrence. NOPSEMA's 24-hour incident notification phone number is +61 8 6461 7090.
■	■		CSSR (from a Contractor operated facility), or SSR (from an SHELL operated facility) to verbally notify AMSA.	Section 2.4.2 External agencies notification Table 2-2: Jurisdictional Boundaries, Jurisdictional Authority and Control Agencies. Table 2-4: External notifications matrix. IMT W L2 Emergency Response Plan	AMSA is required to be notified for all Facility spills. Notification of AMSA will be through the incidents through the AMSA Rescue Coordination Centre (RCC) Australia on +61 2 6230 6811.
■	■		CSSR (from a Contractor operated facility), or SSR (from an SHELL operated facility) prepare marine pollution report (POLREP), submit to AMSA. SSR to forward copy of POLREP to IMT Leader.	POLREP. (See Section 2.5 and Oil spill forms register Table 5-1: Oil Spill Response Forms).	



Action by			Spill from a facility (SHELL Control Agency Scenario)		
			Definitions for 'Action by' persons are as follows: CSSR – Contractor Senior Site Representative. SSR – Shell Senior Site Representative. IMT – Incident Management Team (Shell). CSSR includes: (Onboard facility – Contractor most senior representative), (Onboard MODU - Contractor OIM), (Onboard vessel conducting activity as a Facility/AOP – Vessel Master). SSR includes: (Onboard FLNG/CPF/FPSO –OIM), (Onboard MODU – Shell Drilling Supervisor), (Onboard vessel conducting activity as a Facility/AOP – Shell Client Site Representative).		
CSSR	SSR	IMT	Immediate Response Actions	Information/Resources	Comments
		■	IMT Leader to establish contact with AMSA RCC and confirm AMSA has received POLREP. As required, discuss any NatPlan capability AMSA may offer to support the response.	POLREP. (See Section 2.5 and Oil spill forms register Table 5-1: Oil Spill Response Forms).	Notification of AMSA will be through the incidents through the AMSA Rescue Coordination Centre (RCC) Australia on +61 2 6230 6811. If a vessel is the source of the spill, and the vessel was classified as a 'Facility, or Associated Offshore Place' at the time of event, Titleholder is the Control Agency. As Titleholder is the Control Agency, the IMT Leader can formally (verbally, or written on the POLREP) request AMSA to activate/mobilise oil spill response resources available under the National Plan for Maritime Environmental Emergencies. If the vessel was not a Facility or Associated Offshore Place at the time of the incident, refer to Table I-1-2 below.
		■	Activate Australian Marine Oil Spill Centre (AMOSC) IMT support for all Level 2/3 spills – to commence immediate integration within the SHELL IMT.	IMT W L2 Emergency Response Plan	AMOSC will provide support and guidance to the IMT during any Level 2 or Level 3 spill event. AMOSC 24-hour mobile number; +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. All IMT Leaders have the call-out authority to activate AMOSC. AMOSC will email a service contract which must be completed with the requested resources/personnel required from AMOSC and must be signed by the IMT Leader. IMT Leader must email completed form back to AMOSC to complete the mobilisation process.
		■	Notify Oil Spill Response Limited (OSRL) of all Level 2/3 spills. Consider the need for additional mobilisation of OSRL IMT/Field Response support as required.	IMT W L2 Emergency Response Plan	A notification to OSRL should be conducted for any Level 2/3 spill event. OSRL 24-hour notification number; +65-6266-1566 Email: dutymanager@oilspillresponse.com OSRL will establish their Emergency Operations Centre and provide technical advice/support, with a team of 5 personnel, for up to 5 days (at zero cost). Should additional support be required, (longer term in-field and/or IMT resources support) OSRL mobilisation must be via the IMT Leader(s), who are persons authorised under the OSRL contract.
		■	Notify additional regulators and stakeholders.	Section 2.4.2 External agencies notification Table 2-4: External notifications matrix. IMT W L2 Emergency Response Plan	External agencies contact information is available in the IMT W L2 Emergency Response Plan. Mandatory notification required to WA DoT in event of a loss of well containment or if spill may move towards/into WA 3nm waters/shorelines.



Action by			Spill from a facility (SHELL Control Agency Scenario)		
			Definitions for 'Action by' persons are as follows: CSSR – Contractor Senior Site Representative. SSR – Shell Senior Site Representative. IMT – Incident Management Team (Shell). CSSR includes: (Onboard facility – Contractor most senior representative), (Onboard MODU - Contractor OIM), (Onboard vessel conducting activity as a Facility/AOP – Vessel Master). SSR includes: (Onboard FLNG/CPF/FPSO –OIM), (Onboard MODU – Shell Drilling Supervisor), (Onboard vessel conducting activity as a Facility/AOP – Shell Client Site Representative).		
CSSR	SSR	IMT	Immediate Response Actions	Information/Resources	Comments
					WA DoT Maritime Environmental Emergency Response 24-hour contact number is (08) 9480 9924.
		■	Develop and maintain 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.
		■	Activate oil spill trajectory modelling.	See Section 4.4.1 Surveillance, monitoring and visualisation (SMV). Via AMOSC call off contract with RPS.	Oil Spill Trajectory Modelling should be activated as soon as possible.
	■	■	SSR, in consultation with the IMT, to coordinate visual surveillance activities. Initiate Surveillance, Monitoring and Visualisation - aerial & vessel/facility visual surveillance.	See Section 4.4.1 Surveillance, monitoring and visualisation (SMV).	Obtain visual spill observations from any nearby facilities/vessels Utilise any available crew change helicopters for visual surveillance IMT to coordinate longer term fixed wing aerial surveillance
	■	■	SSR, in consultation with the IMT, to coordinate the deployment of oil spill satellite tracking buoys.	See Section 4.4.1 Surveillance, monitoring and visualisation (SMV). SAFETY ALERT – there are safety considerations for deployment of satellite tracking buoys. Refer Section 4.4.1 for more details.	The location of satellite tracking buoys is on the Prelude FLNG.
	■		GROUP IV SPILLS ONLY SSR to facilitate identification of most suitable vessel for dispersant operations, conduct dispersant test spray and report on effectiveness to the IMT Leader.	See Section 2.6 Immediate (first strike) response measures. See Section 4.5.5 Surface (vessels and aerial) dispersant.	SSR (OIM) to deploy the dispersant system from ISVs. If no contracted vessels available, additional vessel dispersant capability available (best endeavours) via Shell. Request access via Prelude OIM to Ichthys OIM. Ongoing operational dispersant spraying only under direction from IMT Leader.
		■	GROUP IV SPILLS ONLY Commence activation of Containment and Recovery (C&R), and Fixed Wing Aerial Dispersant (FWAD) Capabilities.	See Section 2.6 Immediate (first strike) response measures. See Section 4.5.5 Surface (vessels and aerial) dispersant. See Section 4.5.6 At-sea containment and recovery.	IMT to notify AMOSC to move C&R equipment from Broome stockpile to Broome Wharf. IMT to identify primary C&R vessel (large vessel with rolled stern – E.g., Anchor Handling Tug) and second support vessel (small or large) to assist with boom deployment and towing Notify AMOSC to activate FWAD Capability Contract – AT-802 air-tractor(s) from Batchelor and/or Exmouth – prepare to mobilise to a nominated airfield (E.g., Lombadina or Truscott).



Action by			Spill from a facility (SHELL Control Agency Scenario)		
			Definitions for 'Action by' persons are as follows: CSSR – Contractor Senior Site Representative. SSR – Shell Senior Site Representative. IMT – Incident Management Team (Shell). CSSR includes: (Onboard facility – Contractor most senior representative), (Onboard MODU - Contractor OIM), (Onboard vessel conducting activity as a Facility/AOP – Vessel Master). SSR includes: (Onboard FLNG/CPF/FPSO –OIM), (Onboard MODU – Shell Drilling Supervisor), (Onboard vessel conducting activity as a Facility/AOP – Shell Client Site Representative).		
CSSR	SSR	IMT	Immediate Response Actions	Information/Resources	Comments
					Capabilities can be de-activated later if Operational SIMA determines response strategies are not required.
		■	IMT to request satellite imagery for large Level 2 and all Level 3 spills.	See Section 4.4.1 Surveillance, monitoring and visualisation (SMV).	AMOSC, OSRL and AMSA have ability to provide satellite imagery acquisition/support. Typically, will take a few days to acquire the satellite imagery.
		■	Obtain long-term weather forecasts.	For weather forecast service provider see the IMT W L2 Emergency Response Plan.	Site-specific, long-term weather forecasts are available through the SHELL subscription to the Bureau of Meteorology (BOM).
		■	Identify protection priorities.	See Section 3.3 Protection priorities. See Appendix C – SHELL Environmental Values and Sensitivities Maps	
		■	Complete Operational spill impact mitigation assessment (SIMA) template to generate Operational SIMA and select response strategies.	See Section 3.4 Operational SIMA.	
		■	Develop Incident Action Plan (IAP).	See Section 3.5 Incident Action Plan. Appendix B: Shell Digital Incident Action Plan overview.	Spill response strategy capability descriptions, activation arrangements and implementation processes are provided in Section 4 Spill Response Resources. Utilise this information during the development of the IAP.
		■	Implement IAP.	See Section 4 Oil Spill Response Strategy Implementation Guide.	
		■	Use oil spill surveillance and reconnaissance (OM) data to update oil spill trajectory modelling outputs (SM).	See Section 4.4.1 Surveillance, monitoring and visualisation. See Section 4.7 Operational and scientific monitoring.	
		■	Use operational monitoring (OM) program data to determine scientific monitoring (SM) activation.	Section 4.7 Operational and scientific monitoring.	
		■	Terminate response.	See Section 3.6 Response termination and Section 4.	General response termination considerations are provided in Section 3.6. Response strategy specific termination criteria considerations are provided in Section 4.



Table I-I-2: Initial response requirements – vessel spills

Action by			Spill from vessel (AMSA Control Agency)		
Definitions for 'Action by' persons are as follows: CSSR – Contractor Senior Site Representative. SSR – Shell Senior Site Representative. IMT – Incident Management Team (Shell). CSSR includes: (Onboard vessel – Vessel Master). SSR includes: (Onboard vessel – Shell Client Site Representative).					
CSSR	SSR	IMT	Immediate Response Actions	Information/Resources	Comments
■			ALL - report the spill to relevant CSSR/SSR. If safe to do so - stop the source of the spill (CSSR from a Contractor operated facility, or SSR from an Shell operated facility).	Activate vessel shipboard oil pollution emergency plan (SOPEP).	
■	■		CSSR to alert the SSR.	See Section 2.4.1 Internal notification.	
	■	■	SSR to notify IMT Leader. IMT Leader notify SHELL Crisis Management Team (CMT) Leader. IMT Leader to activate IMT.	Activate IMT via IMT Leader See Section 2.4.1 Internal notification Table 2-2: Jurisdictional Boundaries, Jurisdictional Authority and Control Agencies. IMT W Weekly Contact List IMT W Confidential Phone List	Shell is the Control Agency for spills from the Facility in Commonwealth Waters. Shell is required to coordinate the response to the spill in accordance with this BROPEP. Shell IMT Leader activation number is: +61(0) 420 909 376
■	■	■	Classify the spill incident level.	See Section 2.1 Spill classification. See Table 2-1: Incident classification.	This BROPEP is only activated if the spill is a Level 2 or 3 spill. (NOPSEMA 2hr notification not required, if not a Level 2/3 spill.)
■			CSSR to verbally notify AMSA.	See Section 2.4.2 External agencies notification. Table 2-2: Jurisdictional Boundaries, Jurisdictional Authority and Control Agencies Table 2-4: External notifications matrix. IMT W L2 Emergency Response Plan.	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.
	■	■	SSR (or IMT Leader at request of SSR) to verbally notify the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) of Level 2 or Level 3 spills.	See Section 2.4.2. Table 2-2: Jurisdictional Boundaries, Jurisdictional Authority and Control Agencies. IMT W L2 Emergency Response Plan.	NOPSEMA is the Jurisdictional Authority for spills from Facilities in Commonwealth Waters. Complete verbal notification to NOPSEMA within two hours of spill occurrence. NOPSEMA's 24-hour incident notification phone number is +61 8 6461 7090.
■	■		CSSR prepare marine pollution report (POLREP), submit to AMSA. SSR to forward copy of POLREP to IMT Leader.	POLREP. (See Section 2.5 and Oil spill forms register Table 5-1: Oil Spill Response Forms).	
		■	IMT Leader to establish contact with AMSA Confirm AMSA has received POLREP. IMT to confirm Control Agency status (AMSA for vessel spills).	POLREP. (See Section 2.5 and Oil spill forms register Table 5-1: Oil Spill Response Forms).	If the vessel was classified as a 'vessel' at the time of event, AMSA is the Control Agency. AMSA and Shell acknowledge that AMSA retains Control Agency responsibility for all ship sourced marine pollution incidents. Shell agrees to provide all available support to



Action by			Spill from vessel (AMSA Control Agency)		
Definitions for 'Action by' persons are as follows: CSSR – Contractor Senior Site Representative. SSR – Shell Senior Site Representative. IMT – Incident Management Team (Shell). CSSR includes: (Onboard vessel – Vessel Master). SSR includes: (Onboard vessel – Shell Client Site Representative).					
CSSR	SSR	IMT	Immediate Response Actions	Information/Resources	Comments
			If AMSA are Control Agency, IMT to offer support as per Shell/AMSA memorandum of understanding (MOU).		AMSA in AMSA's performance of its Control Agency responsibilities under the National Plan for Maritime Environmental Emergencies. All resources and capabilities within this BROPEP can be implemented upon AMSAs request. AMSA position is that Shell should activate all Shell 'first strike' capabilities, where there is no 'risk' of additional environmental harm, associated with the mobilisation/activation of that capability. Shell mobilised capabilities can be 'turned-off' at any time, as directed by AMSA. Whilst initially mobilised by the Shell IMT, operational control of these capabilities will be taken over by AMSA as the Control Agency, as the scenario evolves and IMT's become established. Transfer of control of Shell mobilised capabilities to AMSA will occur via consultation between the Shell IMT and the AMSA IMT. Shell IMT to maintain communications with AMSA IMT including the mobilisation/activation and continuous operational feedback for each response capability, until such time as operational control is transferred to the AMSA IMT.
		■	Activate oil spill trajectory modelling.	See Section 4.4.1 Surveillance, monitoring and visualisation (SMV). Oil Spill Response Forms Register (C075-AH-LIS-10006).	Oil Spill Trajectory Modelling should be activated as soon as possible. RPS modelling request activated via 24/7 duty phone – 0408 477 196, followed by email of modelling request form to response@rpsgroup.com.au
	■	■	SSR, in consultation with the IMT, to coordinate visual surveillance activities. Initiate Surveillance, Monitoring and Visualisation - aerial & vessel/facility visual surveillance.	See Section 4.4.1 Surveillance, monitoring and visualisation (SMV).	Obtain visual spill observations from any nearby facilities/vessels Utilise any available crew change helicopters for visual surveillance IMT to coordinate longer term fixed wing aerial surveillance
	■	■	SSR, in consultation with the IMT, to coordinate the deployment of oil spill satellite tracking buoys.	See Section 4.4.1 Surveillance, monitoring and visualisation (SMV). SAFETY ALERT – there are safety considerations for deployment of satellite tracking buoys. Refer Section 4.4.1 for more details.	The location of satellite tracking buoys is on the Prelude FLNG
	■		GROUP IV SPILLS ONLY SSR to facilitate identification of most suitable vessel for dispersant operations. SSR to mobilise dispersant equipment and PREPARE for dispersant test spray.	See Section 2.5 Immediate (first strike) response measures. See Section 4.5.4 Surface (vessels and aerial) dispersant.	SSR (FPSO OIM) to deploy the FPSO dispersant stockpile (and FPSO AFEDO system and FPSO dispersant trained personnel as required), to suitable support vessel. If no Shell contracted vessels available, additional vessel dispersant capability available (best endeavours) via Prelude. Request access via Ichthys OIM to Prelude OIM.



Action by			Spill from vessel (AMSA Control Agency)		
			Definitions for 'Action by' persons are as follows: CSSR – Contractor Senior Site Representative. SSR – Shell Senior Site Representative. IMT – Incident Management Team (Shell). CSSR includes: (Onboard vessel – Vessel Master). SSR includes: (Onboard vessel – Shell Client Site Representative).		
CSSR	SSR	IMT	Immediate Response Actions	Information/Resources	Comments
			Activate test spray ONLY when authorised by AMSA .		Initial test spray and ongoing operational dispersant spraying only under direction from AMSA.
		■	GROUP IV SPILLS ONLY Commence activation of Containment and Recovery (C&R). (Note, FWAD capability will be mobilised by AMSA directly).	See Section 2.5 Immediate (first strike) response measures. See Section 4.5.4 Surface (vessels and aerial) dispersant. See Section 4.5.5 At-sea containment and recovery.	IMT to notify AMOSC to move C&R equipment from Broome stockpile to Broome Wharf and identify/mobilise suitable Core-Group personnel for boom deployment. IMT to identify primary C&R vessel (large vessel with rolled stern – E.g., Anchor Handling Tug) and second support vessel (small or large) to assist with boom deployment and towing.



II. Abbreviations and acronyms

Abbreviation/acronym	Meaning
AFEDO	Ayles Fernie Even Drop Out
AFR	Aerotech First Response Ltd
AIMS	Australian Institute of Marine Science
AIS	automatic identification system
AHT	anchor handing tugs
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.
AOP	associated offshore place
ARP	applied research program
ASV	accommodation support vessel
AT	air tractor
BACI	before–after, control–impact
BIA	biologically important area



Abbreviation/acronym	Meaning
BOM	Bureau of Meteorology
BROPEP	Browse Regional Oil Pollution Emergency Plan (HSE_GEN_016765)
CMT	crisis management team
COP	common operating picture
CPF	central processing facility
CSSR	contractor senior site representative
Cwlth	Commonwealth
C&R	containment & recovery
DAWE	Department of Agriculture, Water and the Environment (Cwlth) (formerly the Cwlth Department of Environment and Energy)
DBCA	Department of Biodiversity, Conservation and Attractions (WA)
DEPWS	Department of Environment, Parks and Water Security (NT)
DITRDC	Department of Infrastructure, Transport, Regional Development and Communications (Cwlth)
DWER	Department of Water and Environmental Regulation (WA)
DIIS	Department of Industry, Innovation and Science (Cwlth)
DIPL	Department of Planning, Infrastructure and Logistics (NT)
DNP	Director of National Parks (Cwlth)



Abbreviation/acronym	Meaning
DoT	Department of Transport (WA)
DPaW	Department of Parks and Wildlife (WA) now WA DBCA
DWER	Department of Water and Environment Regulation (WA)
EEZ	exclusive economic zone
EMBA	environment that may be affected
EP	environment plan
EPA	Environment Protection Authority (NT)
EPBC	Environment Protection and Biodiversity Conservation
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cwlth)
EPO	environmental performance outcome
EPS	environmental performance standard
ERT	emergency response team
ESP	environmental service provider
ESTB	Electronic surface tracking buoys
E&P	exploration and production
FLNG	floating liquified natural gas
FOB	forward operating base



Abbreviation/acronym	Meaning
FWAD	Fixed wing dispersant application
GEP	gas export pipeline
GIS	geographic information system
GPS	global positioning system
Group I	condensate
Group II	MGO/diesel
Group IV	IFO/HFO/LSHFO
HFO	heavy fuel oil
HMA	Hazard Management Agency
HSE	health, safety and environment
IAP	incident action plan
IBC	intermediate bulk container
IC	Incident Controller
IFO	Intermediate Fuel Oil
I-GEM	Industry–Government Environmental Metadata
IMG	incident management guide
IMT	incident management team (Shell specifically – unless stated otherwise)



Abbreviation/acronym	Meaning
IOT	Indian Ocean Territories
SSR	INPEX senior site representative
JPDA	Joint Petroleum Development Area
JSCC	Joint Strategic Coordination Committee
KEF	key ecological feature
LAT	lowest astronomical tide
LSHFO	low sulphur heavy fuel oil
MARPOL 73/78	International Convention for the Prevention of Pollution from Ships, 1973/1978
MGO	marine gas oil
MNES	matter of national environmental significance
MODU	mobile offshore drilling unit
MOP	Marine Oil Pollution
MoU	memorandum of understanding
NATA	National Association of Testing Authorities
NatPlan	National Plan for Maritime Environmental Emergencies
NAXA	Northern Australia Exercise Area



Abbreviation/acronym	Meaning
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority (Cwlth)
nm	nautical mile
NT	Northern Territory
NT OSCP	Northern Territory Oil Spill Contingency Plan
OM	operational monitoring
OIM	Offshore Installation Manager
OPEP	oil pollution emergency plan
OPGGS (E) Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cwlth)
OSCA	oil spill control agent
OSCP	oil spill contingency plan
OSMP	operational and scientific monitoring program
OSRL	Oil Spill Response Limited
OSRO	Oil spill response organisation
OSTM	oil spill trajectory modelling
OSV	offtake support vessel
OWR	oiled wildlife response



Abbreviation/acronym	Meaning
PaWC	Parks and Wildlife Commission (NT)
PEARS	People, Environment, Assets, Reputation and Sustainability
PEZ	potential exposure zone
POLREP	marine pollution report
PPE	personal protective equipment
PSV	platform support vessel
PTW	permit to work
P&D	protection and deflection
RCC	Rescue Coordination Centre
ROV	remotely operated underwater vehicle
SAR	synthetic aperture radar / search and rescue
SCAT	shoreline clean-up and assessment technique
SFRT	subsea first response toolkit
SHP-MEE	State Hazard Plan – Maritime Environmental Emergencies
SIMA	spill impact mitigation assessment
SITREP	situation report
SM	scientific monitoring



Abbreviation/acronym	Meaning
SMV	surveillance, monitoring and visualisation
SOPEP	shipboard oil pollution emergency plan
SSDI	subsea dispersant injection
Titleholder	Within this document, it refers to Shell.
TMPC	Territory marine pollution coordinator
UXO	unexploded ordnance
VOC	volatile organic compound
WA	Western Australia
WCSS	Worst Credible Spill Scenario



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 Regional Oil Pollution Emergency Plan (BROPEP) has been developed specifically to respond to emergency conditions as described and defined in Titleholders Environment Plans (EPs).

The scope of this BROPEP is related to Shell Australia's petroleum activities in Australian commonwealth waters, between waters offshore (west) of Broome/Dampier Peninsula (Western Australia (WA)) and waters offshore (north and west) of Darwin (Northern Territory (NT)) and out to the boundary of the Australian Exclusive Economic Zone (EEZ)/international maritime boundaries. Shell Australia will be referred to as 'Titleholder' throughout this document. This includes the Canning, Browse and Bonaparte petroleum basins, hereafter referred to as BROPEP region (Refer to Figure 1-2).

The purpose of this BROPEP is to:

- describe the oil spill emergency response capabilities and arrangements that are in place for Shell Australia's petroleum activities being undertaken within the Browse Basin and adjacent Commonwealth waters.
- provide high level guidance and process support for the Shell Incident Management Team (IMT).
- demonstrate that the intent of Regulation 14 (and associated sub-regulations) of the OPGGS (E) Regulations has been met.
- The inter-relationship of this document to other BROPEP documentation is presented in Figure 1-1 and Table 1-1.

Note, the implementation strategy for the Browse Regional Oil Pollution Emergency Plan suite of documents (Table 1-1), is described in the Browse Regional Oil Pollution Emergency Plan - Basis of Design and Field Capability Assessment Report (HSE_GEN_016764).

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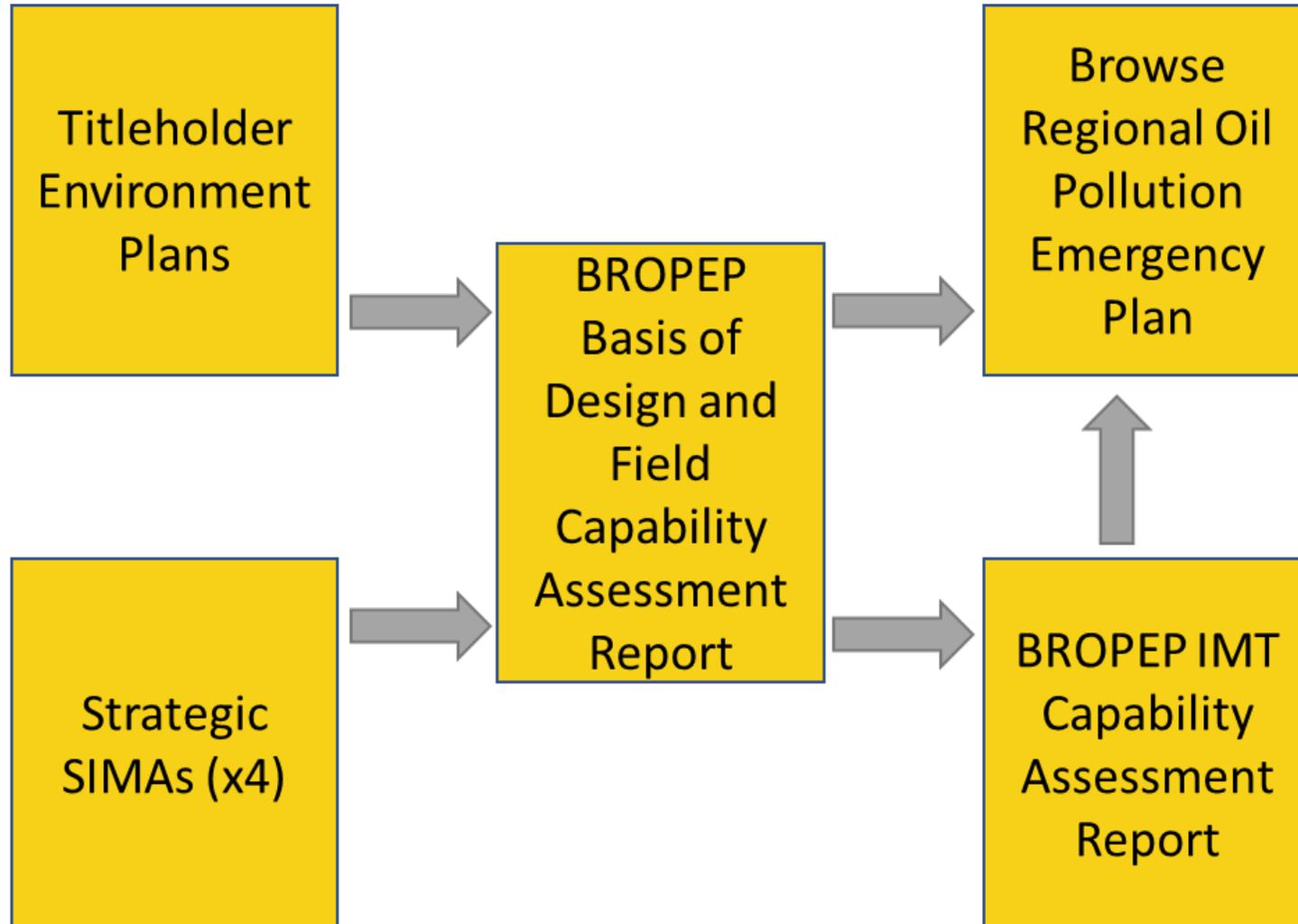


Figure 1-1: BROPEP document structure



Table 1-1: BROPEP documentation overview

Document Title	Reference Location	Document Purpose
Titleholder Environment Plans	NOPSEMA Website	All Titleholder EPs contain a detailed activity description, activity specific oil spill hazard identification, including potential release rates, volumes, locations, hydrocarbon types etc, activity specific oil spill modelling, used to inform environmental risk assessments, risk assessment of oil spills on environmental values and sensitivities and evaluations of controls to prevent oil pollution from the described activity. The Worst Credible Spill Scenario (WCSS) from all Titleholder EPs are included in the BROPEP Basis of Design and Field Capability Assessment (HSE_GEN_016764).
Browse Region - Oil Pollution Emergency Plan (HSE_GEN_016765) (this document)	N/A	This document is the tool which will be utilised by the Incident Management Team (IMT) during any impending/actual oil spill event. This document assists/guides the IMT through the process of notifications, gaining/maintaining situational awareness, response strategy evaluation and incident action plan (IAP) development, and mobilisation of field response capabilities. The document provides Environmental Performance Objectives (EPOs) and Environmental Performance Standard (EPSs) related to the implementation of response strategies.
Browse Region Oil Pollution Emergency Plan - Basis of Design and Field Capability Assessment (HSE_GEN_016764)	Attachment 1	This document presents an overview of all Titleholder's offshore (Browse/Bonaparte basin) petroleum activities and associated oil spill risks. This document evaluates modelling outcomes from a series of selected WCSSs and presents an oil spill response field capability analysis. This document also presents the EPOs and EPSs associated with the preparedness and environmental risk assessment of field response capability and arrangements.



BROPEP – Incident Management Team Capability Assessment Report	Attachment 2	The document utilises the field capability assessments as inputs to evaluate the size and structure of the IMT necessary to mobilise and maintain the field capability. The document also presents the EPOs and EPSs associated with the IMT capability and arrangements.
Strategic Spill Impact Mitigation Assessment (SIMA)s. Condensate spill – instantaneous surface release MGO/diesel spill – instantaneous surface release Intermediate/heavy fuel oil spill – instantaneous surface release Condensate/gas well or pipeline blowout – long duration subsea release	Attachment 3	The four Titleholder Strategic SIMA documents are pre-spill planning tools used to facilitate response option selection by identifying and comparing the potential effectiveness and impacts of the various oil spill response strategies on a range of environmental values and sensitivities. The Strategic SIMAs utilise a semi-quantitative process to evaluate the impact mitigation potential of each response strategy. This method provides a transparent decision-making process for determining which response strategies are most likely to be effective at minimising oil spill impacts. The SIMA process includes environmental considerations as well as a range of shared values such as ecological, socio-economic and cultural aspects.
Joint Industry Operational and Scientific Monitoring (OSM) Framework (APPEA, 2021)	APPEA Environment Publications Webpage	Operational and Scientific Monitoring (OSM) is a key component of the environmental management document framework for offshore petroleum activities, which also include an Environment Plan (EP) and Oil Pollution Emergency Plan (OPEP). OSM and its supporting documents are instrumental in providing situational awareness of a hydrocarbon spill, enabling Incident Management Teams/Emergency Management Teams (IMT/EMTs) to mount a timely and effective spill response and continually monitor the effectiveness of the response. OSM is also the principle tool for determining the extent, severity and persistence of environmental impacts from a hydrocarbon spill and resultant remediation activities.



Browse Regional Operational and Scientific Monitoring Bridging Implementation Plan (HSE_PRE_016370)	NOPSEMA Website	This Plan is presented in two parts. Part A outlines the relationship between the Shell Australia Pty Ltd.'s (Shell) environmental management document framework and the Joint Industry Operational and Scientific Monitoring (OSM) Framework (APPEA, 2021). Part B provides operationally focussed guidance for Titleholder personnel and OSM Service Providers to coordinate the implementation of monitoring plans.
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1.2 Plan scope

Titleholder defines an Emergency Condition as:

'A sudden, abnormal or unplanned situation that may endanger human life or the environment, or damage assets or reputation, and which requires immediate attention.'

Shells offshore petroleum E&P permits/licence areas in and around the BROPEP region, and the types of petroleum activities and potential sources of oil spills managed under this BROPEP are presented in Figure 1-2 and Table 1-2.

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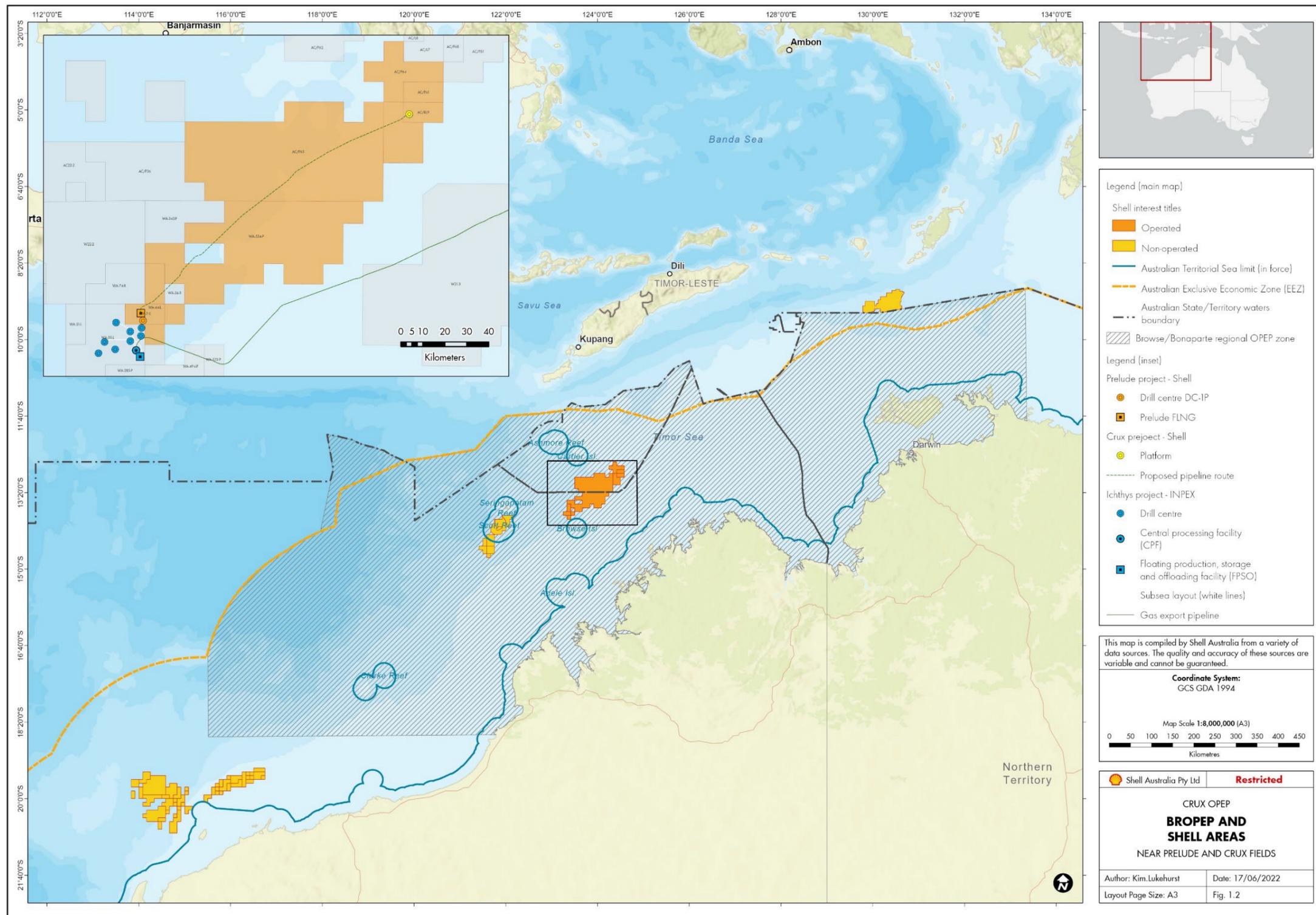


Figure 1-2: Geographical coverage of this BROPEP and INPEX Australia offshore petroleum permit/licence areas

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Table 1-2: Commonwealth water E&P activities – Potential Level 2/3 spill source

Activity Type	Potential Level 2/3 Spill Sources				
	Well blowout	Vessel collision (MGO)	Vessel Collision (IFO/HFO)	Topside facility (loss of containment (condensate))	Pipeline/flowline rupture (condensate)
Seismic surveys		X			
Exploration/appraisal/production drilling, including well workovers, plug and abandonment.	X	X			
Geophysical/geotechnical survey		X			
Subsea/topside infrastructure installation & commissioning		X	X		
Operation of production facilities including production wells	X	X	X	X	
Operation of subsea production systems & pipelines		X	X		X



Activity Type	Potential Level 2/3 Spill Sources				
	Well blowout	Vessel collision (MGO)	Vessel Collision (IFO/HFO)	Topside facility (loss of containment (condensate))	Pipeline/flowline rupture (condensate)
Decommissioning and suspension of subsea production systems and pipelines		X	X		X
Decommissioning and suspension of production facilities	X	X	X	X	



2 Spill classification, responsible agencies and Initial Actions

2.1 Spill classification

Under the National Plan for Maritime Environmental Emergencies (AMSA 2020a) (here-after referred to as the 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 regarding the spill, and the level of support required to respond.

Table 2-1 summarises the hydrocarbon spill level response models adopted for this BROPEP. This model is aligned with the Nat Plan.

In the event of a spill occurring where effective response is considered beyond the immediate response capabilities of Shell (i.e. a spill above Level 1), the response will be escalated immediately to the next level. Spill volumes are a guide only and are 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). (refer Section 2.6 for further information).
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.



2.2.1 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.

2.2.2 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 act 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.

2.2.3 Control Agency in Commonwealth Waters

The NatPlan specifies that for spills in Commonwealth waters, resulting from a 'Facility' (including a vessel operating as a 'Facility' or 'Associated Offshore Place' (AOP), the Operator (Shell) 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 (OPGGGS 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, Shell has committed, under Clause 7 of a memorandum of understanding (MoU) between Shell and AMSA, that Shell: "agrees to provide all available support to AMSA in AMSA's performance of its Combat (Control) Agency responsibilities".

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.

2.3 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 Titleholder 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.

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2.3.1 Western Australia

The WA DoT Maritime Environmental Emergency Response 24-hour reporting number is (08) 9480 9924.

Detailed cross jurisdiction arrangements are available in the *WA State Hazard Plan - Maritime Environmental Emergencies* (SHP-MEE) (WA DoT 2021) and the described in the *WA DoT Marine Oil Pollution: Response and Consultation Arrangements* (WA DoT 2020).

Cross Jurisdictional arrangements described in these documents are summarised as follows:

WA DoT will only assume the role of Controlling Agency for that portion of the response that occurs within State waters as per its jurisdictional responsibilities. The WA DoT's Marine Safety General Manager is the Hazard Management Agency (HMA) for the Marine Oil Pollution (MOP) hazards in State waters.

WA DoT nominating officers to facilitate aligned communications, share situation awareness and coordinate response actions with the IMT.

WA DoT also establishing an Incident Control Centre in Fremantle and the IMT providing a number of emergency management support personnel to work within the WA DoT IMT (the IMT would still function and lead the response in Commonwealth waters and liaise with WA DoT IMT).

A Joint Strategic Coordination Committee (JSCC) will be established between Controlling Agencies and their respective IMT's. The role of the JSCC is to ensure appropriate coordination between the respective IMTs established by multiple Controlling Agencies (e.g., Titleholder and WA DoT).

WA DoT may provide a liaison officer to the IMT where State waters may be impacted by a spill event.

The *Response and Consultation Arrangements* (WA DoT 2020) provides a series of tools to facilitate the interface between the WA DoT and a Petroleum Titleholder IMT. These include:

- Incident Control Transfer Checklist (State Water)
- IMT Functions and "Lead IMT Designations"
- Initial DoT IMT Personnel Requirements upon Petroleum Titleholders
- Initial Petroleum Titleholder CMT/IMT Personnel Requirements upon DoT
- MOP Incident Notification Flowchart.
- INPEX and Shell has prepared, in consultation with the WA DoT, a *Browse Island Oil Spill Incident Management Guide* (IMG).

The IMG provides details of how to support WA DoT in managing a spill in State waters and demonstrates how the IMT would integrate into the WA DoT IMT, in accordance with the SHP-MEE (WA DoT 2021) and the *Response and Consultation Arrangements* (WA DoT 2020), including detailed organisational charts and roles and responsibilities descriptions for the IMT during a cross jurisdictional response.

This document also provides specific guidance on planning, logistics, health and safety and specific response strategies/tactics for responses at Browse Island, or other similar offshore island locations in the Browse Basin or other remote north west or northern Australian remote coastlines and islands.

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2.3.2 Northern Territory

A review of the NT Oil Spill Contingency Plan (OSCP) has been triggered by change to Departmental structure and change to legislative authority. At the time of writing this document (Rev0, August 2021) a new NT OSCP steering committee was 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. 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, Parks and Water Security (DEPWS) (previously Department of Environment and Natural Resources) 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 a Titleholder activity, as soon as possible, and in any case, within 24 hours of Shell becoming aware of an incident/spill that could reach in NT coastal waters, Shell 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 the 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 Shell to form the IMT and the IMT will provide all operational taskings or Incident Action Plans (IAPs) to the NT IC for approval prior to their release/implementation by the IMT.

The NT IC with advice from NT Environment, Scientific & Technical advisors will work with the 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 NT emergency response arrangements, as defined in the NT *Emergency Management Act 2013*, through the Territory Emergency Management Council and the NT Government Functional Groups. Titleholder will provide support to the NT IMT, from the IMT (Perth), and support from a titleholder forward operating base and other titleholder resources in Darwin.

At the request of the TMPC, Shell 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 IMT during a response, the NT IMT and Shell forward operating base (FOB) will be established to ensure alignment of objectives and provide a mechanism for de-conflicting priorities and resourcing requests directly

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between the IMT in Perth and NT IMT in Darwin. The lines of communication between the titleholder and the NT Government are shown in Figure 2-1.

The NT Government will utilise the *Northern Territory Oiled Wildlife Response Plan (AMOSC 2019)* as the basis for their determination of protection priorities and shoreline response planning. This has been reflected throughout this document.

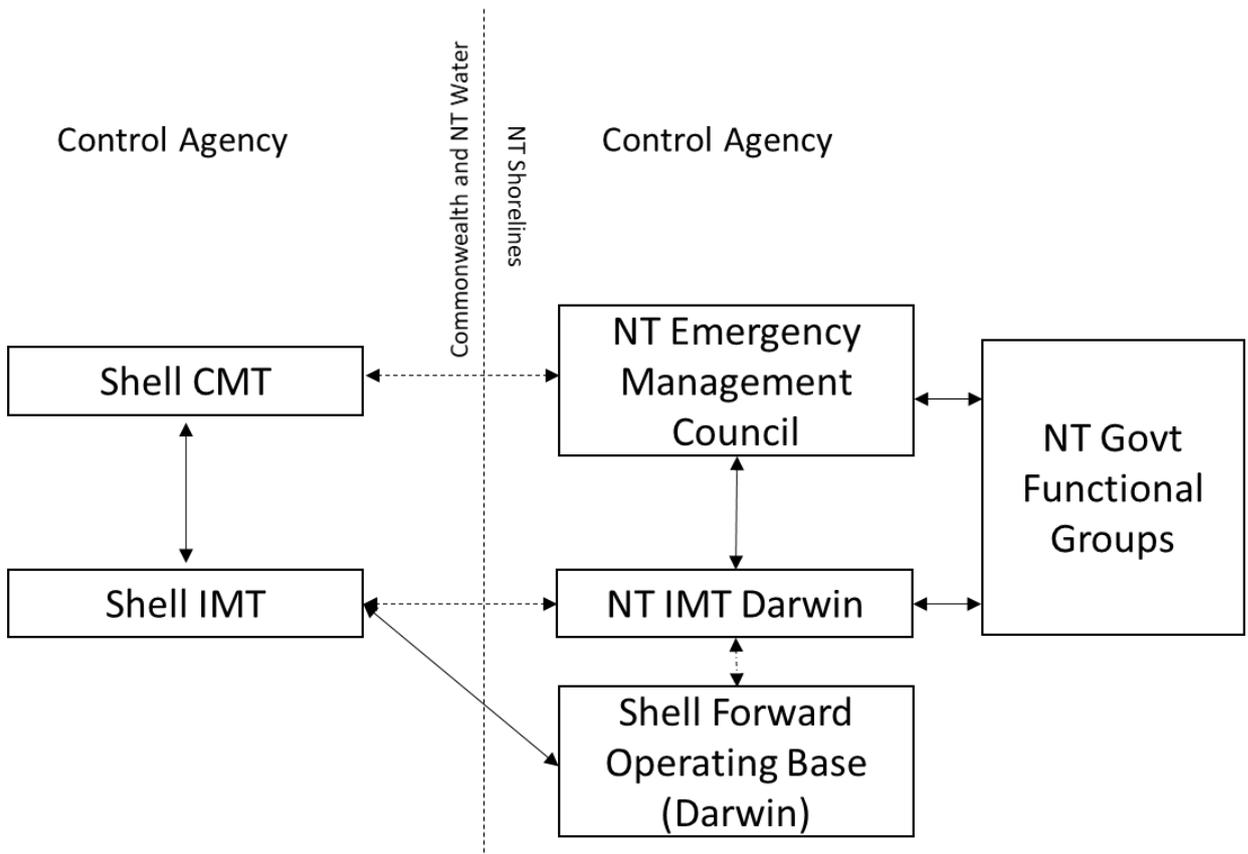


Figure 2-1: Lines of communication between Titleholder and NT Government



Table 2-2: Jurisdictional Boundaries, 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).	Facility (e.g., CPF, FPSO, subsea pipeline or MODU) conducting a petroleum activity within a petroleum permit or licence area.	NOPSEMA	Titleholder Level 1 spill response from Facility, with support provided by Facility ERT/Contractor.	Titleholder With support from AMOSC and AMSA if required.	Titleholder With support from AMOSC, AMSA and Oil Spill Response Limited (OSRL), if required.	Facility/MODU Shipboard Oil Pollution Emergency Plan (SOPEP) and this BROPEP.
	MODU or other Facility whilst in transit.	AMSA	AMSA With support from MODU/Facility contractor and Titleholder if required.	AMSA With support from MODU/Facility contractor and AMOSC and OSRL if required.	AMSA With support from MODU/Facility contractor, AMOSC and OSRL if required.	MODU/Facility SOPEP and Nat Plan.
	Vessel within a petroleum permit or licence area conducting an activity as a 'Facility' or 'AOP'.	NOPSEMA	Titleholder Level 1 spill response from support vessels.	Titleholder With support from AMOSC and OSRL RL and AMSA if required.	Titleholder With support from, AMOSC, AMSA and OSRL if required.	(This) BROPEP.
	Vessel within a petroleum permit or licence area, not conducting an activity as a 'Facility' or 'AOP'.	AMSA	AMSA With support from vessel contractor and Titleholder if required.	AMSA With support from vessel contractor, Titleholder (including AMOSC and OSRL) if required.	AMSA With support from vessel contractor, Titleholder and AMOSC and OSRL if required.	Vessel SOPEP, NatPlan and (this) BROPEP
Northern Territory (NT) waters (territorial sea baseline to 3 nautical miles and some areas	Facility/MODU or vessel conducting an activity as a 'Facility or AOP'; spill from Commonwealth waters travelling into NT waters.	NT Department of Environment and Natural Resources (NT DEPWS).	NT DEPWS With support from Titleholder .	NT DEPWS With support from Titleholder (including AMOSC and OSRL), if required.	NT DEPWS With support from Titleholder (including AMSA, AMOSC and OSRL) if required.	NT OSCP, and any support as requested by NT DEPWS from the BROPEP.



Jurisdictional Boundary	Spill source	Jurisdictional Authority	Control Agency			Relevant documentation
			Level 1	Level 2*	Level 3*	
around offshore atolls and islands (i.e. Tiwi Islands)).	MODU/Facility in transit, or vessel not conducting an activity as a 'Facility or AOP'; spill from Commonwealth waters travelling into NT waters.	NT DEPWS	NT DEPWS With support from Titleholder.	NT DEPWS With support from Titleholder (including AMOSC and OSRL), if required.	NT DEPWS With support from Titleholder (including AMSA, AMOSC and OSRL), if required.	NT OSCP, and any support as requested by NT DEPWS from the BROPEP.
WA waters and shoreline/waters (territorial sea baseline to 3 nautical miles and some areas around offshore atolls and islands (i.e. Browse Island)).	Facility/MODU or vessel conducting an activity as a 'Facility or AOP'; spill from Commonwealth waters travelling into WA waters.	WA DoT	WA DoT [†] With support from Titleholder.	WA DoT [†] With support from Titleholder (including AMOSC and OSRL), if required.	WA DoT [†] With support from Titleholder (including AMSA, AMOSC and OSRL), if required.	WA DoT SHP-MEE, and any support as requested by WA DoT from the BROPEP.
	MODU/Facility in transit, or vessel not conducting an activity as a 'Facility or AOP'; spill from Commonwealth waters travelling into WA waters.	WA DoT	WA DoT [†] With support from Titleholder.	WA DoT [†] With support from Titleholder (including AMOSC and OSRL), if required.	WA DoT [†] With support from Titleholder (including AMSA, AMOSC and OSRL), if required.	WA DoT SHP-MEE, and any support as requested by WA DoT from the BROPEP.

*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.



2.4 Incident notification and IMT activation

2.4.1 Internal notification and IMT activation

The internal notification and IMT activation process is as follows:

- The spill observer shall raise the alarm and act to stop the spill, if safe to do so.
- The Contractor Senior Site Representative (CSSR), such as a Contractor vessel master/MODU OIM etc., will notify the Shell Senior Site Representative (SSR) (as relevant to Contractor vessels/facilities).

The SSR associated with the activity will notify the IMT Leader. The SSR's include:

- Client Site Representative associated with vessel activities.
- Drilling Supervisor associated with drilling activities.
- Offshore Installation Manager (OIM) associated with an Shell production facility.
- 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.

Once the IMT has been activated, it shall become responsible (as Control Agency for spills from a Facility (including vessels which are classified as a 'Facility' or 'Associated Offshore Place' (AOP) for implementing spill response control measures, interaction with regulatory authorities and support agencies, monitoring, reporting and response termination.

Alternatively, the IMT will provide all available support to AMSA, as Control Agency for vessels spills.

For any Level 2/3 oil spill event, oil spill response organisation (OSRO) personnel will be required to support the IMT. OSRO support includes the following:

- AMOSC IMT personnel will become an integrated part of the IMT.
- OSRL may also provide IMT support, if required.

Notification/activation of OSRO/mutual aid arrangements are detailed in Table 2-4.

Example IMT structures for two WCSSs (condensate well blow-out and Group IV spill) are provided in Figure 2-2 and Figure 2-3.

Guidance on which roles are likely to be fulfilled exclusively by IMT personnel, compared with roles which may or will be partially or exclusively fulfilled by OSRO/mutual aid IMT capabilities is provided in Table 2-3.

Further information regarding the Shell emergency and crisis management organisation can be found within the BROPEP IMT Capability Assessment Report (Attachment 2).

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Well Blowout
IMT Structure

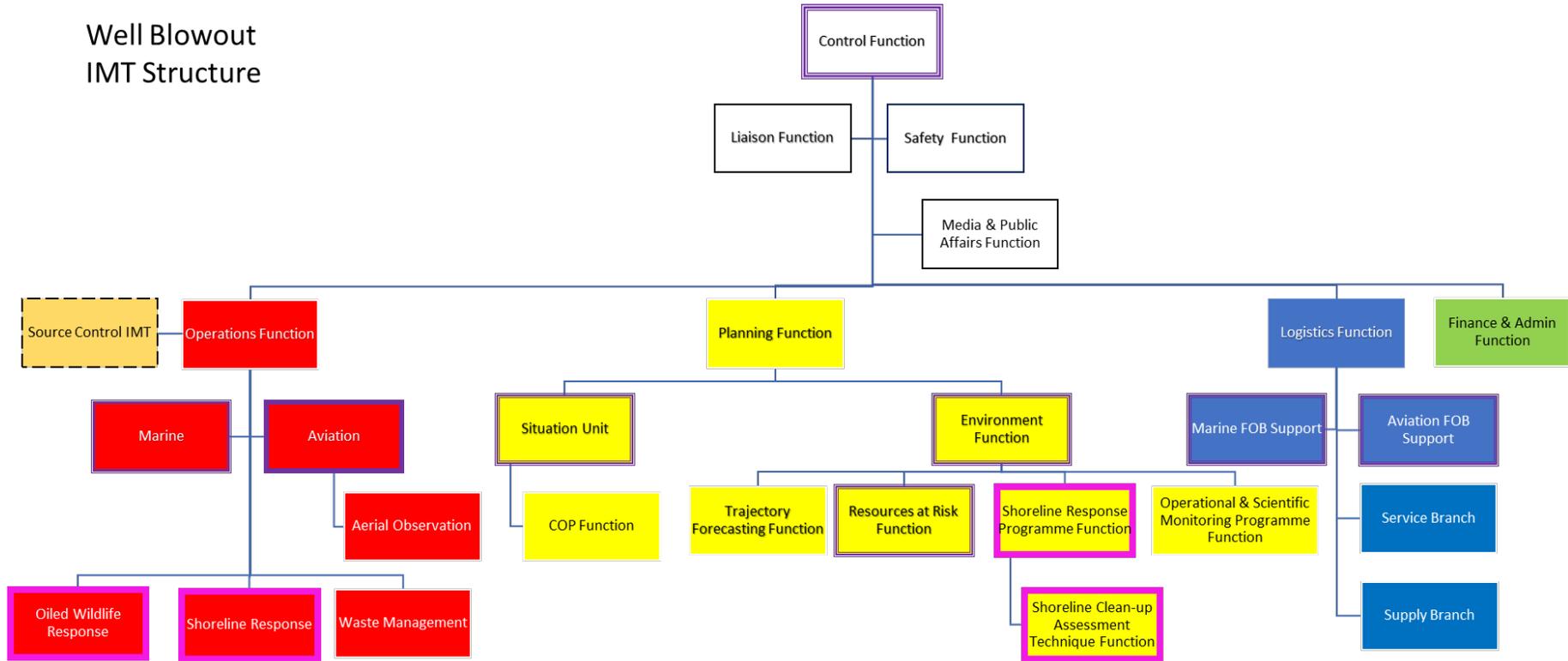


Figure 2-2: Example IMT structure – condensate well blowout scenario

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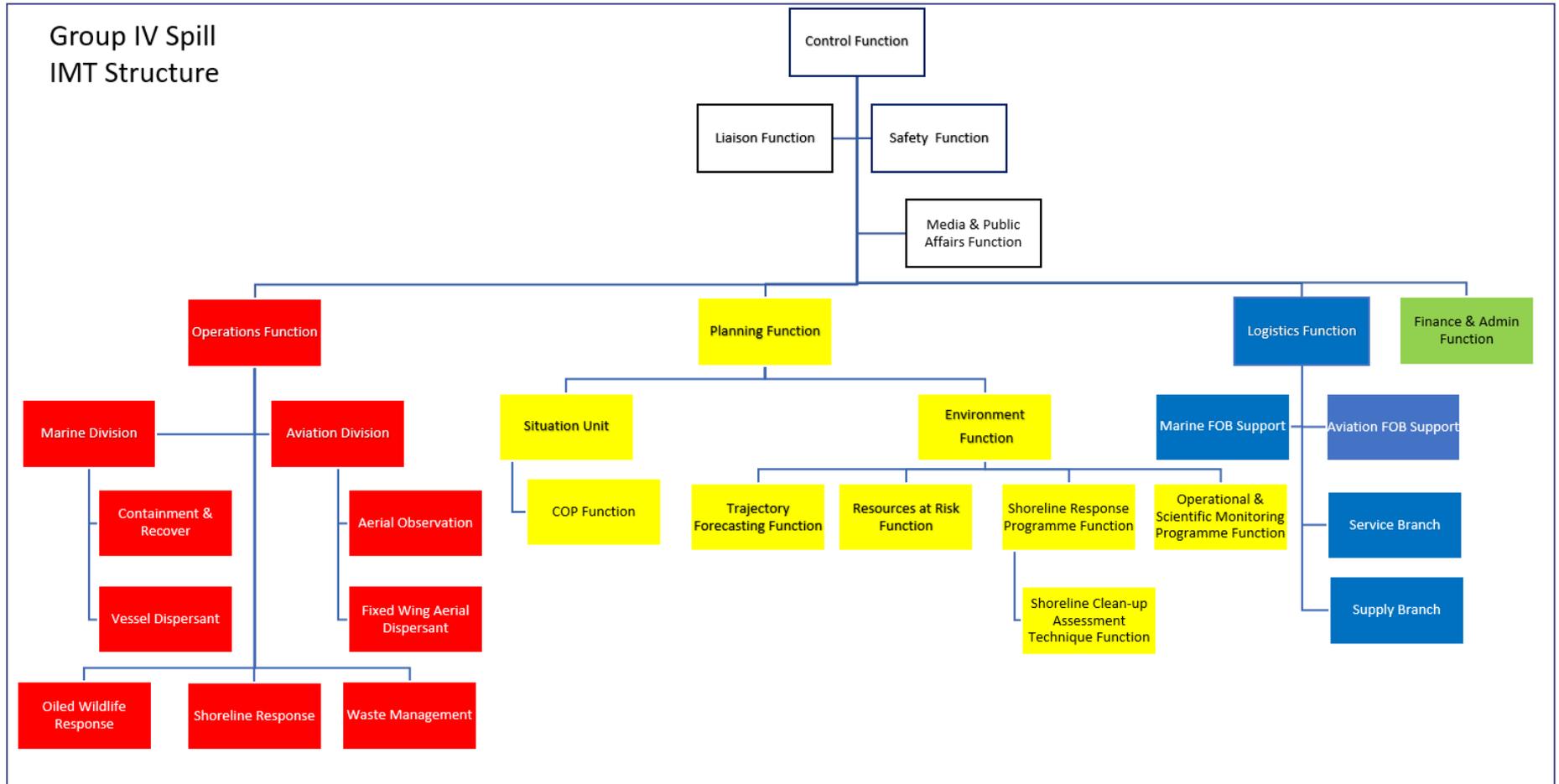


Figure 2-3: Example IMT structure – Group IV spill scenario



Table 2-3: Titleholder and OSRO IMT functions

Function	Titleholder	OSRO
Control / Leadership Function	Provided by IMT Leaders.	Additional/supporting capability provided as required.
Liaison Function	Provided by IMT Leaders.	Additional/supporting capability provided as required.
Safety Function	Provided by IMT Safety personnel.	Additional/supporting capability provided as required.
Media & Public Affairs Function	Provided the External Affairs/Joint Venture (EA/JV) Function.	Not applicable.
Operations Function	Provided by IMT Operations Function Leads.	Additional/supporting capability provided as required.
Operations Marine Function	Provided by IMT Operations Function personnel.	Additional/supporting capability provided as required.
Operations Aviation Function	Some capability provided by IMT Operations Function personnel.	Majority of capability provided by OSRO - especially if Fixed Wing Aerial Dispersant (FWAD) capability activated.
Operations Protection of Sensitive Resources Function	Not provided by IMT.	Capability provided by OSRO.
Operations Shoreline Response Function	Not provided by IMT.	Capability provided by OSRO.



Function	Titleholder	OSRO
Oiled Wildlife Response Function	Not provided by IMT.	Capability provided by OSRO.
Planning Function	Provided by IMT Planning Function Leads.	Additional/supporting capability provided as required.
Environment Function	Provided by IMT Environment Function personnel.	Additional/supporting capability provided as required.
Situation Function	Provided by IMT Planning Function personnel.	Additional/supporting capability provided as required.
Resources at Risk Function	Provided by IMT Environment Function personnel.	Additional/supporting capability provided as required.
Shoreline Clean-up Assessment Technique Function	Not applicable.	Capability provided by OSRO.
Shoreline Response Programme Function	Not applicable.	Capability provided by OSRO.
Operational & Scientific Monitoring Programme Function	Provided by IMT Environment Function personnel.	Not applicable.
Situation Unit Function	Provided by IMT Situation Unit personnel.	Additional/supporting capability provided as required.
Common Operating Picture Function	Provided by IMT Situation Unit personnel.	Additional/supporting capability provided as required.



Function	Titleholder	OSRO
Logistics Function (and sub-functions)	Provided by IMT Logistics Function Leads.	Additional/supporting capability provided as required.
Finance and Admin Function	Provided by IMT Finance and Admin Function Leads.	Not applicable.



2.4.2 External agencies notification

The CSSR, SSR 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 2-4.

The IMT Leader, (in consultation with AMSA for vessel spills), should consider additional stakeholder notifications, based on values and sensitivities affected or potentially at risk.

If written forms are required as part of a notification, access to forms can be found in Oil spill forms register

Table 5-1 of this BROPEP.

If activated, the IMT shall notify AMOSC of the spill event. AMOSC shall provide IMT personnel and other technical support to assist and shall also provide access to oil spill response equipment and field response personnel, as required.

OSRL should also be notified/put on stand-by in the event of any Level 2/3 spill.

Details of oil spill response strategy capabilities and arrangements are provided in Section 4 of this BROPEP.

Event reporting is described in Section 9 of Titleholder EPs; however, notifications are dependent on the activity being undertaken and the Control Agency status. Jurisdictional Authority and Control Agency status is discussed in Section 2.2 of this BROPEP.

2.4.3 Emergency Contacts Directory

All relevant contact details (as applicable to this BROPEP) are contained within the Shell IMT Weekly Contact List and IMT(W) Level 2 Emergency Response Plan. .

The Weekly Contact List is updated weekly to reflect on duty IMT positions and the Confidential Phone List is reviewed routinely and tested during exercises to check all relevant call-off contract contact numbers (as described in sections 4.1 and 4.2) are up to date.

Some key emergency contact numbers, required for initial notifications, are also listed within this BROPEP.



Table 2-4: External notifications matrix

Contact	Comments	Method	Timing	Responsibility
Spill in any location				
AMOSC (will assist as integrated part of the IMT).	For all Level 2/3 spills - activate as integrated part of IMT.	Phone call and email. Service contract with AMOSC to be signed by IMT Leader. Refer to Oil spill forms register Table 5-1.	As soon as practicable.	IMT Leader or delegate.
OSRL (may assist as a support response agency).	For all Level 2/3 spills - provide initial notification/stand-by alert. Activate if spill response escalates in order to mobilise both IMT and field response resources.	Phone call and email. Service contract with OSRL to be signed by IMT Leader. Refer to Oil spill forms register Table 5-1.	As soon as practicable.	IMT Leader or delegate.
Oil spill modelling service provider.	Provide POLREP and any 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 Oil spill forms register Table 5-1.	As soon as practicable (must be activated within 2 hours of IMT formation)	IMT Leader or 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 Oil spill forms register Table 5-1. Written update via SITREP as required, via SITREP form. Refer to Oil spill forms register Table 5-1.	Verbally, within two hours. Written POLREP, within 24 hours. SITREP as required.	Titleholder Senior Site Representative.
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 Oil spill forms register Table 5-1.	Verbally, within 2 hours. Written within three days.	Titleholder Senior Site Representative or IMT Leader (or delegate).
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).



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. Titleholder 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 to be implemented and provide 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: <ul style="list-style-type: none"> • 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, Transport, Regional Development and Communications, administers the IOTs, which include Ashmore Reef, Cartier Island, Christmas Island and Cocos (Keeling) Islands, outside of National Marine Reserve/Park boundaries. Consultation with DITRDC will be required during any spill response in the IOT.	Phone call, as soon as practicable to DITRDC once it is identified a spill is moving towards/into the IOTs.	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 Oil spill forms register 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.
WA Department of Biodiversity and Conservation and Attractions (DBCA)	Contact the Kimberley office in the event of a hydrocarbon spill which is predicted to cause contamination of WA state waters and/or shorelines	Phone call, as soon as practicable.	As required.	IMT Leader or delegate.
Spill heading towards NT waters (e.g., Tiwi islands)				



Contact	Comments	Method	Timing	Responsibility
NT DIPL	<p>Jurisdictional authority for spills in NT waters.</p> <p>Notification is required as soon as practicable in the event of a hydrocarbon spill which is predicted to enter NT waters.</p> <p>The NT OSCP operates within the framework of the NatPlan and consists of the NT Marine Oil Pollution Manual, the NT OSCP and supporting port OSCPs.</p>	<p>Phone call, as soon as practicable by calling the marine pollution coordinator (TMPC).</p> <p>Written notification by POLREP.</p> <p>Written update via SITREP, as required.</p> <p>Refer (Oil spill forms register Table 5-1).</p>	<p>Verbally, as soon as practicable.</p> <p>Written POLREP, within 24 hours.</p> <p>SITREP, as required.</p>	IMT leader or delegate.
Northern Territory Environment Protection Authority (NT EPA).	<p>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.</p> <p>Notification is required as soon as practicable in the event of a hydrocarbon spill which is predicted to enter NT waters.</p>	Phone call and email.	Verbally and by email, as soon as practicable.	IMT Leader or delegate.
NT Department of Environment, Parks and Water Security	Notification is required within 24 hours in the event of a hydrocarbon spill which is predicted to enter NT waters.	<p>Email</p> <p>Marine Pollution Reports (POLREPs) are to be emailed to pollution@nt.gov.au (Environmental Operations)</p> <p>Instructions for submitting POLREPs (including a POLREP Template) are provided on the NT Government webpage https://nt.gov.au/marine/marine-safety/report-marine-pollution</p>	Written POLREP, within 24 hours.	IMT Leader or delegate.
Spill heading towards defence areas e.g., Northern Australia Exercise Area (NAXA)				
Department of Defence.	<p>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.</p> <p>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).</p>	<p>Phone call to Department of Defence - Defence Switchboard.</p> <p>Relevant contacts:</p> <p>Director General Maritime Operations, Headquarters Joint Operations Command.</p> <p>Assistant Secretary, Property Management Branch.</p>	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 foreign 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 or facility-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 Oil spill forms register

Table 5-1 for further information regarding POLREP template and submission timeframes.

2.6 Immediate (first strike) response measures

In accordance with Table 2-1, a Level 1 event should be managed by first strike response measures, utilising only the resources available to the Emergency Response Team (ERT) in the field.

As such, within the context of a spill in the Browse/Bonaparte Basin, where a small spill (<10 m³) would be highly unlikely to result in any significant environmental impact to any shoreline, the 'first strike' measures associated with a Level 1 event only include the following:

- visual surveillance from vessels and facilities
- visual surveillance from opportunistic crew-change helicopters.

If these are the only resources required to visually monitor a spill, until the spill has evaporated or is confirmed to no longer present a risk to the environment, then this would be classified as a Level 1 spill, and the IMT and this BROPEP would not be activated.

However, in accordance with Table 2-1, should the nature/complexity of the spill require support from the IMT, the spill would be classified as a Level 2/3 event, and this BROPEP would be activated.

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2.6.1 All Level 2/3 spills

The immediate response actions which need to be undertaken by the IMT for all Level 2/3 spill events is the activation of Surveillance, Monitoring and Visualisation (SMV), as detailed in Section 4.4.1 of this BROPEP.

2.6.2 Group IV spill only

Group IV products include the following:

- Intermediate Fuel Oil (IFO)
- Heavy Fuel Oil (HFO)
- Low Sulphur Fuel Oil (LSHFO).

In the event of a Group IV spill, the additional immediate/first-strike response actions to be undertaken, (as described in Table I-I-1), are the following:

Vessel dispersant

SSR to facilitate identification of the most suitable vessel for dispersant operations, conduct dispersant test spray and report on effectiveness to the IMT Leader.

IMT Leader to authorise ongoing vessel dispersant, by using the Dispersant Application Decision Matrix (refer Table 4-13).

At-sea containment and recovery

IMT to commence activation of at-sea containment and recovery by notifying AMOSC to move containment and recovery (C&R) equipment from Broome stockpile to Broome Wharf.

IMT to identify primary C&R vessel (large vessel with rolled stern – (E.g., anchor handling tug) and second support vessel (small or large) to assist with boom deployment and towing

Fixed Wing Aerial Dispersant (FWAD)

Notify AMOSC to activate FWAD Contract; air-tractor from Batchelor and/or Exmouth – to prepare to mobilise to a nominated airfield (E.g., Lombadina or Truscott).

Details of surface dispersant and at-sea containment and recovery response strategies, capabilities and arrangements are provided in Section 4.5.5 and Section 4.5.6 respectively.

Note, the vessel dispersant, FWAD and C&R capabilities can be rapidly de-activated if the Operational SIMA determines one or more of the response strategies are not required.

3 Incident Action Plan (IAP) development

The process for identifying appropriate IAPs is illustrated in Figure 3-1.

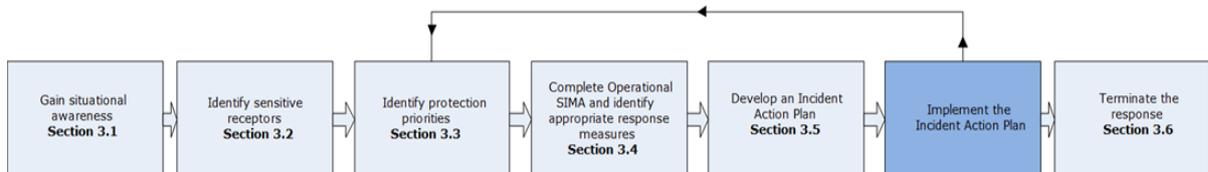


Figure 3-1: Typical response procedure

3.1 Gain situational awareness

The IMT will gain situational awareness from all available sources including:



- surveillance, monitoring and visualisation data
- POLREP
- ongoing updates from the facilities/MODU/vessels in the vicinity of the spill
- long-term weather forecast
- other operators' activities.

3.2 Identify sensitive receptors

Particular values and sensitivities with the potential to be exposed/impacted by activity oil spill events are described within Section 4 of each activity specific EP.

Appendix A contains maps of the environmental values and sensitivities of the BROPEP region.

The Titleholder GIS is pre-loaded with the spatial layers of these values and sensitivities maps, to enable rapid overlay of oil spill trajectory modelling (OSTM) outputs and other SMV data, to evaluate known and/or potentially affected values and sensitivities.

Table 3-1 presents the seasonal abundance associated with particular values and sensitivity which have been identified within the BROPEP geographic region.

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Table 3-1: Seasonality of values and sensitivities within the BROPEP region

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/NT coast, Rowley Shoals, Scott Reef, Seringapatam Reef, Rowley Shoals, Hibernia Reef												
Green turtle breeding and hatching	Browse Island and Scott Reef (Sandy Islet)*												
	80 Mile Beach, 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	Buccaneer, Bonaparte Archipelago**												
	Lacapede Islands and 80 Mile Beach*												
	Tiwi Islands*												
	Cassini Island and Maret Islands*												
Humpback whale migration	Kimberley coast												
Humpback whale calving	North-west Commonwealth Marine Reserves Network, Lalang-garram / Camden Sound Marine Park and humpback whale Biologically Important Areas (BIA)**												
Blue whale and pygmy blue whale migration	Open ocean (approx. 500 m depth contour)												
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.												
Shorebird migration	Migratory birds present in coastal habitats												



Values and sensitivities	Example Locations	Month											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Shorebird breeding	Marine avifauna BIA and WA/NT coastline	Peak occurrence/activity (reliable and predictable)			No occurrence						Peak occurrence/activity (reliable and predictable)		
Indonesian traditional fishing	Offshore islands and reefs located within the traditional fishing MoU area.	Low occurrence/activity (may vary from year to year)		Peak occurrence/activity (reliable and predictable)				Intermediate occurrence/activity (less reliable and less predictable)		Peak occurrence/activity (reliable and predictable)			
Recreational fishing	Open ocean and WA/NT coastline	Low occurrence/activity (may vary from year to year)		Intermediate occurrence/activity (less reliable and less predictable)		Peak occurrence/activity (reliable and predictable)						Intermediate occurrence/activity (less reliable and less predictable)	
Commercial fishing	Throughout entire BROPEP region	Low occurrence/activity (may vary from year to year)					Intermediate occurrence/activity (less reliable and less predictable)				Low occurrence/activity (may vary from year to year)		Low occurrence/activity (may vary from year to year)
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 Protection priorities

In the event of a spill, the primary aims of the response will be aligned with the NatPlan (AMSA 2020a) and the Shell People, Environment, Assets, Reputation (PEAR) 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.

Within offshore/deep Commonwealth waters, there are no specific locations which can be classified as protection priorities. However, shallow submerged habitats or intertidal habitats (banks, shoals, reefs, etc.) within Commonwealth waters are typically associated with increased biological diversity and abundance, and are typically habitats utilised by EPBC listed species such as marine mega-fauna, for foraging/feeding, inter-nesting, aggregation, etc. These locations should be evaluated as potential protection priorities. Examples of these locations include (but are not limited to):

- Mermaid Reef (Rowley Shoals)
- Heyward Shoal
- Echuca Shoal
- Big Bank Shoals

For a more comprehensive list of shallow subtidal habitats, refer Figure 4-5 and Figure 4-6 and Appendix C: Environmental values and sensitivities maps.

Shorelines/nearshore habitats, which support the highest ecological diversity, and are considered key ecological habitats for many EPBC-listed species (such as turtles, marine avifauna etc) are considered as key the protection priorities under the BROPEP.

The WA/NT Control Agencies are responsible for the determination of the protection priorities within 3nm of any shoreline and are responsible for the final decision on which spill response strategies/tactics are deployed at each shoreline location.

In the event of a spill, the IMT is responsible for providing all available SMV data to the relevant Control Agency, to enable the Control Agency to determine the protection priorities, in accordance with the WA SHP-MEE/NT OSCP.

3.3.1 Western Australia

For any oil spill entering or within WA State waters/shorelines, the WA Control Agency is the ultimate decision maker regarding identification and selection of protection priorities.

The WA Control Agency will utilise their internal processes which typically includes the following:

- evaluation of situational awareness information, including all surveillance, monitoring and visualisation data provided by the Titleholder
- evaluation of resources at risk including use of the WA Oil Spill Response Atlas and any other relevant WA/Commonwealth government databases or other information sources
- evaluate shoreline types, habitat types and seasonality of environmental, socio-economic and cultural values and sensitivities

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- consultation with the State Environmental Scientific Coordinator and other relevant State and Federal government departments with environmental responsibilities
- consultation with other relevant oil spill agencies, including the AMSA Environment, Science and Technology network or any other experts as necessary
- all information is utilised in a NEBA/SIMA type process, to determine protection priorities and response strategies.

The WA Controlling Agency will adjust/amend their internal processes to suit the spill situation at the time.

3.3.2 Northern Territory

Within the Northern Territory, it is expected that priority protection areas will be selected by the NT Government by utilising a similar process as described for the WA Control Agency, with guidance taken from the *Northern Territory Oiled Wildlife Response Plan (AMOSC 2019)*.

3.3.3 Indian Ocean Territories

For any spill entering the Indian Ocean Territories, (including Ashmore Reef, Cartier Island, Christmas Island and Cocos (Keeling) Islands), consultation will be undertaken (as per Table 2-4) to agree protection priorities and associated response strategies and tactics.

3.4 Operational SIMA

Strategic spill impact mitigation assessments (SIMAs) outcomes for the well blowout and vessel collision spill scenarios are summarised in Section 5 of the BROPEP BOD and Field Capability Assessment Report.

This BROPEP provides a single Operational SIMA Template (Table 3-2), for all worst credible Group I, II and IV spill scenarios.

The Operational SIMA template includes a summary of key points from the Strategic SIMAs as well as ALARP/implementation considerations. IMT Planning and Environment shall evaluate and complete the Operational SIMA Template, and it should then be endorsed by the IMT Leader. The outcome of the Operational SIMA will be as the basis for response strategy selection, for inclusion in the development of the IAP.

During the review of the Operational SIMA, the IMT will need to consider the specific conditions of the spill event, such as the oil type, spill location, trajectory and fate of the oil, long-range weather forecast, environmental values and sensitivities (and any associated seasonality factors), all of which may have a bearing on the effectiveness and feasibility of implementing various response strategies.

Consultation with relevant State/Territory Control Agencies may also be required if the spill is anticipated to enter State/Territory waters.

The Operational SIMA(s) shall remain as a record of the reasoning behind the selection or elimination of various response strategies at various points in time during an actual event.

The Operational SIMA should be re-evaluated frequently during the response (e.g., as new SMV data or response strategy effectiveness/monitoring data becomes available), to ensure the selected response strategies and IAP remain appropriate for the scenario and response strategy effectiveness at the time.

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In summary, the IMT should:

- evaluate the validity of the assumptions of the Strategic SIMA
- review all available situational awareness information (including any available SMV data at the time)
- evaluate the ALARP/implementation considerations
- consult with AMOSC/OSRL as required
- complete the comments section – to provide operational justifications related to the decision to active/not activate each response strategy
- ensure IMT Leader sign-off is achieved (digital/email endorsement considered acceptable if operating in 'remote' IMT setting)
- review/revise the Operational SIMA, as necessary.

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Table 3-2: Operational SIMA Template

Incident Name				IMT Planner Name			IMT Leader Name		
Operational Date/Time	SIMA	Review	(dd/mm/yy) ___/___/ 20___ (__:__ hrs)	IMT Environment Name			IMT Leader (endorsement)	Signature	

Response Strategy	Spill Source Applicability	Strategic SIMA Summary	Operational Considerations	Operational SIMA comments
Surveillance, Monitoring and Visualisation (SMV)	Group I surface YES Group I subsurface YES Group II YES Group IV YES	SMV 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.	In the event of any Level 2/3 spill, the IMT should prioritise the activation of the following activities: Oil spill trajectory modelling Activate within 2 hours of IMT formation for all Level 2/3 spills. Visual surveillance: Aerial surveillance is the primary/preferred method of visual surveillance. Any available crew change helicopters should also be used for aerial surveillance, provided the crew change helicopters are not required for other emergency tasks (target timeframe <5 hours). Longer-term aerial surveillance operations should utilise fixed-wing aircraft and trained aerial observers. Where possible, obtain additional visual surveillance from nearby vessels and facilities, especially during early stages of a spill. Vessel and/or facility-based surveillance is less efficient than aerial surveillance. Data from opportunistic vessels/facilities can be collected, but this should not be a primary strategy for visual observations of slicks over longer term. Electronic surface tracker buoys (ESTBs): When deploying ESTBs, preferably deploy 3 during the initial stages (hours) of the spill, in close proximity to each other at leading edge of the slick. Additional three at end of daylight hours. Consider the atmospheric risks and VOC exposure for any ESTB deployments (refer Section 4.4.1). Satellite Imagery: Consider satellite imagery acquisition to complement longer-term aerial surveillance programs and support OSTM validation.	
At Sea Containment and Recovery (C&R)	Group I surface spill NO Group I subsurface NO	Generally, oil needs to be Bonn Code 4/5 (minimum thickness of >100 g/m ² , (O' Brien 2002) to feasibly corral oil with a boom and achieve any significant level of oil recovery (reasonable level of efficiency) with the skimmers. In general, this strategy is not appropriate for any Group I/condensate spills (surface/subsurface) or surface Group	In event of a Group IV spill, the IMT should, as soon as reasonably practicable, request AMOSC to commence mobilisation of C&R equipment from Broome AMOSC stockpile (or Darwin AMSA stockpile as back-up location) identify available large support vessels with rolled/open sterns, suitable for deployment of offshore booms. Preferably select vessels closest to Broome (or Darwin as back-up location)	



Response Strategy	Spill Source Applicability	Strategic SIMA Summary	Operational Considerations	Operational SIMA comments
	<p>Group II NO</p> <p>Group IV YES</p>	<p>II /diesel spills due to the very rapid spreading and high VOC risks associated with spills of these products.</p> <p>For a Group IV (IFO/HFO/LSHFO) spill, where the slick is typically persistent, with low volatility, and likely to be present on the sea surface at appropriate concentrations (>100 g/m²) for an extended period of time, a C&R operation may be possible.</p> <p>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 may sometimes be limited by the prevailing sea state conditions of the BROPEP region.</p> <p>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). Other limitations include reduced effectiveness at >0.7 to 1 knot current speeds (IPIECA 2015a) (these current speeds are often experienced in the BROPEP region); ineffectiveness in adverse sea states (>20 knots/1.8m wave height, routinely experienced during dry season and monsoonal conditions in the Timor Sea); skimmer reduced effectiveness in open ocean and with emulsified oils; and logistical issues associated with recovered waste at sea (IPIECA 2015a). As such, containment and recovery will remain a challenging response strategy against Group IV spills in the Timor Sea.</p> <p>Weather conditions permitting, if SMV data indicates a positive outcome could be safely achieved it may be possible undertake a C&R operation.</p>	<p>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. Darwin stockpile available upon request via AMSA.</p> <p>A period of relatively calm sea-states and an oil amendable to recovery with skimmers would be required to undertake a successful response - ideally average wind speeds <20 knots.</p> <p>The final decision to undertake C&R activities in Commonwealth waters should be undertaken by the IMT in consultation with AMOSC, using available SMV/situation awareness data, confirm a positive outcome could be achieved by the activation of this response strategy (otherwise de-active the response strategy).</p> <p>The WA/NT Control Agency will make the final decision to undertake C&R activities in WA/NT waters.</p>	
Surface dispersant (vessel and/or aerial based)	<p>Group I surface NO</p> <p>Group I subsurface NO</p> <p>Group II NO</p>	<p>Due to high natural entrainment rates, surface dispersant will not result in any benefit against Group I or Group II spills.</p> <p>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 2015b). 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</p>	<p>In event of a Group IV spill, the IMT should, as soon as reasonably practicable.</p> <p>Request the Field Manager to coordinate the identification and deployment of dispersant capabilities, or request dispersant capability support via Prelude OIM.</p> <p>Request AMOSC commence mobilisation of FWAD capability.</p> <p>The Dispersant Application Decision Matrix (Table 4-13) must be completed and signed by the IMT Leader before dispersant application can commence.</p> <p>Chemical dispersant using aerial and/or vessel spraying can be undertaken on fresh (non-weathered, non-emulsified) Group IV slicks only.</p> <p>Vessel-based dispersant can be rapidly mobilised using the following:</p> <ul style="list-style-type: none"> Prelude ISVs (x3) dispersant system (5 m³ each) and trained personnel. 	



Response Strategy	Spill Source Applicability	Strategic SIMA Summary	Operational Considerations	Operational SIMA comments
	Group IV YES	<p>(particularly nesting activities), intertidal corals, and intertidal traditional fisheries.</p> <p>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.</p> <p>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:</p> <p>pelagic species - transient populations or individuals, particularly those using the upper reaches of the water column, including subtidal protected species (whales, whale sharks etc)</p> <p>subtidal corals and benthic primary producer habitat in the top 25 m of the water column.</p> <p>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 benthic primary producer habitat would be minor if dispersant is applied at significant distance from the reef/shoal.</p> <p>In view of this, values and sensitivities unlikely to be impacted by dispersant or the dispersed hydrocarbons include:</p> <p>Australian Martine Parks (AMPs)</p> <p>Key Ecological Features (KEFs)</p> <p>all banks and shoals deeper than 25 m</p> <p>demersal commercial fisheries.</p>	<ul style="list-style-type: none"> • Prelude PSVs (x 1) have dispersant deployment systems and trained personnel (without any dispersant onboard). • INPEX FPSO 16 m³ dispersant stockpile • Inpex OSV and 2 x PSVs fitted with dispersant spray systems and trained crew • INPEX FPSO AFEDO dispersant spray system and trained personnel (the FPSO AFEDO system and trained personnel can be moved to any other available support vessel). <p>Additional vessel-based dispersant spray equipment and stockpiles are in Darwin and Broome - access via AMOSC.</p> <p>The ‘window of opportunity’ for effective dispersant application is generally from a few hours to a day before the viscosity threshold for effective dispersant application is exceeded. However, for ongoing spill scenarios (e.g., a vessel slowly leaking a Group IV oil), both longer duration vessel-based dispersant, and FWAD capability (day 2 onwards) could be used.</p> <p>Vessel-based dispersant application is limited to daylight hours, good visibility and Beaufort seas-state of 2 - 7 (ideal conditions Beaufort 3-6).</p> <p>The FWAD capability (crop-duster aircraft) located in Batchelor (NT) and Exmouth (WA) can be mobilised through AMOSC. For FWAD in the Browse Basin;</p> <p>The most likely ‘nominated airbase’ would be Lombadina or Mungalalu/Truscott airport</p> <p>The mobilisation of FWAD capability to the ‘nominated airbase’, including all required support personnel, air attack supervisor, air attack aircraft, ancillary equipment and dispersant stockpile, would take at least 24 hours</p> <p>The FWAD aircraft are limited to dispersant spraying during daylight operations only</p> <p>Titleholder IMT are required to complete a FWAD Operations Plan and provide the air attack aircraft (crew-change helicopter) and SAR platform (helicopter or vessel-based), and any additional resources required by AMSA/AMOSC to activate the FWAD capability.</p> <p>SAFETY ALERT</p> <p>Fixed facilities with shallow/hull mounted seawater intakes may potentially be impacted by dispersant/dispersed oil (E.g., a MODU or INPEX FPSO). If a fixed facility may be exposed, ensure the relevant facility OIM is aware that exposure to very high concentration of entrained/dispersed oil may potentially require:</p> <ul style="list-style-type: none"> • monitoring of quality of RO/desalination water. Additional cleaning of RO/desalination filters may be required. • monitoring of operability of cooling water system. Additional cleaning of heat exchange plates may be required. • Note - not a credible risk unless thick oil being dispersed very close (within a few hundred metres) of the facility. 	



Response Strategy	Spill Source Applicability	Strategic SIMA Summary	Operational Considerations	Operational SIMA comments
Dispersant subsea	<p>Group I surface NO</p> <p>Group I subsurface YES (within approved dispersant areas)</p> <p>Group II NO</p> <p>Group IV NO</p>	<p>Atmospheric modelling (RPS 2019) of several worst-case well-blowout scenarios indicates that VOC concentrations would routinely be expected to exceed the 500 ppm VOC 15-minute short-term exposure threshold, resulting in the shut-down of any vessel activities near the well blowout location. This VOC risk would therefore potentially stop 'source control' activities, such as debris clearance or capping stack installation, potentially prolonging the duration of a well blowout and associated surface and entrained oil exposures. If SSDI were used during a well blow-out, for the time that SSDI was applied, modelling (RPS 2019) indicates the rates of entrainment would increase and rates of evaporation would decrease. With SSDI application, during light wind conditions, ~70% of the condensate would entrain in the shallow water column (top 3m), with evaporation (and associated atmospheric VOC exposure) reducing to ~30%. Under increased wind conditions (>6 knots), evaporation becomes close to zero (RPS 2019). Therefore, SSDI will cause a reduction in atmospheric VOC concentration, enabling a safe debris clearance/capping stack installation.</p> <p>Any impacts to the environment, associated with the use of SSDI to achieve a successful well-kill using a capping stack are offset by the significant reduction in the overall duration of the blow-out (and net reduction in entrained hydrocarbons) compared to a relief well-kill scenario.</p> <p>The increase in entrainment from SSDI is similar to normal levels of entrainment expected to occur under higher wind conditions, and the effects of increased entrainment due to SSDI are partially offset due to a reduction in oil droplet size, resulting in a significant increase in biodegradation rates (up to 50%).</p>	<p>Should a condensate well blow-out have occurred, and debris clearance/capping stack installation are required, SSDI may be required, to ensure the safety of vessel-based personnel undertaking source control activities.</p> <p>VOC modelling and in-field monitoring of VOCs at surface from the subsea release is required, to determine requirement for SSDI activation.</p> <p>An SSDI spread is maintained by AMOSC as part of the subsea first response toolkit (SFRT). The SFRT is located in Fremantle, WA and includes 500 m³ of Slick-Gone-NS dispersant and injection wands.</p> <p>Vessels with work-class ROVs, and topside (vessel deck mounted) dispersant pumping spread and downlines will be required to be provided by Titleholder Source Control IMT.</p>	
Source Control	<p>Group I surface NO</p> <p>Group I subsurface YES</p> <p>Group II NO</p>	<p>Source control is a key activity to limit and eventually stop a subsea loss of well control incident. It can involve multiple strategies from, debris clearance, deploying a capping stack (including OIE) and drilling a relief well.</p> <p>The source control response options are assessed and adopted based on the nature and scale of the loss of well control incident. A key consideration is the response timing in relation to an actual incident, which will inform which source control response options are appropriate for selection.</p>	<p>The operational considerations of source control are partly outlined in Dispersant Subsea strategy described above above, but also involve many other considerations. These response options are outlined in detail within Section 4.5.1 below and are further detailed within the Browse Basin Source Control Contingency Plan (TEC_GEN_015842).</p> <p>The Browse Basin Source Control Contingency Plan (TEC_GEN_015842) is the primary response plan which sets out Shells source control capabilities and response arrangements. All wells covered under the SCREP have been designed in a way that allows them to withstand the pressure build-up and thermal loading which results from capping.</p>	



Response Strategy	Spill Source Applicability	Strategic SIMA Summary	Operational Considerations	Operational SIMA comments
	Group IV NO	<p>Relief well drilling is the primary response capability with regard to source control. This response strategy involves intersecting the blown well and inserting permanent barriers to isolate the well from the reservoir.</p> <p>For open water wells, as seen during exploration drilling, production drilling or when Xmas Tress are removed during well workovers), the use of a capping stack can limit the duration of the release while a relief well is being planned/drilled.</p> <p>Assessment of viability of this response option must consider access to the blown well (due to safety risks described in the SSID row above) and where vertical access to land the capping stack cannot be achieved, the mobilisation of the OIE (stored in Trestle, Italy) may be required.</p> <p>The use of the capping stack and OIE should only occur where the response timing shows that the installation of cap, results in the reduction of the release duration compared to a intersection by a relief well.</p> <p>In most cases, consideration should be given to the initial simultaneous mobilisation of the capping stack and OIE, while mobilisation effort of the relief well MODU is ongoing. This will ensure that there are no delays in mobilisation if this response option is pursued.</p>		
Protection of Sensitive Resources	Group I surface NO Group I subsurface NO Group II YES Group IV YES	<p>Booms can be used to protect and deflect (P&D) spills away from sensitive habitats or capture oil within natural collection points to protect adjacent areas. This technique is most likely to be more effective against Group II and Group IV slicks. However, the strategic SIMA found that it was unlikely to result in a tangible benefit against low concentration, weathered condensates. P&D is less effective in areas of high wave energy or strong currents, which are seasonally prevalent at offshore islands in the Browse & Bonaparte Basins and along the outer islands of the Kimberley/NT coastline (calmer periods more likely during transition months, generally March-May and Sept-Nov).</p> <p>Given the size of the offshore island shorelines (e.g., Browse Island intertidal zone is 3 km in diameter, and is one of the smallest offshore islands), substantial numbers of booms would need to be deployed to protect the</p>	<p>The WA/NT Control Agencies will make the final decision to undertake P&D activities in WA/NT waters/shorelines.</p> <p>If SMV data demonstrated a tangible, positive outcome, and with weather conditions permitting (<1m sea-state) and conducive to a resource protection operation, there is the potential to undertake this response activity within a nearshore/intertidal environment.</p> <p>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.</p> <p>P&D equipment transport to and from the shoreline would be by small vessels.</p> <p>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.</p> <p>A large support vessel (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for response personnel.</p>	



Response Strategy	Spill Source Applicability	Strategic SIMA Summary	Operational Considerations	Operational SIMA comments
		<p>offshore island 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.</p> <p>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.</p> <p>If a slick were potentially reaching a more sheltered location such as the Kimberley or NT coastlines, shoreline booming may be a more appropriate strategy, on sheltered sandy beaches (not mangrove systems or rocky headlands), however the extreme tidal ranges (+7m) and presence of estuarine crocodiles in all Kimberley/NT sheltered coastal waters present very significant challenges.</p> <p>Therefore, if a tangible, positive outcome could be demonstrated and with the right weather conditions a resource protection operation may be possible.</p>	<p>In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with minimum numbers of response personnel may be appropriate.</p>	
SCAT & Shoreline clean-up	<p>Group I surface YES</p> <p>Group I subsurface YES</p> <p>Group II YES</p> <p>Group IV YES</p>	<p>The shoreline clean-up assessment technique (SCAT) should be used to evaluate the likely success of shoreline clean-up activities.</p> <p>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 2015c).</p> <p>The clean-up of Group I or II spills on a shoreline is likely to be difficult, generating high volumes of waste in comparison to the volume of oil recovered.</p> <p>Most offshore island shorelines would be expected to 'self-clean' any accumulated Group I or II oils, due to the lack of adhesiveness of these oil types, the coarse substrate, the high wave energy and high tidal regime, and generally high temperatures and UV exposures.</p>	<p>The WA/NT Control Agencies will make the final decision to undertake SCAT and shoreline clean-up activities in WA/NT waters/shorelines.</p> <p>Utilise SMV and SCAT data to determine the likely success of any shoreline clean-up response compared to allowing natural weathering to occur.</p> <p>Shoreline clean-up techniques should focus on manual clean-up techniques, such as the use of rakes and shovels.</p> <p>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 or 'dingo') can be used to assist in moving collected oily waste around a remote shoreline.</p> <p>Careful planning of track routes is required to avoid disturbance of any turtle/bird nesting sites.</p> <p>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.</p> <p>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.</p>	



Response Strategy	Spill Source Applicability	Strategic SIMA Summary	Operational Considerations	Operational SIMA comments
		<p>Weathered Group IV oils (including emulsions) have relatively high viscosity and are expected to form a thick adhesive layer on a shoreline.</p> <p>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.</p> <p>The clean-up of Group IV spills on a shoreline is likely to generate high volumes of waste in comparison to the volume of oil recovered.</p> <p>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 clean-up at these locations should be evaluated for overall benefit vs risk of creating further damage.</p>	<p>Upon successful clean-up of the shoreline, bulka bags/intermediate bulk containers (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.</p> <p>To reduce wildlife disturbance at offshore/remote shorelines, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective may be desired.</p>	
Pre-contact oiled wildlife response (OWR)	<p>Group I surface YES</p> <p>Group I subsurface YES</p> <p>Group II YES</p> <p>Group IV YES</p>	<p>Group I and 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.</p> <p>However, 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 the intertidal zone, or coat large numbers of seabirds.</p> <p>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.</p> <p>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.</p>	<p>The relevant WA/NT Control Agencies will make the final decision to undertake wildlife response activities in WA/NT waters/shorelines, including the practicalities, likely success and risks associated with a wildlife response operation.</p> <p>Wildlife hazing or wildlife capture and translocation in the open ocean should only be considered when SMV/situational awareness data clearly indicates that a positive outcome could be achieved.</p> <p>The merits of wildlife hazing or wildlife capture and translocation at a shoreline should be considered by the IMT when SMV 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.</p> <p>There are significant manual handling risks associated with translocating adult turtles, (adult green turtles are often >100 kg), which need to be evaluated and managed if this activity is to occur. Therefore, translocation of turtle hatchlings is more likely to be successful.</p> <p>Wildlife response personnel and equipment transport to and from the shoreline would be by helicopter and/or vessels.</p> <p>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.</p> <p>A large support vessel (with a helicopter pad, if relevant) would need to be used as the accommodation and logistics base for shoreline response personnel.</p>	



Response Strategy	Spill Source Applicability	Strategic SIMA Summary	Operational Considerations	Operational SIMA comments
		<p>Attempting to capture large numbers (or an entire flock) of healthy seabirds would be very challenging, if not impossible (DPaW & AMOSC 2014), especially at a remote shoreline location (e.g., Browse Island). There is no practicable method to capture healthy seabirds at sea (DPAW & 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.</p> <p>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.</p>	<p>To reduce wildlife disturbance at offshore/remote shorelines, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective may be desired.</p>	
Post-contact OWR	<p>Group I surface YES</p> <p>Group I subsurface YES</p> <p>Group II YES</p> <p>Group IV YES</p>	<p>Group I and 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.</p> <p>However, 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 the intertidal zone, or coat large numbers of seabirds.</p> <p>Capture, relocation, assessment, cleaning and rehabilitation of oiled wildlife has the ability to increase the survival of individuals (IPIECA 2017).</p> <p>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 (DBCA pers. Comms 2021) that the bird species present in the BROPEP Region will have very low survival rates, even when rescue and cleaning is attempted.</p> <p>Any seabirds captured, cleaned and released are at risk of flying 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</p>	<p>The WA/NT Control Agencies will make the final decision to undertake wildlife response activities in WA/NT waters/shorelines, including the practicalities, likely success and risks associated with a wildlife response operation.</p> <p>Oiled wildlife capture in the open ocean should only be considered when SMV/situational awareness data clearly indicates that a positive outcome could be achieved.</p> <p>The recommended method for capture of oiled birds at sea is with the use of hand nets (DPaW & AMOSC 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.</p> <p>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.</p> <p>The merits of wildlife capture, cleaning and rehabilitation at a shoreline should be considered by the IMT when SMV/situational awareness data indicates that populations of wildlife on a shoreline have been impacted by the spill and conditions are suitable for this activity to occur.</p> <p>Wildlife response personnel and equipment transport to and from the shoreline would be by helicopter and/or vessels.</p>	



Response Strategy	Spill Source Applicability	Strategic SIMA Summary	Operational Considerations	Operational SIMA comments
		<p>remediation had occurred, and it was safe to release the seabirds.</p> <p>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.</p>	<p>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.</p> <p>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.</p> <p>To reduce wildlife disturbance at offshore/remote shorelines, a longer duration response with minimum numbers of response personnel required to achieve the IAP objective may be desired.</p>	
In-situ burning	<p>Group I surface NO</p> <p>Group I subsurface NO</p> <p>Group II NO</p> <p>Group IV NO</p>	The SIMA evaluations found that in-situ burning was not an appropriate response strategy for any of Titleholder' s WCSS.	There are no fire-retardant booms or trained personnel in Australia.	



3.5 Incident Action Plan

The IMT must commence the development of an IAP once it has gained accurate and reliable situational awareness, reviewed protection priorities and completed the Operational SIMA.

An IAP must be prepared for response activities beyond the immediate response measures (first strike) timeframes.

The IAP must:

- establish the overall incident response objectives and strategies – determine what is to be achieved, where, when and by whom
- ensure continuity of incident control to ensure objectives, decisions and actions to be undertaken are recorded and cascaded through operational teams
- provide for the coordinated and effective use of resources.

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 IAP will be used to direct response operations while ensuring that all response personnel are aware of response objectives and priorities, and are undertaking appropriate actions to control any identified risks. Therefore, the IAP must:

- provide response personnel with clear statements of objectives, strategies and detailed task assignments/briefs
- supply information on the resources, methods and protocols to be used in order to maintain and monitor/report response effectiveness
- provide documentation regarding the decisions, strategies, safety controls, plans and other key pieces of information critical to achieving the incident response objectives.
- 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 will be in-force for its defined operational period (start/end - date/time). The IAP shall be reviewed, updated and communicated to field teams prior to the next operational period.

The steps for the development of the IAP are provided for in the Shell Incident Management Team (West) Emergency Response Plan (HSE_GEN_011209) which details the use the Shells Digital IAP Tool.

As part of the IMT Capability Assessment Report (Attachment 2), a number of example spill response objectives were prepared, for three initial operational periods. These example objectives are duplicated, as Table 3-3, for the IMT to utilise (as appropriate to the spill situation) as part of IAP development.



Table 3-3: Example spill response objectives for initial operational periods

Operational Period	IMT Spill Response Objectives
<p>0 – 24 Hours</p>	<p>Establish/maintain an IMT with appropriate oil spill response trained personnel including mutual aid capabilities for specialist oil spill roles</p> <p>Gain situational awareness of spill trajectory, weathering, and potential environmental impact (use of response strategies/tactics including; oil spill trajectory modelling (OSTM), visual surveillance, satellite imagery and SCAT. Use of IMT tools including; Operational SIMA, resources at risk evaluation, and Common Operating Picture (COP).</p> <p>Establish Forward Operational Bases (FOBs)/Staging Areas for aviation, shore and marine response strategies (E.g., establish FOBs at Broome Airport, Darwin Airport, Broome Port, Darwin Port as required)</p> <p>Pre-deploy shoreline assessment/response capabilities including SCAT, OWR, resource protection and shoreline clean-up resources to FOB in anticipation of future deployment.</p> <p>(Group IV spill only) – Mobilise/activate at sea response strategies, including:</p> <ul style="list-style-type: none"> Activate in-field vessel-based dispersant, test spray and commence dispersant spraying Mobilise FWAD capability to a nominated airfield along Kimberley coastline Mobilise C&R capability at Broome/Darwin port <p>(Well blow-out only) – Mobilise SSDI spread to FOB.</p> <p>Undertake risk assessments and develop HSE plan(s).</p>
<p>24 – 72 Hours</p>	<p>Establish/maintain an IMT with appropriate oil spill response trained personnel including mutual aid capabilities for specialist oil spill roles</p> <p>Support the mobilisation/deployment of response strategies/field capabilities through FOBs</p>



Operational Period	IMT Spill Response Objectives
	<p>Continue the pre-deployment of shoreline assessment/response capabilities including SCAT, OWR, resource protection, and shoreline clean-up resources to FOB in anticipation of future deployment.</p> <p>(Group IV spill only) – Mobilise/activate at sea response strategies, including:</p> <p>Continue in-field vessel-based dispersant spraying</p> <p>Continue mobilisation and/or commence FWAD dispersant spraying from a nominated airfield along Kimberley coastline</p> <p>Continue mobilisation of C&R capability from Broome/Darwin port – commence operations in the field if possible.</p> <p>(Well blow-out only) – Mobilise SSDI spread to FOB.</p> <p>Review hazard assessments and execute HSE plans for operational activities.</p>
72 – onwards	<p>Establish/maintain an IMT with appropriate oil spill response trained personnel including mutual aid capabilities for specialist oil spill roles</p> <p>Maintain situational awareness of spill trajectory, weathering, and potential environmental impacts.</p> <p>Support the mobilisation/deployment of response strategies/field capabilities through FOBs</p> <p>Continue the pre-deployment of shoreline assessment/response capabilities including SCAT, OWR, resource protection and shoreline clean-up resources to FOB in anticipation of future deployment. As directed by relevant State/Territory Control Agency - commence deployment of shoreline assessment/response capabilities into the field.</p> <p>(Group IV spill only) – Mobilise/activate at sea response strategies, including:</p> <p>Continue in-field vessel-based dispersant spraying</p> <p>Continue mobilisation and/or commence FWAD dispersant spraying from a nominated airfield along Kimberley coastline</p> <p>Commence/continue with C&R activities in the field</p> <p>(Well blow-out only) – Mobilise subsea dispersant injection (SSDI) spread to FOB.</p>



Operational Period	IMT Spill Response Objectives
	Review hazard assessments and execute HSE plan for operational activities.



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 the spill (e.g., no further improvement/positive environmental outcomes is expected by continuing the response).

The termination of response strategies associated with 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.

4 Oil Spill Response Strategy Implementation Guide

4.1 Support vessel capability and arrangements

Titleholder 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 helicopter, if required for shoreline response activities.

An environmental risk assessment associate with spill response has been completed in the BROPEP BOD and Field Capability Assessment Report (HSE_GEN_016764). The relevant environmental performance outcomes and standards associated with use of vessels during spill response is presented in Table 4-1.

Table 4-1: EPOs and EPSs to manage risks from vessels during spill response

Environmental performance outcome	Environmental performance standard	Measurement criteria
Risks of impacts to the environment from vessel discharges during oil spill response activities will be	All vessels involved in oil spill response activities will conduct sewage disposal activities in accordance with MARPOL 73/78, Annex IV.	Emergency event response records.



Environmental performance outcome	Environmental performance standard	Measurement criteria
reduced and maintained at ALARP and acceptable levels.	All vessels involved in oil spill response activities will conduct food scrap disposal activities in accordance with MARPOL 73/78, Annex V.	Emergency event response records.
No inappropriate disposal of waste to the marine environment from vessels during spill response.	All vessels involved in oil spill response activities will conduct garbage management in accordance with MARPOL 73/78, Annex V.	Emergency event response records.
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.	Emergency event response records.
No disturbance/ mortality of cetaceans, whale sharks or turtles resulting from interactions with vessels undertaking spill response activities.	<p>Interactions between support vessels and cetaceans will be consistent with EPBC Regulations 2000 – Part 8, Division 8.1 (Regulation 8.05) Interacting with cetaceans (modified to include turtles):</p> <p>Spill response vessels will not travel faster than 6 knots within 300 m of a cetacean or turtle (caution zone) and minimise noise.</p> <p>Spill response vessels will not approach closer than 50 m to a dolphin or turtle and/or 100 m for a whale (with the exception of bow riding).</p> <p>If a cetacean shows signs of being disturbed, support vessels will immediately</p>	Records of event reports if vessel strike occurs during spill response.



Environmental performance outcome	Environmental performance standard	Measurement criteria
	<p>withdraw from the caution zone at a constant speed of less than 6 knots.</p>	
	<p>Interactions between spill response vessels and whale sharks will be consistent with the Whale Shark Wildlife Management Program no. 57 (DPaW 2013); specifically, spill response vessels will not travel faster than 8 knots within 250 m of a whale shark (exclusive contact zone) and not approach closer than 30 m of a whale shark.</p>	<p>Records of breaches of whale shark code of conduct are documented.</p>
<p>No introduction of terrestrial exotic pests to island ecosystems or introduction and establishment of introduced marine species of concern to State/Territory or Commonwealth marine parks during response activities.</p>	<p>Premobilisation visual inspections of vessels and equipment before mobilisation to an island location and recorded on quarantine inspection checklists.</p>	<p>Emergency event response records.</p>
	<p>No de-ballasting within State, Territory or Commonwealth marine parks during oil spill response activities.</p>	
<p>Risks of impacts to transient, EPBC-listed species, (marine turtles) and intertidal habitats from a shoreline response are reduced and maintained to ALARP and acceptable levels.</p>	<p>In the event of a shoreline response, a vessel-specific lighting plan will be prepared, for vessels supporting remote shoreline response operations, adjacent to identified turtle nesting beaches, during turtle nesting season.</p> <p>The plan will address specific issues including:</p>	<p>Emergency event response records.</p>



Environmental performance outcome	Environmental performance standard	Measurement criteria
	<ul style="list-style-type: none"> • minimum lighting required for navigation • permitted/restricted activities on deck at night, and the minimum lighting requirements for the safe conduct of those permitted activities. <p>The vessel specific lighting plans will be developed by the Vessel's bridge crew, in consultation with AMOSC and DAWE (for response on Cwlth shorelines), and WA/NT Control Agencies and wildlife agencies for responses on WA/NT shorelines.</p>	

4.2 Aviation asset capability and arrangements

Titleholder 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.

Crew change helicopters can be used for:

- aerial surveillance
- Air Attack Supervisor platforms, in support of FWAD activities
- routine crew change activities for remote shoreline response, to approved helicopter pads (E.g., helicopter pads on accommodation support vessels).

Fixed wing aircraft with good all-around visibility are best suited to ongoing aerial observations.

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.

The Titleholder membership of AMOSC provides access to the fixed wing aerial dispersant aircraft managed by AMSA.

All aircraft used during spill response should to comply with the Titleholder Aviation Standard. In an emergency event where an aircraft may be required and is unable to meet the Titleholder 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.

An environmental risk assessment associate with spill response has been completed in the BROPEP BOD and Field Capability Assessment Report (HSE_GEN_016764). The relevant environmental performance outcomes and standards associated with use of aviation assets during spill response is presented in Table 4-2.

Table 4-2: EPOs and EPSs to manage risks from aircraft during spill response

Environmental performance outcome	Environmental performance standard	Measurement criteria
No introduction of terrestrial exotic pests to island ecosystems or introduction and establishment of introduced marine species of concern to State/Territory or Commonwealth marine parks during response activities.	<p>Premobilisation visual inspections of helicopters and equipment before mobilisation to an island location.</p> <p>Inspection date/time/outcome to be recorded on aircraft technical log.</p>	Emergency event response records.
No disturbance/injury/mortality of cetaceans, whale sharks or turtles resulting from interactions with vessels and aircraft undertaking spill response activities.	<p>Interactions between spill response aircraft and cetaceans will be consistent with EPBC Regulations 2000 – Part 8, Division 8.1 (Regulation 8.07) - aircraft/cetacean separation requirements (500m altitude and radius for helicopters, 300m altitude and radius for fixed wing aircraft).</p>	Emergency event response records.

4.3 Oil spill preparedness and response tools

4.3.1 Oil Spill Forms Register

The Oil Spill Forms Register provides a consolidated list of forms which may be utilised by the IMT during a spill response. This register is provided in Section 5 of this document. It contains forms such as:

- notification and reporting forms (such as POLREP/SITREPs)
- modelling activation forms
- mutual aid activation forms (e.g. AMOSC/OSRL)
- wildlife disturbance permits.



4.3.2 Oil Spill Observation and Dispersant Guide

The Shell Dispersant Application Guide provides guidance on estimating type, size and minimum/maximum volume of a spill, to any person conducting oil spill observation activities (from any platform, vessel or aircraft).

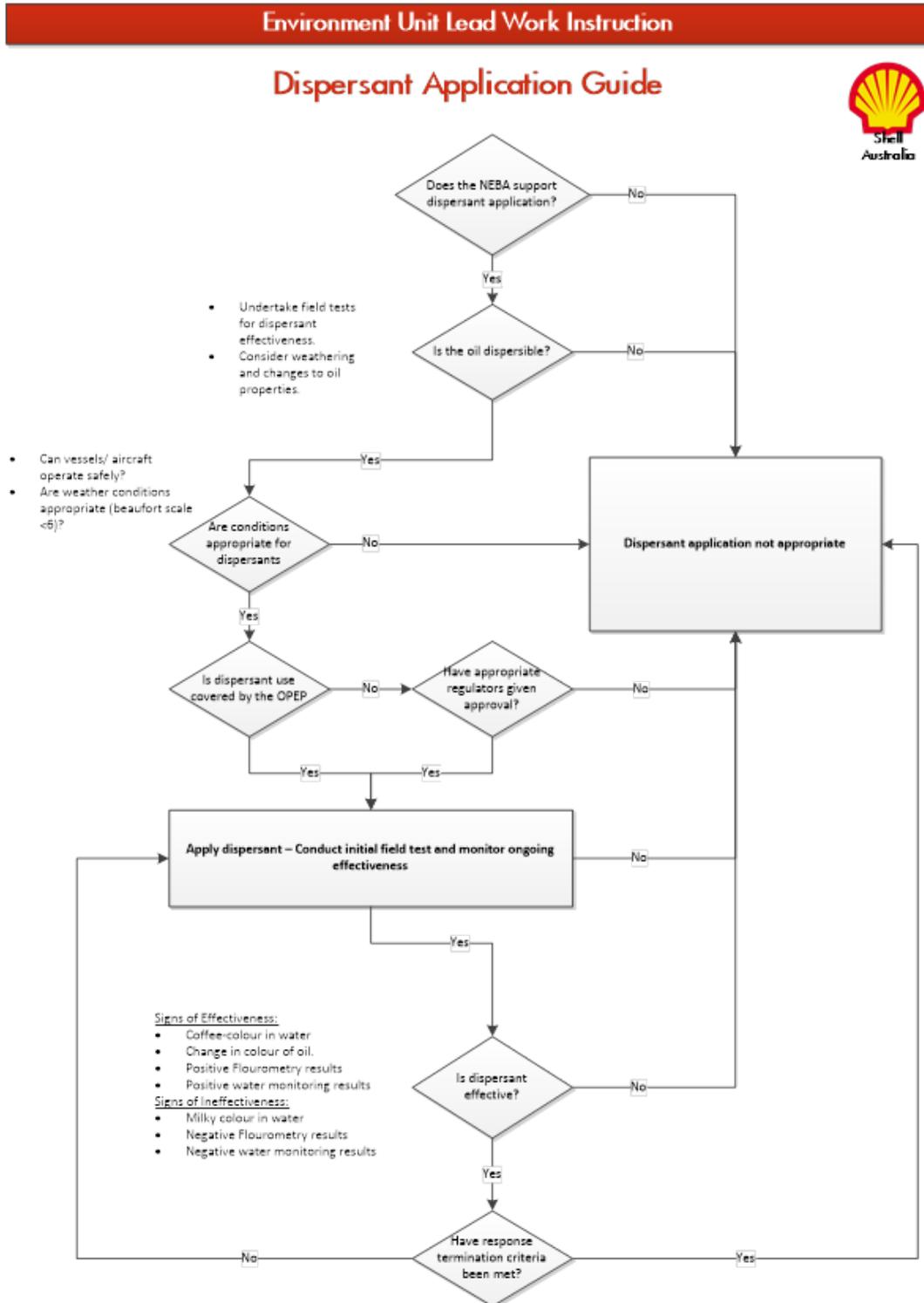


Figure 4-1: Shell Surface Dispersant Application Guide



4.3.3 Oil Spill Surface Volume Calculator

The Oil Spill Surface Volume Calculator is a Microsoft Excel sheet which assists with calculating minimum/maximum oil spill thickness estimates, based on visual observations. This tool should be used in conjunction with the Oil Spill Observation and Dispersant Guide, as it significantly reduces the likelihood of manual errors in the oil spill thickness estimation calculations.

4.4 Immediate (first strike) response capability and arrangements

A detailed description of first strike capability requirements is provided in Section 2.6.

The immediate response actions which need to be undertaken by the IMT for all Level 2/3 spill events is the activation of Surveillance, Monitoring and Visualisation (SMV), as detailed in Section 4.4.1.

Note – in the event of a Group IV spill vessel dispersant (test-spray), and commencement of mobilisation of FWAD and at-sea containment and recovery capabilities should also be undertaken. The vessel dispersant, FWAD and at-sea containment and recovery capabilities can be de-activated if the Operational SIMA determines one or more of the response strategies are not required.

Detailed descriptions of surface (vessel/aerial) dispersant, and at-sea containment and recovery capabilities and arrangements are provided in Section 4.5.5 and Section 4.5.6 respectively.

4.4.1 Surveillance, monitoring and visualisation (SMV)

4.4.1.1 Response Objective

SMV data will be acquired and utilised to enable informed and timely IMT decision making during a response.

4.4.1.2 Response Strategy Summary

SMV does not in itself control or reduce the impacts of a spill; however, it allows 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 is the spill?
 - how big it is?
 - where it is going?
 - what is happening to it over time (weathering)?
 - how long it will take to get there?
 - what will it make contact with?
- 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, SMV tactics that may be used to gain situational awareness could include:

- oil spill trajectory modelling (OSTM)
- electronic surface tracking buoy(s)

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- aerial surveillance
- vessel surveillance
- satellite imagery analysis.

The SMV program overlaps with the OSMO operational monitoring plans including:

- Hydrocarbon properties and weathering behaviour at sea
- Fate and weathering modelling – uses computer modelling (e.g. Automated Data Inquiry for Oil Spills (ADIOS2)) to estimate the weathering of an oil spill
- Pre-emptive assessment of sensitive receptors at risk

Additional details of these operational monitoring plans are provided in Section 4.7.

4.4.1.3 Activation

SMV should be activated in accordance with the timeframes presented in Table 4-3 for all Level 2/3 spills.

4.4.1.4 Aerial surveillance summary

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 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

weather conditions can affect visibility and may therefore make surveillance flying impractical.

4.4.1.4.1 Aerial surveillance personnel

Aerial observers should ideally be trained, experienced and able to reliably detect, recognise and record oil pollution at sea.

AMOSC core-group provides a pool of trained aerial observers – typically available within 48 hours.

OSRL can provide additional trained aerial observers for a longer duration event.

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.

4.4.1.4.2 Aerial surveillance tools/equipment/plans

The Oil Spill Observation and Dispersant Guide and the Oil Spill Surface Volume Calculator should be used by personnel undertaking observations from crew change helicopters or any other fixed wing surveillance platforms, until trained aerial observers are available.

The AMOSC Air Operations Plan (AMOSC 2020a) should be used to guide the development of aerial surveillance operations.

4.4.1.4.3 Aerial surveillance logistics

Aircraft used for aerial observation should preferably feature good, all-round visibility.

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Crew change helicopters should be used for initial observations.

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, or along more complex shorelines such as the Kimberley/NT coastlines and islands.

The minimum deployment time of fixed wing surveillance aircraft is typically 24 hours.

4.4.1.5 Vessel surveillance summary

Oil spill surveillance can be carried out from vessels (or near-by facilities), although its practicality is limited by the availability vessels, their other emergency response priority activities and the scale of the spill.

For smaller spills, the slick 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 slick, such as its colour, thickness, weathering and the direction of travel.

As such, aerial surveillance is the preferred method of visual surveillance in the BROPEP region.

4.4.1.5.1 Vessel surveillance personnel

All contracted vessel Emergency Response Team (ERT) personnel are provided with an oil spill induction, which includes training in the Oil Spill Observation and Dispersant Guide and the Oil Spill Surface Volume Calculator.

4.4.1.5.2 Vessel surveillance tools/equipment/plans

The Oil Spill Observation and Dispersant Guide and the Oil Spill Surface Volume Calculator should be used by personnel undertaking observations from a vessel/facility.

4.4.1.5.3 Vessel surveillance logistics

Vessels on contract (or owned/contracted facilities) which are in the vicinity of a spill should be requested to undertake surveillance activities, and report observation to the IMT.

Vessels would not normally be specifically contracted to undertake vessel surveillance activities, as aerial surveillance is the optimal visual surveillance platform in the BROPEP region.

4.4.1.6 Oil spill trajectory modelling summary

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.

Titleholder can access oil spill trajectory modelling through the existing AMOSC contract which is in place.

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4.4.1.7 Electronic surface tracking buoy summary

Electronic surface tracking buoys (ESTBs) 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 ESTBs enable the trajectory of surface oil to be tracked.

When deploying ESTBs, 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 ESTBs 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.

Shell maintains ten ESTBs located on the Prelude FLNG for use in oil spills within the browse region.

Occasionally, a ESTB will be out of circulation, for biannual servicing.

FOR IMT AWARENESS - the following **SAFETY ALERT** text is attached (hard-copy) to the pelican-case of all ESTBs:

- Not intrinsically safe – do not deploy into fresh oil spill
- Allow slick to weather:
 - condensate – minimum 3 hours before deployment
 - diesel/IFO/HFO – minimum 1 hour before deployment
- Do not drop from height
- deploy close to water from deck of vessel
- if no vessel, lower and release with rope
- If possible – best practice is to deploy 3 buoys together at leading edge of the slick

4.4.1.8 Satellite imagery analysis

Satellite-based remote sensors can be used to detect oil on water. Because satellite 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.

Information gained from satellite imagery would be used in combination with other controls such as visual surveillance and OSTM, to enable informed and timely IMT decision making during a response.

Access to satellite imagery is limited due to the continuous movement and orbit of satellites around the globe. Typically, imagery can only be obtained a few days after the initial request is made to the satellite imagery from service providers.

The delays are not considered as a risk to reducing the IMT's situational awareness, as during the first few days of a spill, the slick will remain in a small geographic area, and other techniques

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including vessel and aerial surveillance should provide sufficiently accurate information, to inform IMT decision making.

If the spill was 'Level 2', with a slick which will be easily monitored via air surveillance, and no significant or complex shoreline contacts are expected, satellite imagery may not be required. However, satellite imagery would be required for any Level 3 event, where monitoring of a significantly large or dispersed slick is required, or complex/multiple shoreline contacts in remote areas are anticipated, and therefore satellite imagery would help support OSTM validation, impact predictions and response strategy/tactical planning.

4.4.1.9 Termination criteria

Termination of SMV tactics 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 longer any practicable response strategies/tactics that can be implemented to further reduce the risk to the environment from the spill
- termination criteria for Operational Monitoring (OM) program have been met and processes have been established to transition to a Scientific Monitoring (SM) program.

4.4.1.10 Capability, arrangements and performance outcomes and standards

The arrangements and capabilities as described in the subsections above are summarised in Table 4-3.

The EPOs and EPSs related to the implementation of SMV are provided in Table 4-4.

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Table 4-3: Arrangements and capabilities – surveillance, monitoring and visualisation

Technique	Resource capability and availability	Implementation time	Activation guidance
Oil spill trajectory modelling (OSTM)	AMOSC maintain a contracted spill modelling service provider for 24-hour support.	OSTM contractor activated within 2 hours of IMT formation.	AMOSC activation of RPS modelling service.
Aerial surveillance	Crew change helicopters are 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). Fixed wing aircraft should be utilised from second daylight period onwards for the duration of the spill. Additional fixed wing aircraft required as necessary, based on spill size/trajectory.	IMT (aviation operations) to coordinate use of crew-change helicopters (or any other available aircraft) to commence initial aerial surveillance. Fixed wing aircraft provider contact details available through Titleholder aviation team. Trained aerial observers to be accessed via AMOSC. AMOSC and OSRL notification/activation forms available in the Oil Spill Forms Register (refer Section 5).
	Trained aerial observers to be sourced via AMOSC (or OSRL) and mobilised to selected airbase.	Trained aerial observers to commence aerial observation task from Broome/Darwin (or other selected airbase) within 48 hours.	
Vessel/facility surveillance	Conduct visual surveillance using opportunistically available vessels/facilities in the vicinity of the spill. (aerial surveillance will become the primary form of visual surveillance).	As soon as practicable following the initial spill event.	IMT (Operations) to request all vessels and facilities in the vicinity of the spill to provide visual surveillance (provided this does not impact other safety related emergency response activities underway by the relevant ERT).
Electronic surface tracking buoy(s)	Titleholder has numerous oil spill tracking buoys on the Prelude FLNG. Inpex has several surface tracking buoys positioned in offshore including the following: CPF, FPSO, OSV, 3 x Drilling support vessels. Additional buoys will be on other vessels and located at Broome/Darwin logistics bases.	Deploy initial tracker buoys (deployment from vessels) as soon as safety practicable. condensate – minimum 3 hours before deployment diesel/IFH/HFO – minimum 1 hour before deployment.	Tracking buoys deployed from vessels, as directed by the OIM or IMT.
Satellite imagery analysis	Sourced via OSRL, AMOSC and/or AMSA third party satellite imagery providers.	IMT to request satellite imagery within 6 hours of IMT formation (Level 3 event only).	IMT to request satellite imagery via AMOSC, OSRL and/or AMSA. AMOSC and OSRL notification/activation forms/numbers available in the Oil Spill Forms Register (refer Section 5).



Table 4-4: EPO, EPS and measurement criteria for the activation and implementation of surveillance, monitoring and visualisation

Environmental performance outcome	Environmental performance standard	Measurement criteria
<p>SMV data will be acquired and utilised to enable informed and timely IMT decision making during a response.</p>	<p>For any Level 2/3 spill event, the IMT will activate SMV capability, as described in Table 4-3.</p>	<p>Emergency event response records.</p>
	<p>Initial visual surveillance (e.g., helicopter, vessel or facility) will be undertaken utilising the INPEX Oil Spill Observation and Dispersant Guide and the INPEX Oil Spill Surface Volume Calculator.</p>	<p>Emergency event response records.</p>
	<p>SMV data will be utilised by the IMT to maintain situational awareness and inform ongoing review of the Operational SIMA and IAP, including consideration of the various SMV tactics against the response termination criteria.</p>	<p>Emergency event response records.</p>

4.5 Secondary response measures capability and arrangements

This section provides the details of the capabilities and arrangements for the following response strategies:

- Source Control
- SCAT and shoreline clean-up
- oiled wildlife response
- protection of sensitive resources
- surface (vessel/aerial) dispersant
- at-sea containment and recovery
- waste management.



4.5.1 Source Control

4.5.1.1 Response Objective

To minimise the total volume of spilled oil into the marine environment during a Level/Tier 2-3 spill from a loss of well control or well blow out incident.

4.5.1.2 Response strategy summary

Source control involves stopping the discharge of hydrocarbons from the source of the spill. The source of the spill may be a loss of well control (LOWC) or well blowout during either drilling, production or suspension/P&A activities. If the source of the spill is a LOWC or well blowout, then source control typically involves subsea well intervention, which includes the methods outlined below.

Should a LOWC or well blowout event occur a number of source control activities may be implemented depending on the specific circumstances of the loss mechanism. The initial phase of source control is data gathering to inform decision on the appropriate selection of actions through the development of the IAP. This may include the capability to undertake visual observations of the well location utilising ROV where it is safe to do so (site survey). Following this the tools, equipment, specialists personnel and actions can be mobilised to undertake source control activities. Key source control activities may include:

- Site Survey (vessel based activity including the use of ROV)
- SFRT/SIRT (including SSDI) Equipment
- Relief Well Drilling
- Capping Stack and and Offset Installation Equipment (OIE)

Individual EPs set out which source control options are available for the specifics of the activity being undertaken and the following is presented as generic options that Shell has available. The development of the IAP will further detail which Source Control options are selected in response to a spill.

4.5.1.3 Activation

The activation of any source control response tactics are the responsibility of the IMT Lead with advice from the Source Control Branch Lead and will be selected to limit, reduce and stop a spill at its source.

The Shell Source Control Branch is activated via the IMT Lead and forms part of the IMT structure for all LOWC or well blow out incidents.

The Source Control Branch (if required), falls under the Operations Section of the IMT and develops and implements strategies and tactics to regain control of the well, and stop or contain the discharge of hydrocarbons.

4.5.1.4 Personnel

Shell Source Control Branch has a team of technical specialists located both locally and internationally to plan and execute a well control response which include:

- Shell: WCVERT, various subsea engineers, marine/shipping, logistics, geotechnical, flow modelling and Wells Process safety group.

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- Contractors: Oceaneering (owner of the SIRT kits), OSRL (custodian of the equipment), Specialist Personnel from Wild Well Control and Boots and Coots (Well Control advisors), AMOSC (custodians of SFRT), freight forwarders for logistics help and Clarksons Plateau for vessel identification/brokering.

The activities of the Source Control Branch in Australia will be organised into additional groups, according to the specific requirements of the incident. These groups may include a Capping and Subsea Intervention Group, Well Control Group and Offset Installation Taskforce. All source control personnel complete ICS 100 and 200 training.

4.5.1.5 Tools/equipment/plans and Logistics

Site survey

If a loss of well control incident was to occur, the seabed and subsea equipment around a well would require an assessment to determine the most suitable subsea well intervention methods to employ. This activity requires the use a suitably classed Vessel and ROV. The vessel and ROV to undertake the site survey would be sourced from within Australia using Shell’s established vessel contracting procedures.

The following well and subsea tree valves are fail-safe closed valves (SCSSSV, PMV, PWV and PSDV). With the subsea tree still connected, if there is a leak then the initial response would be to attempt to isolate the failure by remotely functioning one or more valves from the facility. There is also some ROV intervention capability.

Subsea First Response Toolkit (SFRT)

Shell Australia is a founding member of the AMOSC-managed SFRT consortium. The SFRT is a suite of ROV tools designed to support a well source control emergency response for the purposes of subsea debris clearance; Blowout preventer intervention equipment and ancillary tools, including subsea dispersant injection equipment.

This Toolkit provides the capability to assess the well site and prepare the well and surrounding area for relief well drilling. It does this via remotely operated vehicles (ROVs), which Shell is required to provide independently of the SFRT.

In the event of a well control incident, Shell will mobilise the AMOSC SFRT from Perth to Broome for transshipment to a suitable vessel for transport and deployment at the incident location. The SFRT is located at Oceaneering’s facilities at Jandakot and the dispersants are held at Fremantle. If required, the equipment would be mobilised via road from Fremantle and Jandakot to either Broome or Darwin. It is estimated this would take 24 – 48 hours to arrange and about 120 hours (5 days) to transport, a suitable vessel will be acquired by Shell during this timeframe for onloading of equipment.

Alternatively, a Subsea Incident Response Toolkit (SIRT) is available and managed by Oil Spill Response Limited (OSRL). Both toolkits are in essence the same, but the OSRL equipment would be mobilised from Norway (with Brazil as back-up option).

Detailed guidelines for mobilising the SFRT and SIRT are contained within the Source Control Equipment Mobilisation Plan (IMT_GEN_001595) and the Browse Basin Source Control

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Contingency Plan (TEC_GEN_015842). OSRL do not hold dispersant in Australia. The nearest stockpile for Shell Australia through OSRL is Singapore and South Africa.

Subsea Dispersant Injection

Subsea dispersant injection (SSDI) aims to disperse hydrocarbons close to the release point and minimise the amount of hydrocarbons reaching the sea surface. This technique helps to break up the oil droplets so that they are dispersed, diluted and biodegraded more rapidly in the water column, reducing the amount of surface hydrocarbons drifting towards sensitive receptors. An additional benefit of this technique is that it can successfully reduce volatile organic compounds from reaching the surface close to the release site, which is beneficial to the health and safety of personnel involved in any source control operations.

As described above, Shell can mobilise the AMOSC SFRT through its membership, which also includes a dedicated dispersant stockpile (500 m³ of Dasic Slickgone NS) plus ancillary equipment (e.g. pumps, flying leads, coiled tubing head, dispersant wands). Shell would still be required to obtain a suitable vessel for transportation of the subsea dispersant injection system and ancillary equipment including ROVs and coiled tubing/hydraulic hose/umbilical.

It is assumed the dispersant to oil ratio (DOR) would commence at 1:100 and would be modified based on the results of the effectiveness monitoring, conducted as part of operational monitoring (Section 15). Research conducted by Brandvik et al., 2014 indicated that DORs of 1:50 to 1:100 may be sufficient to cause substantial additional dispersion, particularly if the dispersant is injected close to the nozzle. As an example, to achieve a DOR of 1:100, IPIECA-IOGP (2015a) recommend for a flow rate of 20,000 bbl./day, a dispersant pump rate of 22 L/min (31.6 m³/day) is required.

The SFRT stockpile in Fremantle is sufficient to sustain SSDI for a well blowout for approximately 15 days. By this stage, additional quantities of dispersant would be sought from additional AMOSC and AMSA stockpiles within Australia and/or international OSRL stockpiles. Shell will prioritise the use of chemical dispersants listed on the OSCA register. If a chemical dispersant is available and is not listed on the OSCA register, Shell will assess its acceptability for use via its Chemical Management Process (HSE_GEN_007879) prior to application.

Subsea dispersant effectiveness monitoring is required as part of SSDI, which will be addressed by the relevant operational monitoring component (Section 4.7). Prior to any application of subsea dispersants, initial monitoring should be conducted at the release point to determine the nature of the release, characterise the properties and behaviour of the oil and estimate the oil and gas flow rates. This information will inform the initial choice of dispersant injection methods (e.g. number of nozzles, nozzle sizes) and application rates. Results from the monitoring will feed into the operational SIMA assessment used for decision-making regarding the continuation or termination of subsea dispersant use.

Relief Well Drilling

A relief well would be the primary method of source control. A relief well requires the mobilisation of a suitable MODU to the location adjacent to the failed well. The MODU then drills an interception well into the failed well, so that it can be killed (e.g. stop the flow of hydrocarbons), enabling trained personnel to safely plug and abandon the well.

Detailed guidelines for mobilising and conducting relief well operations are contained within the Browse Basin Source Control Contingency Plan (TEC_GEN_015842).

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Shell is a signatory to an Australian Petroleum Production and Exploration Association (APPEA) memorandum of understanding (MoU) between Australian offshore operators to provide mutual aid to facilitate and expedite mobilising a MODU and drilling a relief well in the event of a loss of well control incident. The MoU enables the signatories to share rigs, equipment, personnel and services to assist another operator in need. When selecting a suitable rig, the MODU’s Safety Case should be considered (Section 4.5.1.6).

It is estimated a suitable MODU could reach the well location and kill the well within 80 days. This would involve:

- Activation of Source Control Team; and Well Control Specialists; confirmation of relief well drill rig and suspension of well currently being drilled by the suitable relief well drill rig (~ 7 days)
- Transit of suitable relief well drill rig to Prelude or Crux relief well location and at the same time source drilling equipment and tubulars and transport to relief well location (~21 days)
- Conduct relief well drill operation to intercept and kill the well (~52 days).

During the activation and transit phase, a safety case would be revised in parallel (Refer to Section 4.5.1.6).

Capping Stack and OIE

A capping stack is designed to be installed on a subsea well and provides a temporary means of sealing the well until a permanent well kill can be performed either through a relief well or well re-entry. After sufficient debris has been removed, the well may be capped at the source by using a dedicated capping stack or a standard subsea BOP stack run on riser to connect to the wellhead (after removing the existing BOP stack).

Capping stack compatibility varies from well to well and can also depend on the extent of blow out, type and rate of discharge, and damage to an individual well, which would only be known at the time of the spill and assessed via the SFRT and accompanying ROVs. Depending on damage and capping stack compatibility, Shell Australia may use one of four subsea capping stacks it has access to under the OSRL Master Supplementary Agreement.

If conditions prevent direct vertical access to the wellhead or BOP, an Offset Installation Equipment (OIE) system may be used to support well intervention operations. This system may help deploy the capping stack offset from an incident site and is compatible with OSRL’s 10K capping stack located in Singapore as well as the 15K capping stacks located in Brazil and Norway. The offset distance will be determined by the type and rate of discharge from the well, and prevailing weather and current conditions at the well site. The OIE is owned and operated by Saipem and is located in Italy. Shell Australia has access to this equipment via the agreement with OSRL.

The mobilization of the OSRL system is covered in the Source Control Equipment Mobilisation Plan (IMT_GEN_001595). The actual mobilisation strategy to Australia will be determined by the incident requirements. The primary mobilisation strategy for this equipment will be direct from Singapore to the incident location.

Vessel and MODU Availability

Titleholder currently tracks the availability of suitable MODU’s to support well intervention activities via several different sources. On a weekly basis via a company subscription to an

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Industry provided service “Who’s Drilling”. Updated offshore rig locations and availability are listed, including by Well and Basin locations. Secondly, on a quarterly basis through the IADC Offshore Rig Schedule Update presented to Operating Company’s at the DrillWell/DrillSafe meetings and posted on the Drill Safe website. This gives an update on whether offshore rigs in the region are working, idle, overseas Australia bound or on hold. Additionally, via the NOPSEMA website under the “Register of Operators” subsite a list of Operators with MODU’s or Vessels that hold an accepted NOPSEMA Australian Safety Case.

Through the OSRL SWIS Membership, the location of suitable vessels are tracked real-time through the ‘Sea/Response’ portal of Maritech Services Ltd and can be used for identifying suitable vessels for the various source control missions.

4.5.1.6 MODU Safety Case Requirements

The MODU required for a relief well will be required to have an approved safety case before it can commence work at the wellsite location. The following presents a prioritised order, which would be carried out post an event, for sourcing relevant MODU for required relief well activities to enable the most efficient path to an approved safety case:

1. Identify MODU with required facility specifications working in Australia with an approved Safety Case.
2. Identify MODU with required facility specifications working outside Australia with an approved Safety Case.
3. Identify MODU with required facility specifications working outside Australia without an approved Safety Case.

The accepted Shell facility safety case revision would form the basis for any required safety case revision required for priorities 1 and 2 listed above which would be a significant saving of time to develop and receive an accepted safety case.

As described above, in the event of a well blowout, a safety case will be required to be accepted by NOPSEMA for the MODU to drill the relief well. Preference will be for selection of a MODU with an existing valid safety case revision and the availability of suitable MODUs is monitored via the Relief Well Rig Register.

The ability to improve the response time by tracking MODU and associated service contractor availability to match source control functional requirements has been assessed. Having an early view on appropriate and available rigs will reduce the time to respond, resulting in a reduced volume of hydrocarbons released to the marine environment and is considered to be ALARP.

Table 4-5 provides initial guidance to the ERT and IMT, on tasks and responsibilities that should be considered when implementing this response strategy. These actions are provided as a guide to the ERT and IMT. The OIM and/or Incident Commander are ultimately responsible for the implementation of the response and therefore, depending on the circumstances of the spill, may determine that some tasks be varied, should not be undertaken or should be reassigned.

Information on resource capability for this strategy are shown in Table 4-5. Environmental Performance Outcomes, Standards and Measurement Criteria are listed in Table 4-6.

4.5.1.7 Termination Criteria

When flow from the well has been fully controlled via a relief well or other control measures.

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4.5.1.8 Capability, arrangements and performance outcomes and standards

The arrangements and capabilities as described in the subsections above are summarised in Table 4-7EPOs and EPSs for the implementation of Source Control are provided in Table 4-6.

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Table 4-5: Arrangement and capabilities summary – Source Control

Technique	Shell Resources	Location	Mobilisation Time	Service Provider Resources	Location	Service Provider Activation Time
Site Survey	Processes					
	Source Control Equipment Mobilisation Plan (IMT_GEN_001595) Vessel contracting procedures	N/A	N/A	N/A	N/A	N/A
	Equipment					
	N/A	N/A	N/A	Vessel equipped with ROV and tooling	Australia	7 – 10 days
	Personnel					
	Source Control Branch, marine/shipping, Subsea IMR, logistics,	Perth	24-72 hours	ROV trained personnel	Australia	24-72 hours
SFRT and SSDI	Processes					
	Source Control Equipment Mobilisation Plan (IMT_GEN_001595)	N/A	N/A	SFRT Activation Process	N/A	24 – 48 hours



Technique	Shell Resources	Location	Mobilisation Time	Service Provider Resources	Location	Service Provider Activation Time
	Browse Basin Source Control Contingency Plan (TEC_GEN_15842)					
Equipment						
	N/A	N/A	N/A	Subsea First Response Toolkit (SFRT) managed by AMOSC (Perth, Western Australia), including 500m ³ of Dasic Slickgone NS Shell has operational contracts for transport, freight forwarding, laydown, and port access to facilitate these activities	Fremantle	AMOSC SFRT mobilisation and transport interval of approximately 7-10 days to Broome/Darwin
				OSRL Subsea Incident Response Toolkit (SIRT)	Norway	~42 days (if by sea), shorter if air freighted.
Personnel						
	Subsea Intervention Group/Source Control Branch, WCVERT, various subsea engineers, marine/shipping,	Perth and international	24-72 hours	AMOSC and Oceaneering Australia personnel for SFRT deployment and usage	Perth and Geelong	24 hours



Technique	Shell Resources	Location	Mobilisation Time	Service Provider Resources	Location	Service Provider Activation Time
	logistics, geotechnical, flow modelling and Wells Process Safety Group					
Relief well	Processes					
	Browse Basin Source Control Contingency Plan (TEC_GEN_15842)	N/A	N/A	N/A	N/A	N/A
	Equipment					
	N/A	N/A	N/A	MODU with accepted Safety Case	Preference for Australian based MODU with accepted safety case	80 days to kill the well
	Personnel					
Subsea Intervention Group/Source Control Branch, WCVERT, various subsea engineers, marine/shipping, logistics, geotechnical, flow modelling and Wells Process Safety Group	Perth and international	24-72 hours	Specialist personnel from Wild Well Control and Boots and Coats	Various locations internationally	+72 hours	



Technique	Shell Resources	Location	Mobilisation Time	Service Provider Resources	Location	Service Provider Activation Time
Capping Stack and OIE	Processes					
	Browse Basin Source Control Contingency Plan (TEC_GEN_15842) Source Control Equipment Mobilisation Plan (IMT_GEN_001595) Australia Subsea Capping Stack Deployment Procedure (TEC_GEN_15968)	N/A	N/A	N/A	N/A	N/A
	Equipment					
	N/A	N/A	N/A	Capping Stack - OSRL offers four integrated intervention systems ranging from 7-1/6" 10k to 18-3/4" 15K	Singapore, Stavanger (Norway), Saldanha (South Africa) and Angra dos Reis (Brazil).	+72 hours
N/A	N/A	N/A	OIE – OSRL SWISS membership	Trestle, Italy	+72 hours	



Technique	Shell Resources	Location	Mobilisation Time	Service Provider Resources	Location	Service Provider Activation Time
	Personnel					
	Subsea Intervention Group/Source Control Branch, Capping Stack and OIE Task Force, OSRL Specialists various subsea engineers, marine/shipping, logistics, geotechnical, flow modelling and Wells Process Safety Group	Perth and international	24-72 hours	Trendsetter Engineering - capping stack reconfiguration and operational oversight.	Various locations internationally	+72 hours



Table 4-6: EPO, EPS and measurement criteria for Source Control

Environmental Performance Outcome	Environmental Performance Standard	Measurement Criteria
Shell will be prepared and ready to respond to source control events.	Maintain contracts and/or agreements with third-party providers to provide access to suitably qualified and competent personnel and equipment to assist in the implementation of source control methods	AMOSC Participating Member, & Master Services Agreement and SFRT Member
	Key source control documents outlined in Section 4.5.1 of this OPEP are in place and updated during this activity	Records demonstrate source control plans listed in Section 4.5.1 of this OPEP are in place and updated during this activity
	Relief Well Rig Register is maintained during the activity	Records demonstrate Relief Well Rig Register is maintained for the duration of this activity
	Remain on APPEA MOU for mutual assistance to facilitate and expedite the mobilisation of a relief well for the duration of the Environment Plan	Records demonstrate Shell remains on APPEA MOU for mutual assistance
	Source Control Branch stood up within 12 hours of well control incident	Incident log (OneNote)
	SFRT and SSDI activities conducted in accordance with Source Control Equipment Mobilisation Plan (IMT_GEN_001595) and Browse Basin Source Control Contingency Plan (TEC_GEN_15842)	Records demonstrate source control activities conducted in accordance with relevant source control plan
	Transportation arrangements for SFRT equipment arranged within 24-48 hours from decision to implement SFRT	Incident log (OneNote)
	Relief well activities conducted in accordance with Browse Basin Source Control Contingency Plan (TEC_GEN_15842)	Records demonstrate source control activities conducted in accordance with relevant source control plan
		Capping stack and OIE, if selected as a response option, are conducted in accordance with Browse Basin



	Source Control Contingency Plan (TEC_GEN_15842)	accordance with relevant source control plan
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4.5.2 SCAT and shoreline clean-up

4.5.2.1 Response Objective

Shoreline clean-up assessment technique (SCAT) will be implemented to systematically collect data about the location, nature and degree of shoreline oiling including at risk and/or impacted wildlife, to inform shoreline treatment and oiled wildlife response planning.

Shoreline clean-up will be implemented to reduce the volume of oil on shoreline, to reduce the likelihood/consequence of impacts on the values and sensitivities of the shoreline and promote/increase the speed of the natural recovery of the shoreline to its pre-oiled state.

4.5.2.2 Response strategy summary

SCAT involves the visual assessment of the scale/extent of oil on shorelines, using data collection templates (paper based or computer applications). Drones may also be used to assist the SCAT team in remote or logistically challenging locations. SCAT activities also typically include evaluation of risks to wildlife. SCAT data is used to support shoreline response and oiled wildlife response (OWR) planning.

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. Manually collected oily contaminated solid waste must be stored in impermeable/lined bulka-bags or other similar lined/impermeable waste collection containers. The oily waste containers would then most likely be backloaded to a staging area and then be transported to a licenced waste management facility for appropriate disposal.

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
- 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.

4.5.2.3 Activation

The WA/NT Control Agencies are responsible for the final decision to activate SCAT and shoreline clean-up activities on State/Territory shorelines.

If a shoreline clean-up response is required at a Commonwealth shoreline (e.g., Ashmore Reef), the activation and response strategies/tactics selection will occur in consultation relevant Government agencies (refer Table 2-4).

The IMT shall consider all SMV data to determine potential or actual shoreline contacts, to assist in determining SCAT locations.

SMV and SCAT data will be used to inform shoreline clean-up planning and activation/mobilisation.

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The IMT will need to consider the practicalities, likely success and risks associated with any SCAT and shoreline clean-up operation, (including comparison of response compared with allowing stranded oil to naturally weather).

Remote SCAT operations would typically require activation within a minimum of 48 hours, to enable the initial response personnel, equipment and vessels to prepare for mobilisation, and final location/operation specific HSE and emergency response planning to be completed.

Remote shoreline clean-up operations would typically require activation within a minimum of 6 days, to enable the initial response personnel, equipment and vessels to prepare for mobilisation, and final location/operation specific HSE and emergency response planning to be completed.

4.5.2.4 Personnel

There are significant logistical constraints and HSE risks with flying personnel in 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.

In accordance with stakeholder consultation in July 2021 with the WA DoT (WA Control Agency) and WA Department of Biodiversity, Conservation and Attractions (DBCA)¹, the recommended personnel/team compositions for remote SCAT and remote shoreline operations have been defined as follows:

- Remote SCAT team (4 persons)
 - 2 x SCAT trained personnel
 - 1 x OWR trained personnel
 - 1 x local government or parks advisor/aboriginal heritage advisor (person with local knowledge of the area)
- Remote shoreline response unit (44 persons)
 - sector command team (10 personnel – 2 x leader/deputy, 3 x admin, 2 x HSE, 2 x paramedic, 1 x multi-media/communications).
 - SCAT team (4 personnel – 2 x SCAT, 1 x OWR, 1 x local ranger)
 - Shoreline clean-up team (21 personnel - 4 leadership, 17 labour hire)
 - OWR wildlife collection/rescue and preventative actions team (5 personnel)
 - OWR intake (TRIAGE, first aid or other response) (3 personnel including 1 vet)

It is expected the relevant State/Territory Control Agency will provide some government appointed personnel to oversee/lead the remote shoreline response operation. WA Control Agency expect to provide approximately 20 of the response personnel. Titleholder would be required to provide the additional field response personnel.

However, should the Control Agency request/require additional remote shoreline response personnel, or Titleholder is the Control Agency (e.g., Ashmore Reef) Titleholder plus mutual aid capability (AMOSC/OSRL) and labour hire, will provide the full shoreline response personnel capability.

¹ Personal communication, Ms Simone Vitale, Department of Biodiversity, Conservation and Attractions, and Mr Ray Buckholz, WA Department of Transport, Fremantle, pers. comm. 27 July 2021

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Additional labour hire personnel (e.g., general additional shoreline clean-up personnel, who would receive on the job training) are available via Titleholder internal arrangements or existing labour hire agreements.

In a typical shoreline response, a worker is expected to clean between 1 to 2 m³ of oily waste per day. Depending on the planned duration of the remote shoreline clean-up operations, this may require the establishment of a one or two week on/off roster system, drawing on trained personnel from AMOSC and other mutual aid capabilities, and other labour hire sources, until the response is terminated.

4.5.2.5 Tools/equipment/plans

SCAT data recording systems are generally developed by State/Territory Control Agencies, and any shoreline response should utilise the State/Territory Control Agency SCAT data collection system.

However, should a situation arise where no specific SCAT data recording system is available (e.g., a shoreline response at the Indian Ocean Territories), the AMOSC SCAT data recording system and tools can be utilised (available on AMOSC intranet/member portal).

Drones may be utilised to assist in in remote or logistically challenging locations.

Shoreline clean-up is expected to be predominantly undertaken on sandy beaches (not on rocky headlands/cliffs or mangroves) using manual tools such as rakes, shovels.

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 bobcats could be used to help transport collected oily waste and other response equipment around the shoreline.

The relevant WA/NT Control Agency may choose to mobilise their own shoreline clean-up equipment. WA Control Agency spill response trailers are located in Karratha, Fremantle and Albany.

The AMOSC Broome stockpile and AMSA Darwin stockpiles also includes additional shoreline clean-up equipment.

Additional AMOSC shoreline clean-up equipment stockpiles are located at Exmouth, Fremantle and Geelong.

Key reference documents/tools to be used when planning and executing SCAT and shoreline clean-up include the following:

- The IPIECA (2015c) A guide to shoreline clean-up techniques Good practice guidelines for incident management and emergency response personnel provides additional guidance regarding shoreline response operations.
- AMOSC – Shoreline Treatment Recommendations and SCAT document (AMOSC internal tool)
- Browse Island Oil Spill Incident Management Guide (IMG) provides BROPEP regional information which will also support remote shoreline response planning.
- The NT Oiled Wildlife Response Plan (AMOSC 2019) includes extensive mapping, receptor prioritisation and logistics information for NT shoreline sectors.

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4.5.2.6 Logistics

There are several logistical options available to conduct remote SCAT and remote shoreline clean-up operations.

For remote SCAT operations, supporting the 4-person SCAT team plus vessel crew, a small (~20-30m) support vessel, with a small beach landing vessel/tender would be appropriate.

For a full remote shoreline response operation, supporting the 44-person remote shoreline response team and equipment (plus vessel crew), a large accommodation support vessel (ASV), plus beach landing vessels/tenders/barges will be required. Another logistical support vessel (for consumables resupply and waste backload) may also be required.

If weather conditions or other factors preclude the use of small landing craft, helicopters, launched from an ASV helideck would be required.

For the full remote shoreline response operation, response personnel/crew changes could occur via vessel or crew change helicopter, depending on the situation.

A decontamination staging post would be established at the shoreline clean-up location, or on the deck of the ASV, to enable decontamination of equipment and personnel before demobilisation at the end of each day.

All contaminated equipment and personal protective equipment (PPE) would be backloaded from the location to the mainland for cleaning or appropriate disposal.

More detailed planning regarding a remote shoreline clean-up and logistics is available in the Browse Island Oil Spill Incident Management Guide.

Waste management will be a key consideration for a shoreline clean-up operation. A waste management plan would be developed in consultation with AMOSC, prior to commencement of the activity (refer to Table 4-23).

4.5.2.7 Response effectiveness monitoring

During any SCAT and/or shoreline clean-up, daily reports will be provided by the response team to the IMT team regarding the effectiveness of the activity. The report shall include, as a minimum:

- date(s), time(s) and location(s) of SCAT/shoreline clean-up activities
- SCAT reports for all sectors assessed (using State/Territory or AMOSC data recording processes, as necessary)
- the volume of oily waste generated and stockpiled at staging area for each shoreline clean-up sector
- the overall effectiveness of SCAT/shoreline clean-up activities (including photographic evidence, where possible).

4.5.2.8 Termination Criteria

Termination criteria outline when continuing SCAT and shoreline 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 (or phase of the response)
- deteriorating weather conditions (including wind, visibility and sea conditions).

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I TOPF (2002) suggest the use of three questions to determine when termination of the response should occur:

- is the remaining oil likely to damage environmentally sensitive resources?
- does it interfere with the aesthetic appeal and amenity use of the shoreline?
- 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.

IPIECA-ITOF (2020) identify that there will be a wide range of completion or end-point criteria, at various stages throughout a shoreline clean-up. These criteria will need to be set at the time, in consultation with relevant oil spill experts, government agencies and other key stakeholders. Therefore, there is no single, appropriate end-point criteria or termination criteria which can be set prior to an event.

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) the response termination will occur in consultation with AMSA and other relevant Government agencies (refer Table 2-4).

4.5.2.9 Capability, arrangements and performance outcomes and standards

The arrangements and capabilities as described in the subsections above are summarised in Table 4-7. EPOs and EPSs for the implementation of SCAT and shoreline clean-up are provided in Table 4-8.

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Table 4-7: Arrangement and capabilities summary – SCAT and shoreline clean-up

Technique	Resource capability and availability	Implementation time	Activation
SCAT and Shoreline Clean-up personnel	<p>WA DoT/NT DEPWS (as Control Agency) may choose to mobilise their own SCAT assessment and initial shoreline clean-up personnel.</p> <p>Additional trained SCAT and shoreline response personnel would be available through AMOSC Core Group.</p> <p>Additional (Tier 3) capability also available via OSRL.</p> <p>Additional personnel, who would receive on the job training would be sourced from:</p> <ul style="list-style-type: none"> environmental service providers general offshore labour hire contracts 	<p>First remote SCAT operations (4 personnel) required to be able to mobilise from port in 48 hours.</p> <p>(Pending Operational SIMA outcome – target time is two additional remote SCAT teams mobilised by day 7).</p> <p>Remote shoreline response unit team (total of 44 personnel, including SCAT, shoreline clean-up and OWR) required to be able to mobilise from port within 6 days.</p> <p>(Pending Operational SIMA outcome – target time is second remote shoreline response unit mobilised within 14 days, and third unit mobilised within 30 days).</p>	<p>AMOSC, OSRL & labour hire company contact details available via IMT W L2 Emergency Response Plan</p> <p>AMOSC and OSRL notification/activation forms/contacts available in the Oil Spill Forms Register (refer Section 5).</p>
Shoreline clean-up equipment	<p>WA DoT SCAT/first-strike shoreline clean-up stockpiles are in Karratha, Fremantle and Albany.</p> <p>Additional shoreline clean-up equipment can be mobilised from the Broome or Darwin equipment stockpiles.</p> <p>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.</p>	<p>6 days to mobilise equipment required for remote shoreline response unit.</p>	
Helicopters	<p>Titleholder contracted crew transfer helicopters (for personnel transfer to designated landing zones only, not to remote shoreline beaches).</p> <p>Helicopters suitable for landing on remote shorelines are available via Titleholder aviation call-off arrangements.</p>	<p>INPEX routine crew-change helicopters always available.</p> <p>Commence mobilisation activities in Broome within 7 days.</p>	<p>IMT to activate all helicopter assets.</p> <p>Helicopter provider contact details available in the IMT W L2 Emergency Response Plan</p> <p>Aviation mobilisation processes are available via the aviation SMEs.</p>
Vessels	<p>Small support vessels (<40 m length) are available via Titleholder marine call-off contract/framework arrangements to support remote SCAT operations.</p>	<p>Single small support vessel plus tender to support 4-person remote SCAT team, required within 48 hours.</p> <p>(Pending Operational SIMA outcome – target time is two additional remote SCAT teams mobilised by day 7).</p>	<p>IMT to activate all support vessels.</p> <p>Vessel provider contact details available via the IMT W L2 Emergency Response Plan.</p>



Technique	Resource capability and availability	Implementation time	Activation
	Large support vessels/accommodation support vessels are available via INPEX marine call-off contract/framework arrangements, to support remote shoreline response unit operations.	Single ASV and associated support vessels, mobilised with 44-person remote response team, and all equipment, within 6 days. (Pending Operational SIMA outcome – target time is second remote shoreline response unit mobilised within 14 days, and third unit mobilised within 30 days).	



Table 4-8: EPO, EPS and measurement criteria for SCAT and shoreline clean-up

Environmental performance outcome	Environmental performance standard	Measurement criteria
<p>SCAT activities will systematically collect data about the location, nature and degree of shoreline oiling, (including at risk/impacted wildlife), to inform shoreline treatment and oiled wildlife response planning.</p>	<p>Based on the outcome of the Operational SIMA and in consultation with the relevant State/Territory Control Agencies, the IMT will activate SCAT/Shoreline Clean-Up using the capabilities/arrangements as described in Table 4-7.</p>	<p>Emergency event response records.</p>
<p>Shoreline clean-up activities will reduce the volume of oil on shoreline, to reduce the likelihood/consequence of impacts on the values and sensitivities of the shoreline and promote/increase the speed of the natural recovery of the shoreline to its pre-oiled state.</p>	<p>Monitoring of response effectiveness for SCAT and shoreline clean-up will be undertaken as described in Section 4.5.1.</p> <p>Response effectiveness monitoring data will be utilised as part of ongoing IAP review and response termination criteria.</p>	<p>Emergency event response records.</p>
<p>Risks of impacts to transient, EPBC-listed species, (marine turtles) and intertidal habitats from a shoreline response are reduced and maintained to ALARP and acceptable levels.</p>	<p>In the event of a shoreline response, an HSE plan will be prepared, in consultation with AMOSC and WA/NT wildlife agencies (via relevant WA/NT Control Agency) or DAWE (for Commonwealth lands) which addresses potential impacts to turtle nesting including:</p> <p>personnel and equipment movement on turtle-nesting beaches</p> <p>light-spill (if night-time activities are required).</p>	<p>Emergency event response records.</p>



4.5.3 Oiled wildlife response (OWR)

4.5.3.1 Response objective

OWR will be implemented to minimise the impacts of an oil spill on wildlife by both prevention of oiling where possible and mitigating the effects on individuals when oiling has taken place.

4.5.3.2 Response Strategy Summary

SMV data of the spill would provide data regarding spill trajectory and potential wildlife that may be affected by the spill. SCAT activities will also include observations regarding risks to wildlife.

Under specific circumstances, pre-contact oiled wildlife response (OWR) 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 such as Group IV spills; however, it may also be considered for residuals from Group I or Group II spills.

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 application against dissolved or dispersed oils.

Wildlife hazing techniques include:

- human disturbance (the simple presence of people in the wildlife habitat)
- vehicular disturbance (e.g., terrestrial vehicles, boats and aircraft)
- visual disturbance (e.g., lights, reflectors, flags, effigies, vessels etc.)
- auditory disturbance (e.g., noise generators)
- physical structures (e.g., fences) to prevent wildlife accessing contaminated sites.

Oiled wildlife capture at sea is 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 (informed by modelling to determine the best locations for release).

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.

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WA DBCA (previously DPaW) (DPaW pers. comm. 2016)² 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 Parks and Wildlife Commission (PaWC) 'oiled wildlife adviser'.

Stakeholder consultation with WA DBCA³ has confirmed that based on the WCSS modelling and wildlife species most likely to be impacted by shoreline oil in the BROPEP region, a full oiled wildlife remote cleaning operation and/or transport and mainland rehabilitation program would be unlikely to be required. The relevant State/Territory Control Agency would make the decision based on OWR information available at the time.

Therefore, mobilisation of oiled wildlife containers is not anticipated to be required as part of floating remote shoreline response units. However, if oiled wildlife containers were required, they are available for use via AMOSC mutual aid arrangements.

Activation

SMV and SCAT data would be utilised to determine requirement to activate OWR response.

The IMT shall 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 & AMOSC 2015), and the WA OWR Plan and OWR Manual (DBCA 2021a; DBCA 2021b).

The IMT shall 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).

The 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 Commonwealth islands (e.g., Ashmore Reef), the activation and response strategies/tactics selection will occur in consultation with AMSA, and other relevant Government agencies (refer Table 2-4).

Remote OWR assessment (as part of SCAT operations) would typically require activation within a minimum of 48 hours, to enable the initial OWR response personnel, equipment and vessels to prepare for mobilisation, and final location/operation specific HSE and emergency response planning to be completed.

² Personal communication, Mr Brad Daws, Department of Parks and Wildlife, Oil Spill Response Wildlife Management Course, Fremantle, pers. comm. 24-26 May 2016

³ Personal communication, Ms Simone Vitale, Department of Biodiversity, Conservation and Attractions, Fremantle, pers. comm. 27 July 2021

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Remote OWR operations, as part of a full remote shoreline response unit, would typically require activation within a minimum of 6 days, to enable the initial response personnel, equipment and vessels to prepare for mobilisation, and final location/operation specific HSE and emergency response planning to be completed.

4.5.3.3 Personnel

In accordance with stakeholder consultation completed in June/July 2021 with the WA DoT (WA Control Agency), and WA DBCA, the recommended personnel/team compositions for remote SCAT and remote shoreline operations have been defined as follows:

- Remote SCAT team (4 persons)
 - 2 x SCAT trained personnel
 - 1 x OWR trained personnel
 - 1 x local government or parks advisor/aboriginal heritage advisor (person with local knowledge of the area)
- Remote shoreline response unit (44 persons)
 - sector command team (10 personnel – 2 x leader/deputy, 3 x admin, 2 x HSE, 2 x paramedic, 1 x multi-media/communications).
 - SCAT team (4 personnel – 2 x SCAT, 1 x OWR, 1 x local ranger)
 - Shoreline clean-up team (21 personnel - 4 leadership, 17 labour hire)
 - OWR wildlife collection/rescue and preventative actions team (5 personnel)
 - OWR intake (TRIAGE, first aid or other response) (3 personnel including 1 vet).

It is expected the relevant State/Territory Control Agency will provide some government appointed personnel to oversee/lead the remote shoreline response operation. WA Control Agency expect to provide approximately 20 of the response personnel. Titleholder would be required to provide the additional field response personnel.

However, should the Control Agency request/require additional remote shoreline response personnel, or Titleholder is the Control Agency (E.g., Ashmore Reef) Titleholder plus mutual aid capability (AMOSC/OSRL) and labour hire, will provide the full shoreline response personnel capability.

Additional labour hire personnel (E.g., general additional shoreline clean-up personnel, who would receive on the job training) are available via Titleholder existing labour hire agreements.

WA DBCA and AMOSC have collaboratively developed an OWR model (shown in Figure 4-2) 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.

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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. Titleholder 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.

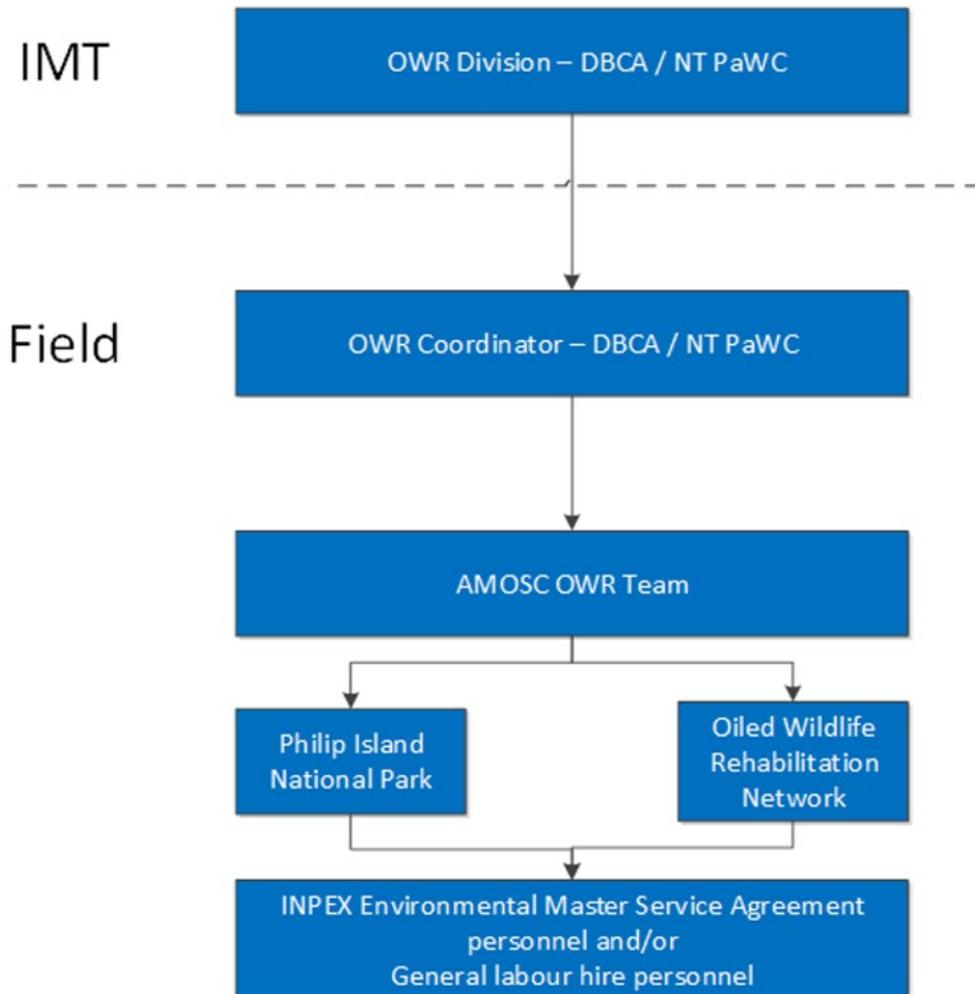


Figure 4-2: Oiled Wildlife Response Division model

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, OSRL, Oiled Wildlife Rehabilitators Network and government agency personnel until the response is terminated.

4.5.3.4 Tools/equipment/plans

The WA DBCA has recently prepared the following documents (in final draft at the time of preparation of this document):



- WA OWR Plan (DBCA 2021a)
- WA OWR Manual (DBCA 2021b)

These two documents are considered the most appropriate overarching documents which should be used to guide/manage all OWR activities, including OWR activities in NT and/or Commonwealth waters/shorelines.

Detailed shoreline sectors and oiled wildlife response priorities are also defined in the NT Oiled Wildlife Response Plan (AMOSC 2019) and the West Kimberley Region Oiled Wildlife Response Plan (DPaW & AMOSC 2015). These plans should also be utilised during the planning and execution of any wildlife response along the Kimberley/NT coastline.

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).

Oiled wildlife response kits (for wildlife collection) and container (for oiled wildlife cleaning) locations are shown in Figure 4-3.

AMOSC bird hazing/scarers are available from the AMOSC stockpiles.

Physical structures, such as drift-fences (e.g., wooden stakes and rolls of shade-cloth), could be set-up on remote beaches to capture emergent turtle hatchlings before they enter an oiled intertidal zone, and relocate/release the hatchlings to an area well away from the slick (informed by modelling etc for best locations for release). This type of equipment (and other visual disturbance type equipment) is readily available from gardening/hardware stores within the region.

4.5.3.5 Logistics

For a full remote shoreline response operation, supporting the 44-person remote shoreline response team and equipment (plus vessel crew), a large accommodation support vessel (ASV), plus beach landing vessels/tenders/barges will be required. Another logistical support vessel (for consumables resupply and waste backload) may also be required.

If weather conditions or other factors preclude the use of small landing craft, helicopters, launched from an ASV helideck would be required.

For the full remote shoreline response operation, response personnel/crew changes could occur via vessel or crew change helicopter, depending on the situation.

A decontamination staging post would be established at the shoreline clean-up location, or on the deck of the ASV, to enable decontamination of equipment and personnel before demobilisation at the end of each day.

All contaminated equipment and personal protective equipment (PPE) would be backloaded from the location to the mainland for cleaning or appropriate disposal.

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Waste management will be a key consideration for a OWR operation. A waste management plan would be developed in consultation with AMOSC, prior to commencement of the activity (refer to Table 4-23).

More detailed planning regarding a remote shoreline clean-up and logistics is available in the Browse Island Oil Spill Incident Management Guide.

Stakeholder consultation with WA DoT and WA DBCA ⁴ (July 2021) has confirmed that based on the WCSS modelling and wildlife species most likely to be impacted by shoreline oil in the BROPEP region, a full oiled wildlife remote cleaning operation and/or transport and mainland rehabilitation program would be unlikely to be required. The relevant State/Territory Control Agency would make the decision based on OWR information available at the time.

Therefore, mobilisation of oiled wildlife containers is not anticipated to be required as part of remote shoreline response units. However, in the highly unlikely event that a full at-sea OWR response including use of OWR containers was required, they are available for use via AMOSC mutual aid arrangements.

According to DPAW & 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 can store oily waste or have an oil-in-water separator and holding tanks for waste oil.

⁴ Personal communication, Ms Simone Vitale, Department of Biodiversity, Conservation and Attractions, and Mr Ray Buckholz, WA Department of Transport. Fremantle, pers. comm. 27 July 2021

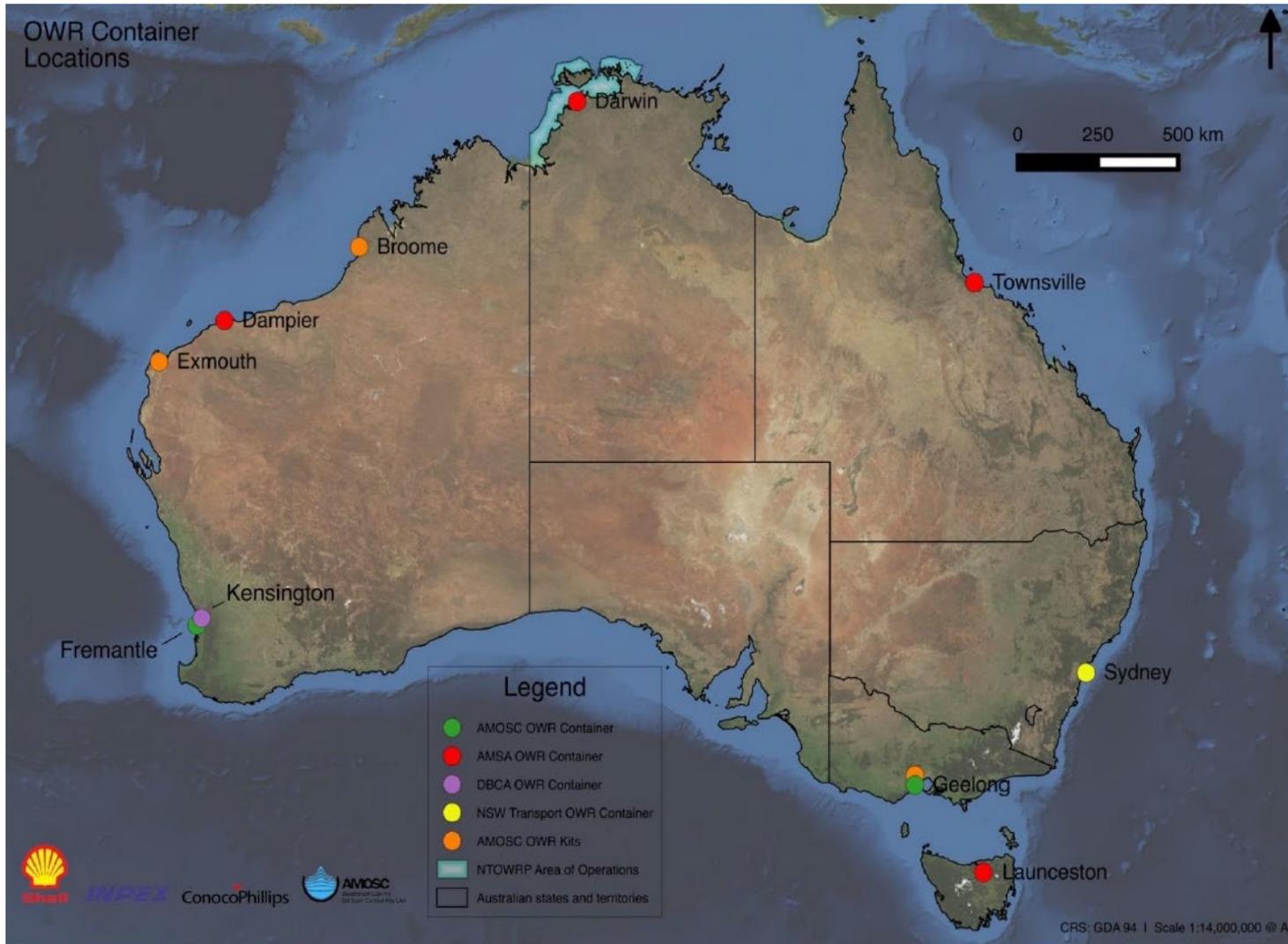


Figure 4-3: Oiled wildlife response kit and container locations

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4.5.3.6 Response effectiveness monitoring

During any pre or post contact OWR activity, daily reports will be provided by the response team to the IMT 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).

4.5.3.7 Termination Criteria

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)
- 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, other appropriate welfare options have been effective
- collection and removal of carcasses has occurred.

The Western Australian Oiled Wildlife Response Plan (DPAW & AMOSC 2014) notes that options to assist the IMT decide 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 relevant Control Agency for the WA/NT shorelines.

If a shoreline wildlife response is required at a Commonwealth shoreline (E.g., Ashmore Reef), the response termination will occur in consultation with AMSA and other relevant Government agencies (refer Table 2-4).

4.5.3.8 Capability, arrangements and performance outcomes and standards

The arrangements and capabilities as described in the subsections above are summarised in Table 4-9.

The EPOs and EPSs related to the implementation of OWR are provided in Table 4-10.

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Table 4-9: Arrangements and capabilities – Pre-contact and post-contact oiled wildlife response

Technique	Resource capability and availability	Implementation time	Activation
Oiled wildlife response personnel	<p>WA DoT/NT DEPWS (as Control Agency) may choose to mobilise their own OWR personnel</p> <p>Additional OWR personnel are available through:</p> <p>AMOSC Oiled Wildlife Response Team</p> <p>OSRL</p> <p>Oiled Wildlife Rehabilitators Network</p> <p>Philip Island Nature Park</p> <p>Additional personnel, who would receive on the job training would be sourced from:</p> <p>AMOSC core-group</p> <p>Titleholder environmental service providers</p> <p>Titleholder general offshore labour hire contracts.</p>	<p>First remote SCAT operations (including 1 x OWR personnel) required to be able to mobilise from port in 48 hours (based on Operational SIMA outcome).</p> <p>(Pending Operational SIMA outcome – target time is two additional remote SCAT teams mobilised by day 7).</p> <p>Remote shoreline response unit team (total of 44 personnel, including SCAT, shoreline clean-up and 8 x OWR personnel) required to be able to mobilise from port within 6 days.</p> <p>(Pending Operational SIMA outcome – target time is second remote shoreline response unit mobilised within 14 days, and third unit mobilised within 30 days).</p>	<p>AMOSC, OSRL & labour hire company contact details available via IMT W L2 Emergency Response Plan</p> <p>AMOSC and OSRL notification/activation forms available in the Oil Spill Forms Register (refer Section 5).</p>
Oiled wildlife response equipment	<p>OWR kits, containers and hazing equipment available via AMOSC (refer Figure 4-3).</p> <p>Additional basic equipment can be purchased from hardware stored in Broome/Darwin etc.</p>	<p>6 days to mobilise equipment required for OWR as part of a remote shoreline response unit.</p>	
Helicopters	<p>Titleholder contracted crew transfer helicopters (for personnel transfer to designated landing zones only, not to remote shoreline beaches).</p> <p>Helicopters suitable for landing on remote shorelines are available via Titleholder contracting arrangements or MOUs.</p>	<p>Titleholder routine crew-change helicopters always available.</p> <p>Commence mobilisation activities in Broome within 7 days.</p>	<p>IMT to activate all helicopter assets.</p> <p>Helicopter provider contact details available in the IMT W L2 Emergency Response Plan</p> <p>Aviation mobilisation processes are available via aviation SMEs.</p>
Vessels	<p>Small support vessels (<40 m length) are available via Titleholder marine contracting procedures and MOU arrangements to support remote SCAT operations.</p> <p>Large support vessels/accommodation support vessels are available via marine call-off contract/framework arrangements, to support remote shoreline response unit operations.</p>	<p>Single small support vessel plus tender to support 4-person remote SCAT team, required within 48 hours.</p> <p>(Pending Operational SIMA outcome – target time is two additional remote SCAT teams mobilised by day 7).</p> <p>Single ASV and associated support vessels, mobilised with 44-person remote response team, and all equipment, within 6 days.</p> <p>(Pending Operational SIMA outcome – target time is second remote shoreline response unit mobilised within 14 days, and third unit mobilised within 30 days).</p>	<p>IMT to activate all support vessels.</p> <p>Vessel provider contact details available via marine SME.</p>



Table 4-10: EPO, EPS and measurement criteria for oiled wildlife response

Environmental performance outcome	Environmental performance standard	Measurement criteria
<p>OWR will be implemented to minimise the impacts of an oil spill on wildlife by both prevention of oiling where possible and mitigating the effects on individuals when oiling has taken place</p>	<p>Based on the outcome of the Operational SIMA and in consultation with the relevant State/Territory Control Agencies, the IMT will activate OWR using the capabilities/arrangements as described in Table 4-9.</p>	<p>Emergency event response records.</p>
	<p>Monitoring of response effectiveness for SCAT and shoreline clean-up will be undertaken as described in Section 4.5.3.</p> <p>Response effectiveness monitoring data will be utilised as part of ongoing IAP review and response termination criteria.</p>	<p>Emergency event response records.</p>
<p>Risks of impacts to transient, EPBC-listed species, (marine turtles, marine mammals and marine avifauna) from wildlife response activities are reduced and maintained to ALARP and acceptable levels.</p>	<p>OWR shall be undertaken in accordance with the relevant State/Territory OWR Plan and/or Manual, under direction from the relevant State/Territory Control Agency, or in consultation with the DAWE (Commonwealth waters and shoreline OWR).</p> <p>All necessary regulatory permits will be obtained prior to commencing wildlife response activities, and conditions will be implemented.</p>	<p>Emergency event response records.</p>



4.5.4 Protection of sensitive resources

4.5.4.1 Response Objective

Protection of sensitive resources will be implemented to prevent and/or reduce the volume of oil on entering a sensitive habitat, resulting in a reduction in the likelihood and/or consequence of impacts associated with floating oil on the values and sensitivities of the habitat.

4.5.4.2 Response Strategy Summary

Protection of sensitive resources (or protect and deflect/P&D) involves a combination of nearshore and shoreline response techniques, to prevent or reduce the volume of oil impacting a sensitive habitat (e.g., a wetland or creek-mouth). Typically, a combination of booms will be used to deflect oil away from a habitat, or deflect oil into a natural collection point, there-by reducing the total volume of oil impacting a sensitive resource.

A P&D operation in remote locations/shorelines would typically be mobilised as part of a broader shoreline response (e.g., as part of a remote shoreline clean-up and wildlife response unit).

P&D activities at exposed shoreline locations in the BROPEP region would be logistically challenging due to the general exposure to unfavourable sea conditions, large tidal range and shallow coral reef (generally P&D is limited to sheltered waters, not exposed reef/beach environments). Only with a long-term forecast for continued calm/low sea-states and appropriate tides would it be safe to conduct vessel activities to carry-out an effective P&D operation at remote offshore islands/shorelines.

4.5.4.3 Activation

The WA/NT Control Agencies are responsible for the final decision to activate P&D activities on State/Territory shorelines.

If a P&D response is determined to be required at a Commonwealth shoreline (E.g., Ashmore Reef), the activation and response strategies/tactics selection will occur in consultation with AMSA, and other relevant Government agencies (refer Table 2-4).

The IMT shall consider all SMV data and Operational SIMA outputs to determine potential or actual shoreline contact and potential impacts. The IMT will need to consider the practicalities, likely success and risks associated with any P&D, (including comparison of response within a sensitive habitat, where trampling of vegetation and disturbance to wildlife could also occur) compared with allowing stranded oil to naturally weather.

If required, remote P&D operations would typically require activation within a minimum of 6 days (as part of a broader remote shoreline response unit), to enable the initial response personnel, equipment and vessels to prepare for mobilisation, and final location/operation specific HSE and emergency response planning to be completed.

4.5.4.4 Personnel

A typical P&D strike-team, deployed to protect a single sensitivity, would consist of 1-2 trained personnel, and 3-5 supporting/labour hire personnel. Typically, at least one small vessel operator is required (could be one of the trained personnel). Within the context of the BROPEP region,

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consultation with the WA DoT (Control Agency) in July 2021 ⁵ confirmed that the P&D strike-team would be considered as part of the shoreline clean-up team within the broader remote shoreline response unit.

State/Territory Control Agencies may provide their own P&D team leaders/personnel.

However, if additional P&D trained personnel are required, these can be accessed via AMOSC and OSRL.

Additional labour hire personnel (e.g., personnel who would receive on the job training) are available via Titleholder existing labour hire agreements.

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.

4.5.4.5 Tools/equipment/plans

Typical equipment required for a P&D activity include:

a combination of nearshore boom and shore-seal booms (including anchor kits, sandbags etc) skimmers and temporary waste storage may be required for collection of solid and liquid oily waste.

small, shallow draft vessels are required for transporting and positioning booms and anchors.

PPE and other shoreline equipment and decontamination areas etc would likely be set-up as part of a broader shoreline response.

Various stockpiles of oil spill response equipment, including P&D booms, skimmers etc are located around Australia. AMOSC stockpiles are in:

- Broome
- Exmouth
- Fremantle
- Geelong.

4.5.4.6 Logistics

P&D would be conducted as part of a broader remote shoreline response unit operation, typically as an additional element to remote shoreline clean-up operations.

For a full remote shoreline response operation, supporting the 44-person remote shoreline response team and equipment (plus vessel crew), a large accommodation support vessel (ASV), plus beach landing vessels/tenders/barges will be required. Another logistical support vessel (for consumables resupply and waste backload) may also be required.

If weather conditions or other factors preclude the use of small landing craft, helicopters, launched from an ASV helideck would be required. The helicopter could be utilised to transport personnel and protect and deflect equipment between the remote shoreline and nearby ASV. Slings of equipment from nearby support vessel may be required for heavier equipment, and also for the back-loading of waste.

⁵ Personal communication, Mr Ray Buckholz, WA Department of Transport, Fremantle, pers. comm. 27 July 2021

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However, if weather conditions or other factors did preclude the use of small landing craft, this will mean limited P&D equipment could be deployed, due to lack of ability to use small/shallow draft vessels for nearshore boom/anchor deployment.

For the full remote shoreline response operation, response personnel/crew changes could occur via vessel or crew change helicopter, depending on the situation.

A decontamination staging post would be established at the shoreline clean-up location, or on the deck of the ASV, to enable decontamination of equipment and personnel before demobilisation at the end of each day.

All contaminated equipment and personal protective equipment (PPE) would be backloaded from the location to the mainland for cleaning or appropriate disposal.

Waste management will be a key consideration for P&D operations. A waste management plan would be developed in consultation with AMOSC and WA DoT, prior to commencement of the activity.

More detailed planning regarding a remote P&D response at an offshore island are available in the Browse Island Oil Spill Incident Management Guide. This document also provides guidance on response at any remote shorelines.

Waste management will be a key consideration for a P&D operation. A waste management plan would be developed in consultation with AMOSC, prior to commencement of the activity (refer to Table 4-23).

4.5.4.7 Response effectiveness monitoring

During any P&D activity, daily reports will be provided by the response team to the IMT regarding the effectiveness of the activity. The report shall include, as a minimum:

- date(s), time(s) and location(s) of the activities
- the volume of solid and liquid oily waste collected/generated
- the overall effectiveness of the protect and deflect activities (including photographic evidence, where possible).

4.5.4.8 Termination criteria

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)
- sensitive habitats are deemed clear from risk of further oiling

The final decision on whether to terminate a P&D response will remain with the relevant Control Agency for the WA/NT shorelines.

If a P&D response is required at a Commonwealth shoreline (e.g., Ashmore Reef) the response termination will occur in consultation with AMSA and other relevant Government agencies (refer Table 2-4).

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4.5.4.9 Capability, arrangements and performance outcomes and standards

The arrangements and capabilities as described in the subsections above are summarised in Table 4-11.

The EPOs and EPSs related to the implementation of P&D are provided in Table 4-12.

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Table 4-11: Arrangements and capabilities – protection of sensitive resources

Technique	Resource capability and availability	Implementation time	Activation
P&D personnel	<p>WA DoT/NT DEPWS (as Control Agency) may choose to mobilise their own P&D personnel.</p> <p>Additional trained P&D and shoreline response personnel would be available through AMOSC Core Group.</p> <p>Additional (Tier 3) capability also available via OSRL.</p> <p>Additional personnel, who would receive on the job training would be sourced from:</p> <p>Titleholder environmental service providers</p> <p>Titleholder general offshore labour hire contracts</p>	<p>Remote shoreline response unit team (total of 44 personnel, including P&D/ shoreline clean-up personnel) required to be able to mobilise from port within 6 days.</p> <p>(Pending Operational SIMA outcome – target time is second remote shoreline response unit mobilised within 14 days, and third unit mobilised within 30 days).</p>	<p>AMOSC, OSRL & labour hire company contact details available via IMT W L2 Emergency Response Plan</p> <p>AMOSC and OSRL notification/activation forms available in the Oil Spill Forms Register (refer Section 5).</p>
P&D equipment	<p>P&D equipment can be mobilised from the AMOSC Broome, Exmouth, Freemantle or Geelong stockpiles.</p> <p>AMSA Darwin and other NatPlan stockpiles also maintain P&D equipment.</p>	<p>6 days to mobilise equipment required for P&D as part of a remote shoreline response unit.</p>	
Helicopters	<p>Titleholder contracted crew transfer helicopters (for personnel transfer to designated landing zones only, not to remote shoreline beaches).</p>	<p>Shell routine crew-change helicopters always available.</p>	<p>IMT to activate all helicopter assets.</p> <p>\</p>
	<p>Helicopters suitable for landing on remote shorelines are available via Titleholder contracting arrangements or MOUs.</p>	<p>Commence mobilisation activities in Broome within 7 days.</p>	<p>Aviation mobilisation processes are available via aviation SME's.</p>
Vessels	<p>Small support vessels including inshore tenders/landing barges are available via Titleholder marine call-off contract/framework arrangements and would be used to transport and position P&D equipment nearshore.</p>	<p>Single ASV and associated support vessels, mobilised with 44-person remote response team, and all equipment, within 6 days.</p>	<p>IMT to active all support vessels.</p>
	<p>Large support vessels/accommodation support vessels are available via Titleholder marine call-off contract/framework arrangements, to support remote shoreline response unit operations.</p>		



Table 4-12: EPO, EPS and measurement criteria for protection of sensitive resources

Environmental performance outcome	Environmental performance standard	Measurement criteria
<p>Protection of sensitive resources response strategy will be implemented to prevent and/or reduce the volume of oil entering a sensitive habitat, resulting in a reduction in the likelihood and/or consequence of impacts associated with floating oil on the values and sensitivities of the habitat.</p>	<p>Based on the outcome of the Operational SIMA and in consultation with the relevant State/Territory Control Agencies, the IMT will activate a protection of sensitive resources response using the capabilities/arrangements as described in Table 4-11.</p>	<p>Emergency event response records.</p>
	<p>Monitoring of response effectiveness for a protection of sensitive resources response will be undertaken as described in Section 4.5.4.</p> <p>Response effectiveness monitoring data will be utilised as part of ongoing IAP review and response termination criteria.</p>	<p>Emergency event response records.</p>
<p>Risks of impacts to intertidal habitats from nearshore/shoreline booming operations will be reduced and maintained to ALARP and acceptable levels.</p>	<p>In the event of a sensitive receptor protection response, an HSE plan will be prepared, in consultation with AMOSC relevant WA/NT Control Agency or DAWE (for Commonwealth lands) which addresses potential impacts to intertidal reefs and defines controls for nearshore/shoreline booming anchor layouts and other controls to limit impacts to intertidal ecosystems.</p>	<p>Emergency event response records.</p>



4.5.5 Surface (vessels and aerial) dispersant

4.5.5.1 Response Objective

Surface dispersants will be implemented to reduce the volume of oil on the sea surface, by dispersing it into the water column, resulting in a reduction in the likelihood and/or consequence of impacts associated with floating oil on the sea surface and on potentially impacted shorelines.

4.5.5.2 Response strategy summary

Dispersant application should be attempted (weather conditions permitting) for any Group IV oil spills (HFO/IFO/LSHFO).

Dispersant is not to be used on Group II (diesel) or Group I (condensate) spills.

Depending on sea-state, atmospheric conditions, weathering and emulsification of Group IV spills, the 'window of opportunity' for effective dispersant application is generally limited – from a few hours, to a few days (ITOPF 2013; IPIECA-IOGP 2015b).

If a spill is ongoing, (i.e. leaking from a vessel over several days), the window of opportunity for dispersant application would be extended for the duration of the release (could be several days).

Shell Prelude FLNG support vessels dispersant capability includes 3 x vessels fitted with dispersant spray systems, trained personnel and dispersants onboard.

INPEX Ichthys FPSO and Offtake Support Vessel (OSV) and 2 x Platform Supply Vessels (PSVs) maintain a vessel dispersant capability for the Ichthys Field. This capability can be requested (mutual aid) by the Prelude OIM directly to the INPEX Ichthys CPF/FPSO OIM.

AMOSC maintain a contract for a Fixed Wing Aerial Dispersant (FWAD) capability with Aerotech First Response. The FWAD capability will be made available (via AMOSC) for oil spills where member Titleholder is the Control Agency.

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 Lombadina Airport. However, it would typically take at least 24 hours to mobilise all aircraft, personnel and equipment to the nominated airbase. Therefore, typically an ongoing release would be required to justify the use of the FWAD capability.

4.5.5.3 Activation

During spill scenarios where AMSA is the Control Agency, or the spill is located within WA/NT waters, (under the control of the relevant State/Territory Control Agency), AMSA or the relevant WA/NT Control Agency may direct Titleholder to undertake dispersant response activities.

During spill scenarios where Titleholder is the Control Agency; specifically, a Group IV spill from a vessel conducting a Petroleum Activity (vessel classified as a Facility or Associated Offshore Place) within the Ichthys Field:

- the OIM has the authority under this BROPEP to approve an initial test-spray of dispersant on Group IV oil spills
- the IMT Leader has the authority under this BROPEP to approve ongoing dispersant use, via the completion of the IMT surface dispersant application decision matrix (Table 4-13).

The OIM should prioritise activating the vessel dispersant 'test-spray' as early as safely and reasonably practicable during the emergency response, due to the potential for a limited window

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of dispersant effectiveness. The initial test spray results will be used to inform the Operational SIMA and support ongoing use (or otherwise) of surface dispersant.

Ongoing dispersant use shall only be authorised if the IMT Leader is satisfied a 'Yes' has been recorded for all of the conditions within Table 4-13.

4.5.5.4 *Acceptable dispersant application zone*

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 m³ Group IV spill at various locations along the Gas Export Pipeline (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.

INPEX stakeholder consultation with WA DoT (WA Control Agency) has confirmed that the application of dispersant on a Group IV spill to protect the values and sensitivities of shorelines, such as seabird and turtle nesting/roosting, will be considered on the situations 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.
- Dispersant use is permitted for any spill that have the potential to reach state waters, if there is a positive outcome for dispersant use based on the Operational SIMA, and relevant WA/NT Control Agency has been informed regarding the Operational SIMA.

The map demonstrating the Acceptable Dispersant Application Zone within the Browse Basin are provided in figure 4-4, Figure 4-5 and Figure 4-6.



Table 4-13: IMT dispersant application decision matrix

Incident name	Dispersant application decision matrix - review date & time	(dd/mm/yy) ___/___/ 20___ (__:__ hrs)	IMT Leader name	IMT Leader signature (endorsement)
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Operational conditions (ALARP considerations)	Decision (Y/N)	Comments
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.		
Initial vessel dispersant test-spray (coordinated by Ichthys Field Manager/FPSO OIM) demonstrated effective dispersant on the oil spill.		
Operational SIMA – positive outcome recorded for ongoing dispersant use		
For FWAD, AMSA satisfied with the ‘Fixed-Wing Dispersant Operations Plan’.		
The area of the floating slick, where dispersant is to be applied, is located within the ‘Acceptable Dispersant Application Zone’ (refer figure 4-4, Figure 4-5 and Figure 4-6). Dispersant use within State/Territory waters is only permitted under instruction from the relevant State/Territory Control Agency. Dispersant use within an Australian Marine Park is only permitted following consultation with the Director of National Parks (or delegate). Dispersant use is also permitted in areas <-30 m LAT and <20 km from an intertidal habitat, (but not within State/Territory waters) where the Operational SIMA indicates a positive outcome for dispersant use to protect MNES (E.g., turtle nesting/ seabird breeding), and the relevant State/Territory Control Agency has been notified and agrees with the Operational SIMA positive outcome. 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, Heyward Shoal etc.).		
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.		
Confirm whether there are any fixed facilities with shallow/hull mounted seawater intakes likely impacted by concentrated dispersant/dispersed oil? (e.g., a MODU or Ichthys CPS or FPSO very near the spill location?). If there are, ensure the relevant OIM is aware that exposure to very high concentration of entrained/dispersed oil may potentially require: monitoring of quality of RO/desalination water. Additional cleaning of RO/desalination filters may be required. monitoring of operability of cooling water system. Additional cleaning of heat exchange plates may be required. Note – not a credible risk unless thick oil being dispersed very close (within a few hundred metres) of the fixed facility.		



Operational conditions (ALARP considerations)	Decision (Y/N)	Comments
If spill is from a vessel which is NOT classified as a "Facility" or "Associated Offshore Place", ensure AMSA (as Control Agency for vessel spills), has authorised dispersant use.		

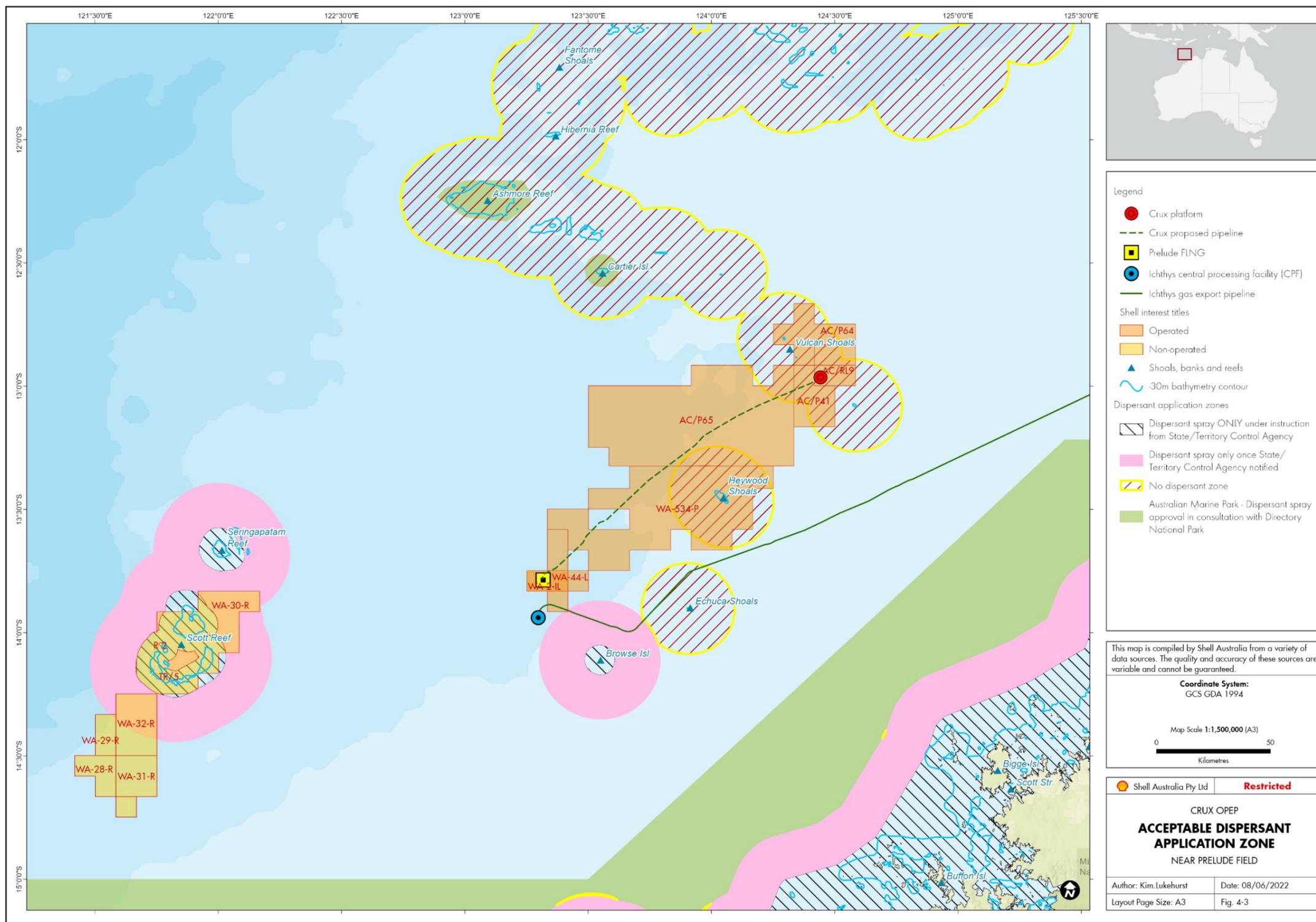


Figure 4-4: Acceptable dispersant application zone near Prelude Field

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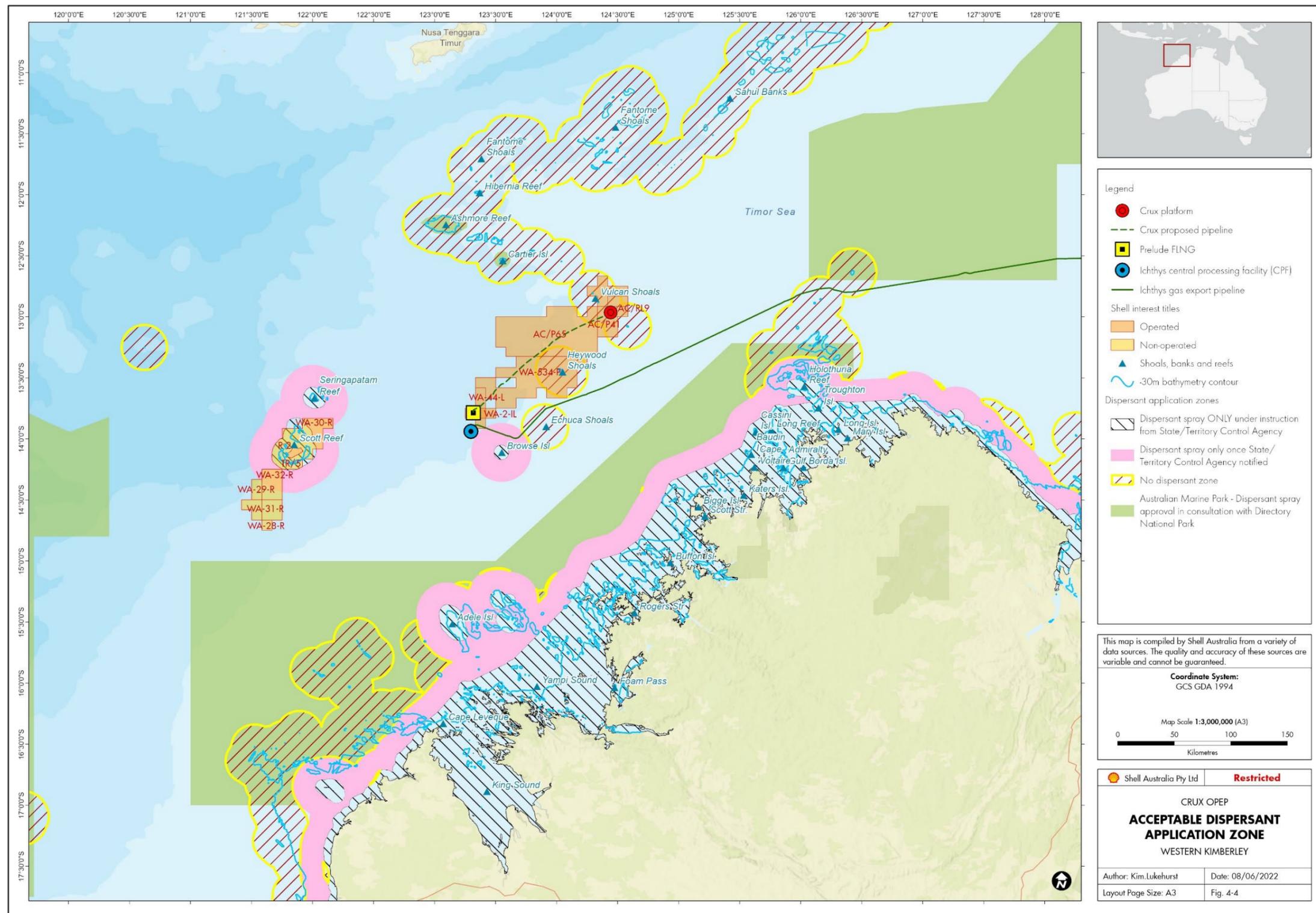


Figure 4-5: Acceptable dispersant application zone – Western Kimberley Region

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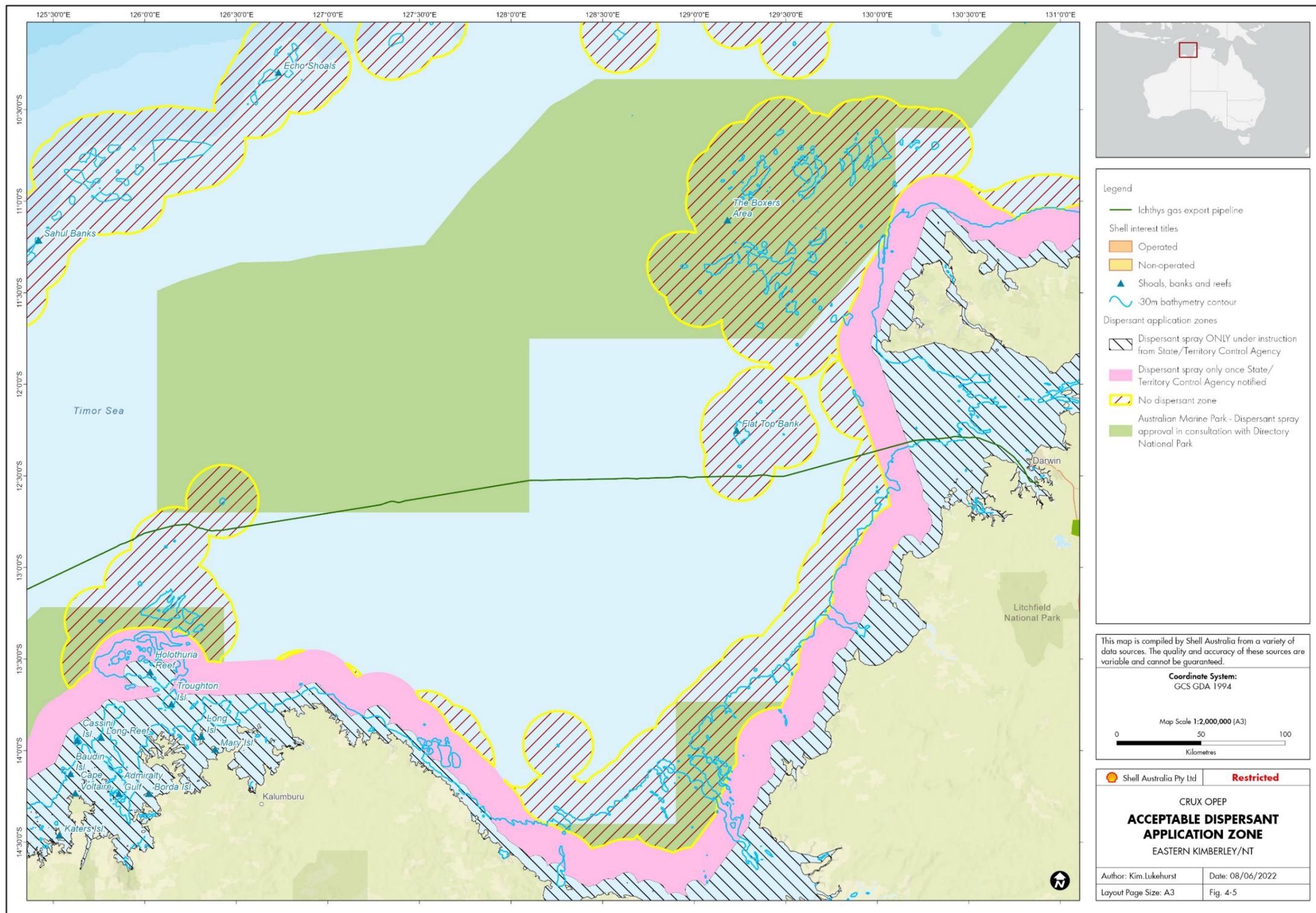


Figure 4-6: Acceptable dispersant application zone – Eastern Kimberley / NT Region

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4.5.5.5 Personnel – vessel dispersant

Personnel trained in vessel based dispersant application are present on the Platform Support Vessels (PSVs) and Infield Support Vessel (ISV).

Additional vessel dispersant trained personnel (including support via remote assistance) can be provided by AMOSC and OSRL.

The Icthyx INPEX support vessels also maintain dispersant trained personnel.

4.5.5.6 Personnel – FWAD

When triggered, the Fixed Wing Aircraft Dispersant Capability (FWADC) contract provides the following: Pilot(s) for the Air Tractor AT802, Aerotech First Response Liaison Officer, an Air Attack Supervisor, an Aircraft Loading Officer, and transportation for all to the nominated location.

A combination of commercial flights, and possibly charter flights, will be necessary to mobilise these personnel to the nominated airbase within 24 hours.

Section 5 of the AMOSC (2020b) *Aerial Dispersant Operations Plan for Oil Spills Off The Northern Coastline of Australia* (here-after referred to as the AMOSC FWAD Northern Operations Plan) provides the typical organisation chart required for FWAD activities.

4.5.5.7 Tools/equipment/plans – vessel dispersant

A stockpile of 15 m³ of Slickgone NS dispersant and a portable AFEDO dispersant spray system is maintained on the three ISV's which support Prelude FLNG.

The Shell operated PSVs and OSV are also equipped with dispersant spray equipment.

The Shell Surface Dispersant Application Guide is available with the dispersant stockpile and mobile spray system on ISVs.

The Shell Surface Dispersant Application Guide is described in Section 4.3.2. This guide shall be used by Titleholder vessel-based dispersant application teams (trained personnel), 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 dispersant effectiveness monitoring/reporting templates.

Tools/equipment/plans – FWAD

The AMOSC FWADC Contract with Aerotech First Response (AFR) provides the FWAD capability for Australia, including availability of 6 air-tractors (AT-802 aircraft), which are 'wheels-up' within 4 hours of activation.

For FWAD activities in the BROPEP region, the FWAD capability would be executed in accordance with the AMOSC FWAD Northern Operations Plan.

This document includes all necessary details to facilitate FWAD from the following airbases:

- Batchlor (NT)
- Darwin International Airport (NT)
- Broome International Airport (WA)
- Mitchell Plateau Airfield
- Mungaluvalu-Truscott Airfield.

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Shell also routinely operates crew change helicopters from Lombadina and could also utilise this location for FWAD operations.

4.5.5.8 Dispersant stockpiles

Dispersant stockpiles closest to Lombadina and Mungalalu-Truscott Airports are located in Darwin, Broome and Exmouth. These can be mobilised to the airport by air or road.

Table 4-14 presents the dispersant stockpile information for the BROPEP region, accurate at the time of preparation of this document (Rev0, August 2021).

Table 4-14: Dispersant stockpiles

Location	Dispersant stockpile and owner
Ichthys Field	16 m ³ (2 x 8 m ³ tote-tanks) –FPSO Ichthys Venturer
Prelude	(Prelude support tugs) – accessible as ‘best-endeavours/mutual aid’ via request from Ichthys OIM to Prelude OIM
Mungalalu-Truscott Airport	5 m ³ - Jadestone Energy (accessible via AMOSC mutual aid request)
Darwin	10 m ³ Slickgone EW – AMSA stockpile 9 m ³ Ardrox 6120 – AMSA stockpile 9 m ³ Slickgone LTSW – AMSA stockpile (NOT on OSCA register)
Broome	15 m ³ Ardrox 6120 – AMOSC stockpile
Exmouth	75 m ³ Slickgone NS – AMOSC stockpile

4.5.5.9 Logistics – vessel dispersant

The Shell infield support vessels (ISV), Shell PSV’s, INPEX OSV and two PSVs are fitted with dispersant spray systems. All the PSV and OSV’s require to become an operational vessel dispersant capability is to lift the FPSO dispersant stockpile onto any of these vessels. The ISV’s already have dispersant onboard.

Should the OSVs or PSVs not be available, the FPSO dispersant stockpile, AFEDO system and FPSO dispersant spray trained personnel can be lifted onto any other available support vessel, such as an Anchor Handling Tug (AHT), to create a vessel dispersant capability.

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 Shell Surface Dispersant Application Guide.

Any aviation support is to be arranged via the IMT.

4.5.5.10 Logistics – FWAD

Aerotech First Response (AFR) is the nominated contractor who provides the FWAD aircraft fleet (AT-802 air-tractors/crop-dusters), under the FWADC Contract.

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.

The AT-802 aircraft capabilities as summarised as follows:

- 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 m³
- maximum dispersant capacity at 200 nm – 3 m³.

Mitchell Plateau Airfield, Mungalalu-Truscott Airfield, and potentially Lombadina airfield are the most likely base from which to launch the FWAD response for a spill in the Ichthys Field.

Mungalalu-Truscott Airfield and Lombadina are the largest all weather airports in the north Kimberley with sealed runways and the necessary lighting for night operations (E.g., dispersant resupply - not air-tractor spray sorties). There is reasonable road access to these airports; however, it may be restricted during the wet season.

Road access to Mitchel Plateau is more challenging, and Mitchel Plateau airfield is an unsealed airstrip, with no lighting.

Relevant distances and timings for the Batchelor and Exmouth (Learmonth) FWAD primary aircraft are presented in Table 4-15.

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Table 4-15: 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)	Lombadina Airport (WA)	955	524	3 h, 30 min
Learmonth Airport (WA)	Lombadina Airport (WA)	1106	607	4 h, 5 min,
Lombadina Airport (WA)	Browse Island	271	148	55 min
Lombadina Airport (WA)	Ichthys Field management area	275	151	55 min

4.5.5.11 FWAD – Air Attack Supervisor platform

In accordance with the AMOSC (2020b) FWAD Northern Operations Plan, the Titleholder/Control Agency must provide the Air Attack Supervisor platform.

The purpose of this platform is to provide a bird’s-eye view of any oil slick, to enable the Air Attack Supervisor to coordinate and direct the dispersant application by the AT-802 aircraft.

The platform can be either a fixed wing aircraft or a helicopter. Titleholder should typically consider the use of a crew-change helicopter as the Air Attack Supervisor platform.

4.5.5.12 FWAD - Search and rescue (SAR) platform

In accordance with the AMOSC (2020b) FWAD Northern Operations Plan, the Titleholder/Control Agency must provide the SAR platform



The SAR platform can be an aircraft or vessel on standby near the proposed location of dispersant application.

Shell has a SAR helicopter located in Broome. Shell could also potentially utilise vessels as a SAR platform.

4.5.5.13 Response effectiveness monitoring

The Shell Surface Dispersant Application Guide will be used by trained personnel during dispersant application. Relevant factors (ITOPF 2013) that need to be considered during dispersant application include:

- 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 (in consultation with AMOSC vessel dispersant experts) 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.

During FWAD activities, an additional observer should be mobilised in the air attack supervisor platform 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 (supported by aerial observation, if possible).

In accordance with the Shell Surface Dispersant Application 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).

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4.5.5.14 Termination criteria

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 surface dispersant on the oil
- habitats/values and sensitivities remaining at risk
- deteriorating weather conditions (including wind, visibility, sea conditions).

4.5.5.15 Capability, arrangements and performance outcomes and standards

The arrangements and capabilities as described in the subsections above are summarised in Table 4-16.

The EPOs and EPSs related to the implementation of surface dispersant are provided in Table 4-17.

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Table 4-16: Arrangements and capabilities – surface dispersant application

Technique	Resource capability and availability	Minimum implementation time	Activation
Vessel-based dispersant application	<p>FPSO maintains 16 m³ dispersant, an AFEDO spray system and dispersant trained personnel. These can be mobilised onto any available support vessel.</p> <p>INPEX and Shell OSV/PSVs maintain dispersant spray systems and dispersant trained personnel. The FPSO can provide the 16 m³ dispersant to these vessels.</p> <p>Shell Prelude FLNG ISV's are equipped with dispersant (15 m³), spray systems and dispersant trained personnel.</p> <p>AMOSC/AMSA dispersant stockpiles (refer Table 4-14) can be mobilised by air or road to Broome wharf to resupply vessels.</p>	<p>Field Manager/FPSO OIM; as soon as safely and reasonably practicable, mobilise a vessel dispersant capability in WA-50-L and conduct a test-spray (provided vessels are not required for other 'Safety/People' related tasks associated with the emergency event).</p>	<p>Field Manager is authorised to coordinate the initial test-spray of vessel-based dispersant.</p> <p>IMT Leader to authorise ongoing vessel-based dispersant spraying, in accordance with dispersant application decision matrix (Refer Table 4-13).</p> <p>The Ichthys vessel dispersant capability can be requested/accessed through Ichthys OIM if requested by the Prelude OIM.</p> <p>AMOSC notification/activation forms available in the Oil Spill Forms Register (refer Section 5).</p>
Fixed wing aerial dispersant application	<p>Nominated airbases would likely be Mitchell Plateau, Lombadina or Mungalalu-Truscott airports.</p> <p>The FWAD capability would be requested to be activated through AMOSC.</p> <p>AFR would provide the FWAD spray aircraft.</p> <p>FWAD personnel would be obtained through AMOSC, AMSA and AFR.</p> <p>An air attack aircraft (preferably helicopter) must be provided by Titleholder.</p> <p>A SAR platform (vessel/SAR helicopter) must be provided by Titleholder.</p> <p>A Jadestone Energy owned dispersant stockpile (5 m³) is located at Mungalalu-Truscott Airport (accessible via request through AMOSC/AMOS-Plan).</p> <p>AMOSC/AMSA dispersant stockpiles (refer Table 4-14) can be mobilised by air or road to the FWAD airbase.</p>	<p>IMT to notify AMOSC to activate FWADC Contract as soon as practicable.</p> <p>24 hours required to mobilise dispersant stockpiles, FWAD aircraft, SAR platform and FWAD personnel required under the AMOSC (2020) FWAD northern operations plan, to a nominated airfield (E.g., Lombadina or Mungalalu Truscott Airport).</p>	<p>IMT Leader to activate FWAD capability through AMOSC.</p> <p>AMOSC notification/activation forms available in the Oil Spill Forms Register (refer Section 5).</p> <p>IMT Leader to authorise aerial dispersant spraying, in accordance with dispersant application decision matrix (Refer Table 4-13).</p>



Table 4-17: EPO, EPS and measurement criteria for surface dispersant application

Environmental performance outcome	Environmental performance standard	Measurement criteria
<p>Surface dispersants will be used to reduce the volume of oil on the sea surface, by dispersing it into the water column, resulting in a reduction in the likelihood and/or consequence of impacts associated with floating oil on the sea surface and on potentially impacted shorelines</p>	<p>In the event of any Group IV spill, the Field Manager (relevant CPF/FPSO OIM) shall coordinate a 'test-spray' of dispersant using the vessel-based dispersant capabilities/arrangements as described in Table 4-16; under the condition that potential dispersant spray vessels are not required for other 'safety/people' related tasks associated with the emergency event.</p> <p>Effectiveness of the test spray will be monitored.</p>	<p>Emergency event response records.</p>
	<p>In the event of any Group IV spill, as soon as practicable, the IMT will notify AMOSC and request immediate activation of the First Response FWADC Contract.</p>	<p>Emergency event response records.</p>
	<p>The IMT will utilise SMV data, the IMT dispersant decision matrix, results from the initial test-spray and Operational SIMA to inform the ongoing use of surface dispersants for all Group IV spills.</p>	<p>Emergency event response records.</p>
	<p>When determined by the Operational SIMA that surface dispersant application should be continued, the IMT will activate vessel-based dispersant and/or FWAD</p>	<p>Emergency event response records.</p>



Environmental performance outcome	Environmental performance standard	Measurement criteria
	dispersant using the capabilities/arrangements as described in Table 4-16.	
	Monitoring of response effectiveness for surface dispersants will be undertaken as described in Section 4.5.5.	Emergency event response records.
	The IMT will utilise response effectiveness monitoring data to inform the ongoing use of surface dispersants against the response termination criteria.	Emergency event response records.
Risks of impacts to marine water quality and shallow benthic communities from surface dispersant application are reduced and maintained to ALARP and acceptable levels.	Vessel and/or aerial dispersant applications will be undertaken in accordance with the IMT dispersant application decision matrix.	Emergency event response records.
	Only dispersants with high efficacy for dispersal of Group IV hydrocarbons which are listed on the AMSA oil spill control agent (OSCA) register will be used in the event of dispersant application.	Emergency event response records.



4.5.6 At-sea containment and recovery

4.5.6.1 Response Objective

At sea containment and recovery (C&R) will be implemented to reduce the volume of oil on the sea surface, resulting in a reduction in the likelihood and/or consequence of impacts associated with floating oil on the sea surface and on potentially impacted shorelines

4.5.6.2 Response Strategy Summary

C&R is the controlled collection and recovery of floating oil from the water's surface.

A minimum single offshore C&R operation would require a large anchor handling tug, or other similar large vessels with a rolled stern, able to deploy offshore boom from the back deck. The capability would also require deployment of suitable skimmers and some form of liquid oily waste storage capacity (E.g., inboard or deck tanks). For a single vessel operation, a boom-vane system would be required to maintain the booms configuration. If no boom-vane system was available, a second vessel (possibly slightly smaller) to tow the leading edge of the boom would also be required.

Alternatively, an advanced booming system (E.g., speed-sweep or current buster system), typically requiring 3-5 vessels could be used, which would be better for recovery of more fragmented spills, as the system can operate at higher speeds.

Regardless of the technique (traditional versus advanced) the encounter rates will vary significantly, depending on the oil behaviour. For example far higher encounter rate will occur if the oil is in very thick patches compared to if the oil has become spread-out into windrows. Chasing patches/windrows is very time consuming, due to slow vessel speeds (typically 0.7 to 1 knot over water for traditional, or 4-5 knots with advanced booming techniques).

In accordance with AMSA (2020b) *Maritime discharges of oil and oily water during emergency and response situations*, the normally tight MARPOL restrictions on oil/oily water discharge quality can be relaxed if it is necessary during a spill response to discharge oil/oily water to minimise the overall damage from pollution, and is approved by the relevant government.

In accordance with AMSA (2020b), the relevant government administrators include the following AMSA positions: the AMSA Local Manager; the Manager Marine Environmental Pollution Response; the General Manager, Marine Environment; and the General Manager, Ship Safety Division.

Some States/Territories may have processes for approval within their relevant jurisdiction, however if the State/Territory is silent on the issue, or in conflict with the MARPOL Regulation intent (to permit the discharge during spill response), then the Commonwealth legislation applies, as the means to implement the international/MARPOL obligation.

Note, the approvals are specified vessels for a particular spill response, and not as a general discharge approval.

There is no specific AMSA form for this application, however the applicant (IMT) should provide a full explanation to assist the person assessing the approval, and as a minimum, should provide the following information:

- who and why - the vessel, the incident and the applicant
- what - the planned response operations that require the oily water discharge

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- how - the state and capability of the ship as a response platform
- result - the expected discharge volumes or rates.

4.5.6.3 Activation

The IMT shall consider all SMV data to determine potential effectiveness of C&R activities.

The IMT will need to consider, in consultation with AMOSC the practicalities, likely success and risks associated with a C&R operation.

Optimal sea-state for C&R activities is Beaufort sea-state of 1-4 (<20 knots).

The C&R operation should target oil slicks which are Bonn Code 4/5 (oil thickness >100 g/m²).

4.5.6.4 Personnel

A typical C&R strike-team would consist of a minimum of 2 C&R trained personnel, and 3-5 supporting deck crew.

C&R trained personnel can be accessed via AMOSC and OSRL.

Deck crew personnel, who can receive on the job training would be available already onboard the vessels, or if additional personnel were required, would be available via Titleholder existing labour hire agreements.

4.5.6.5 Tools/equipment/plans

Various stockpiles of oil spill response equipment, including offshore C&R booms, skimmers etc. are located around Australia.

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.

The AMOSC Broome stockpile includes sufficient C&R equipment for a single traditional (J-boom) strike team.

Additional C&R equipment can be accessed via AMOSC stockpiles in Exmouth, Fremantle and Geelong.

A summary of additional equipment stockpiles, their custodian and locations are presented in Table 4-18.

Table 4-18: contain and recover equipment stockpiles

Level	Custodian	Location
Level 1	AMOSC	Broome
Level 2/3	AMOSC	Exmouth/Fremantle/Geelong
	WA DoT	Fremantle



Level	Custodian	Location
	AMSA	Darwin
Level 3	OSRL	Singapore

4.5.6.6 Logistics

An offshore C&R operation would require the use of at least one or generally two support vessels, to conduct J-booming or other containment techniques.

An AHT or another similar vessel with rolled stern is required to deploy the offshore boom.

Advanced boom systems will typically require more vessels.

An additional logistics support vessel may also be required to transport recovered oil back to shore for treatment/disposal.

Waste management will be a key consideration for C&R operations. A waste management plan would be developed in consultation with AMOSC, prior to commencement of the activity (refer to Table 4-23).

4.5.6.7 Response effectiveness monitoring

During C&R 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 C&R activities (including photographic evidence, where possible).

4.5.6.8 Termination criteria

Termination of a C&R 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 surface dispersant on the oil
- habitats/values and sensitivities remaining at risk
- deteriorating weather conditions (including wind, visibility, sea conditions)

4.5.6.9 Capability, arrangements and performance outcomes and standards

The arrangements and capabilities for C&R are summarised in Table 4-19.

The EPOs and EPSs related to the implementation of C&R are provided in Table 4-20.



Table 4-19: Arrangements and capabilities – at-sea containment and recover

Technique	Resource capability and availability	Minimum implementation time	Activation
C&R personnel	AMOSC core group personnel, who can lead/manage a protect activity are available via the Titleholder membership of AMOSC. Titleholder 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.	48 hours to mobilise personnel to the Ichthys Field to commence C&R on location.	AMOSC, OSRL & labour hire company contact details available via IMT W L2 Emergency Response Plan AMOSC and OSRL notification/activation forms available in the Oil Spill Forms Register (refer Section 5).
C&R equipment	Contain and recover equipment can be mobilised from the various stockpiles including Broome/Darwin stockpiles to the relevant wharf. Additional equipment is located at various ports, as listed in Table 4-18. This equipment is accessible through AMOSC.	Activate AMOSC to move C&R equipment to Broome wharf as soon as practicable (first-strike action for any Group IV spill)	
Vessels	Smaller support vessel assets <40 m in length may be used to support C&R activities.	48 hours to mobilise vessels to the Ichthys Field to commence C&R on location.	IMT to active all support vessels. Vessel provider contact details available via the IMT W L2 Emergency Response Plan.
	AHTs or other large support vessels with rolled-stern required for safe deployment of booms from the back deck.	48 hours to mobilise vessel to the Ichthys Field to commence C&R on location.	



Table 4-20: EPO, EPS and measurement criteria for at sea containment and recovery

Environmental performance outcome	Environmental performance standard	Measurement criteria
<p>At sea containment and recovery will be implemented to reduce the volume of oil on the sea surface, resulting in a reduction in the likelihood and/or consequence of impacts associated with floating oil on the sea surface and on potentially impacted shorelines.</p>	<p>In the event of any Group IV spill in the Ichthys Field, the IMT will:</p> <ul style="list-style-type: none"> request AMOSC to mobilise C&R equipment from the Broome warehouse to Broome wharf identify vessels potentially available to be used for C&R. 	<p>Emergency event response records.</p>
	<p>Based on the outcome of the Operational SIMA, the IMT will activate C&R, using the capabilities/arrangements as described in Table 4-19.</p>	<p>Emergency event response records.</p>
	<p>Monitoring of response effectiveness for at sea containment and recovery will be undertaken as described in Section 4.5.6.</p> <p>Response effectiveness monitoring data will be utilised as part of ongoing IAP review and response termination criteria.</p>	<p>Emergency event response records.</p>
<p>Risks of impacts to the environment from vessel discharges during oil spill response activities will be reduced and maintained to ALARP and acceptable levels.</p>	<p>Any vessel conducting containment and recovery activities in Commonwealth water will obtain a vessel specific approval from AMSA prior to conducting any decanting/discharge of oil/oily water mixtures.</p>	<p>Emergency event response records.</p>



4.6 Waste management

Waste will be managed in accordance with the MARPOL 73/78 Annex V – Garbage, relevant Commonwealth and State/Territory regulations regarding disposal of waste generated as a result of spill-response strategies.

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 5500 m³. Waste storage on remote shorelines and support vessels can be managed with small, easily transportable waste receptacles.

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.

4.6.1.1 Capability, arrangements and performance outcomes and standards

Table 4-21 outlines the waste storage, disposal and treatment options available for the various oily waste streams.

The arrangements and capabilities for waste management are summarised in Table 4-22.

The EPOs and EPSs related to the implementation of waste management are provided in Table 4-23.

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Table 4-21: 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 backloaded by tender or 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 Titleholder Broome Drilling Logistic Base Titleholder 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 backloaded by tender or 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.	Oil drums 1 m ³ IBCs ISO-tanks Slops tanks on vessels	Oily waste containers will be backloaded by tender or 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 backloaded by tender or 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		





Table 4-22: 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
	Provided by licenced waste contractor 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/Darwin supply bases 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	N/A.	IMT



Technique	Resource capability and availability	Implementation time	Activation
	landfill water treatment and discharge.		



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Table 4-23: EPO, EPS and measurement criteria for waste management

Environmental performance outcome	Environmental performance standard	Measurement criteria
<p>Waste management will be implemented to limit the environmental impacts including secondary contamination associated with the transport and disposal of the collected oily waste products.</p>	<p>Based on the outcome of the Operational SIMA and in consultation with the relevant State/Territory Control Agencies and AMOSC, the IMT will activate waste management using the capabilities/arrangements as described in Table 4-22.</p>	<p>Emergency event response records.</p>
<p>No secondary ocean or shoreline contamination due to inappropriate waste management during the implementation of spill response strategies.</p>	<p>Waste management plan(s) will be developed in consultation with AMOSC, and as necessary, the relevant State/Territory Control Agency.</p> <p>Waste management plans will include consideration of:</p> <ul style="list-style-type: none"> methods to eliminate, reduce and re-use materials to reduce the overall volume of waste generated waste storage, transport and disposal arrangements decontamination stations and other relevant processes to prevent secondary contamination. 	<p>Emergency event response records.</p>

Note: EPS related to decanting oily water during containment and recovery is defined in Table 4-20.

4.7 Operational and scientific monitoring

4.7.1 Response strategy summary

Shell has developed a Browse Region Operational and Scientific Monitoring Bridging Implementation Plan (HSE_PRE_16370) (OSMP) which describes a program of monitoring oil pollution that will be adopted in the event of a hydrocarbon spill incident (Level/Tier 2-3) to marine waters. It is aligned to the Joint Industry Operational and Scientific Monitoring Plan Framework (APPEA, 2021) and describes how this Framework applies to Shell's activities and spill risks in Australian waters.



The OSMP is structured so that it can provide a flexible framework that can be adapted to individual spill incidents. A series of Operational Monitoring Plans (OMPs) and Scientific Monitoring Plans (SMPs) form part of the Joint Industry Framework and provide detail on monitoring design, standard operating procedures, data management and reporting.

Table 4-24 lists the plans that are relevant to Shell's activities and the aim of each monitoring plan.

There are two types of monitoring that would occur following a Level/Tier 2-3 spill event:

- Operational Monitoring – which is undertaken during the course of the spill and includes any physical, chemical and biological assessments which may guide operational decisions such as selecting the appropriate response and mitigation methods and / or to determine when to terminate a response activity. The design of operational monitoring requires judgements to be made about scope, methods, data inputs and outputs that are specific to the individual spill incident, balancing the operational needs of the response with the logistical and time constraints of gathering and processing information. There is a need for information to be collected and processed rapidly to suit response needs, with a lower level of sampling and accuracy needed than for scientific purposes. For details on initiation and termination criteria for OM's refer to Shell's OSMP Implementation Plan.
- Scientific Monitoring - which can extend well beyond the termination of response operations. Scientific monitoring has objectives relating to attributing cause-effect interactions of the spill or associated response with changes to the surrounding environment. The SMs will be conducted on a wider study area, extending beyond the spill footprint, will be more systematic and quantitative and aim to account for natural or sampling variation. For further details on the SM's refer to Shell's OSMP Implementation Plan.

Details on personnel, tools, equipment, logistics, monitoring priorities and mobilisation times are outlined in Shell's OSMP. The below information is provided for initial response information only and the OSMP should be referred to directly to guide effective spill response planning for oil spill monitoring activities.

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Table 4-24: Operational and Scientific Monitoring Plans

Document Name	Aim/objective
Operational Monitoring	
Hydrocarbon properties and weathering behaviour at sea	To provide in field information on the hydrocarbon properties, behaviour and weathering of the spilled hydrocarbons to assist in spill response operations
Pre-emptive assessment of sensitive receptors at risk (desktop only)	To undertake a rapid desktop-based assessment of the presence, extent and current status of sensitive receptors at risk of being affected by a hydrocarbon spill, prior to contact
Shoreline clean-up assessment technique (SCAT)	<p>Provide information on the physical and biological characteristics of shorelines within the predicted trajectory of the hydrocarbon spill or that have been exposed to the spill</p> <p>Conduct segmentation of shorelines to aid in response planning and implementation of response activities</p> <p>Inform suitable pre-impact and post-impact response options/activities to minimise the threat posed to sensitive receptors from the spill and establish clean-up end points for the shoreline</p> <p>Inform the IMT/EMT of any potential or actual impacts to sensitive receptors from response options/activities</p> <p>Inform the IMT of any sensitive receptors that may be relevant to scientific monitoring programs</p>
Chemical dispersant effectiveness and fate (surface and subsurface)	To monitor the effectiveness, distribution and fate (surface and subsurface) of chemical dispersants to verify impact/contact predictions for response planning and other monitoring plans
Water quality assessment	To provide a rapid assessment of the presence, type, concentrations and character of hydrocarbons in marine water to assess the extent of spill contact and verify impact predictions for other monitoring plans
Sediment quality assessment	To provide a rapid assessment of the presence, type, concentrations and character of hydrocarbons in marine sediments to assess the extent of spill contact and verify impact predictions for other monitoring plans
Marine fauna assessment <ul style="list-style-type: none"> • Reptiles • Cetaceans (observational only) • Dugongs 	To undertake a rapid assessment of marine fauna at risk to assist in decisions on appropriate management and response actions during a hydrocarbon spill event to minimise the potential impact on marine fauna.



<ul style="list-style-type: none"> • Seabirds and shorebirds • Fish 	
<p>Air quality modelling (responder health and safety)</p>	<p>To assess the impact of the hydrocarbon spill on human health, particularly that of the public and response personnel</p>
<p>Scientific Monitoring</p>	
<p>Water quality impact assessment</p>	<p>Detect and monitor the presence, concentration and persistence of hydrocarbons in marine waters following the spill and associated response activities. The specific objectives of this SMP are as follows:</p> <ul style="list-style-type: none"> • Assess and document the temporal and spatial distribution of hydrocarbons and dispersants in marine waters of sensitive receptors; • Consider the potential sources of any identified hydrocarbons • Verify the presence and extent of hydrocarbons (both on water and in water) that may be directly linked to the source of the spill • Assess hydrocarbon/dispersant content of water samples against accepted environmental guidelines or benchmarks to predict potential areas of impact • Provide information that may be used to interpret potential cause and effect drivers for environmental impacts recorded for sensitive receptors monitored under other SMPs
<p>Sediment quality impact assessment</p>	<p>Detect and monitor the presence, concentration and persistence of hydrocarbons in marine sediments following the spill and associated response activities. The specific objectives of this SMP are as follows:</p> <ul style="list-style-type: none"> • Assess and document the temporal and spatial distribution of hydrocarbons and dispersants in marine sediments of sensitive receptors • Consider the potential sources of any identified hydrocarbons; and • Verify the presence and extent of hydrocarbons that may be directly linked to the source of the spill • Assess hydrocarbon content of sediment samples against accepted environmental guidelines or benchmarks to predict potential areas of impact



<p>Intertidal and coastal habitat assessment</p>	<p>To assess the impact (extent, severity, and persistence) and subsequent recovery of intertidal and coastal habitats and associated biological communities in response to a hydrocarbon release and associated response activities.</p> <p>The specific objectives of this SMP are as follows:</p> <ul style="list-style-type: none"> • collect quantitative data to determine short-term and long-term (including direct and indirect) impacts of hydrocarbon (and implementation of response options) on intertidal and coastal habitats and associated biological communities, post-spill and post-response recovery • monitor the subsequent recovery of intertidal and coastal habitats and associated biological communities from the impacts of the hydrocarbon release
<p>Seabirds and shorebirds</p>	<p>Document and quantify shorebird and seabird presence; and any impacts and potential recovery from hydrocarbon exposure. The objectives are to:</p> <ul style="list-style-type: none"> • Identify and quantify, if time allows, the post-spill/pre-impact presence and status (e.g. foraging and/or nesting activity) of shorebirds and seabirds in the study area • Observe, and if possible quantify and assess, the impacts from exposure of shorebirds and seabirds to hydrocarbons (i.e. post-impact) and to the response activities, including abundance, oiling, mortality, and sub-lethal effects • Identify, quantify and evaluate the post-impact status and if applicable, recovery of key behaviour and breeding activities of shorebirds and seabirds (e.g. foraging and/or nesting activity and reproductive success) over time and with regard to control sites
<p>Marine mega-fauna assessment</p> <ul style="list-style-type: none"> • Reptiles 	<p>Reptiles</p> <p>Identify and quantify the status and recovery of marine reptiles, including marine turtles, sea snakes and estuarine crocodiles, related to a hydrocarbon spill</p> <p>The objectives are to:</p> <ul style="list-style-type: none"> • To observe and quantify the presence of marine reptiles (including life stage) within the area affected by hydrocarbons • Where possible, assess and quantify lethal impacts and/or sub-lethal impacts directly related to the



	<p>hydrocarbon spill or other secondary spill-related impacts (including vessel strike and/or use of dispersants);</p> <ul style="list-style-type: none"> • Assess the impact of the hydrocarbon spill on nesting turtles, nests, and hatchlings • Understand changes in nesting beach usage by marine turtles following the hydrocarbon spill
<p>Benthic habitat assessment</p>	<p>To assess the impact (extent, severity, and persistence) and subsequent recovery of subtidal benthic habitats and associated biological communities in response to a hydrocarbon release and associated response activities.</p> <p>The specific objectives of this SMP are as follows:</p> <ul style="list-style-type: none"> • collect quantitative data to determine short-term and long-term (including direct and indirect) impacts of hydrocarbon (and implementation of response options) on benthic habitats and associated biological communities, post-spill and post-response recovery • monitor the subsequent recovery of benthic habitats and associated biological communities from the impacts of the hydrocarbon release
<p>Marine fish assemblages assessment</p>	<p>To assess the impacts to and subsequent recovery of fish assemblages associated with specific benthic habitats (as identified in SMP: Benthic Habitat Assessment) in response to a hydrocarbon release and associated response activities.</p> <p>The specific objectives of this SMP are as follows:</p> <ul style="list-style-type: none"> • Characterise the status of resident fish populations associated with habitats monitored in SMP: Benthic Habitat Assessment that are exposed/contacted by released hydrocarbons • Quantify any impacts to species (abundance, richness and density) and resident fish population structure (representative functional trophic groups) • Determine and monitor the impact of the released hydrocarbons and potential subsequent recovery to residual demersal fish populations
<p>Fisheries impact assessment</p>	<p>To monitor potential contamination and tainting of important finfish and shellfish species from commercial, aquaculture and recreational fisheries to evaluate the likelihood that a hydrocarbon spill will have an impact on the fishing and/or aquaculture industry.</p>



	<p>The specific objectives of this SMP are as follows:</p> <ul style="list-style-type: none"> • Assess any physiological impacts to important fish and shellfish species and if applicable, seafood quality and safety • Assess targeted fish and shellfish species for hydrocarbon contamination • Provide information that can be used to make inferences on the health of fisheries and the potential magnitude of impacts to fishing industries (commercial, aquaculture and recreational)

4.7.2 Activation

Shell's IMT Environment Function is responsible for activating OSM components, subject to approval from the IMT leader. Table outlines Shell's OSM activation process.

Table activation process

Responsibility	Task	Timeframe
IMT Environment Function	Review initiation criteria of OMPs and SMPs during the preparation of the initial Incident Action Plan (IAPs) and subsequent IAPs; and if any criteria are met, activate relevant OMPs and SMPs	Within 4 hours of spill notification
	Obtain approval from Incident Commander Leader to initiate OSM	Within 4 hours of spill notification
	Contact OSM Services Provider and notify on-call officer of incident, requesting provision of OSM Implementation Lead to the IMT.	Within 4 hours of spill notification
	Provide monitor and evaluate data (e.g. aerial surveillance, fate and weathering modelling and tracking buoy data) to OSM Services Provider	Within 1 hour of data being received by IMT
	Liaise directly with OSM Services Provider to confirm which OMPs and SMPs are to be fully activated	Within 3 hours of monitor and evaluate data being received from IMT
	Provide purchase order to OSM Services Provider (cross reference OSM Standby Services Scope of Work)	Within 72 hours of initial notification to OSM Services Provider
	Record tasks in Personal Log	At time of completion of task



Responsibility	Task	Timeframe
OSM Services Provider	On-call officer to notify Service Provider Manager of activation and contact OSM Implementation Lead and Scientific Logistics Coordinator	Within 8 hours of notification being made to OSM Services Provider
	Send OSM Implementation Lead and Scientific Logistics Coordinator to the Shell IMT	Within 12 hours of notification being made to OSM Services Provider
	Liaise directly with EUL to determine which OMPs and SMPs are to be fully activated	Within 4 hours of monitor and evaluate data being received from IMT
	Confirm availability of initial personnel and equipment resources	Within 5 hours of monitor and evaluate data being received from IMT

4.7.3 Termination Criteria

Monitoring for each component will continue until termination criteria for individual components are reached. Typically, OMPs will terminate when agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the response or a relevant SMP has been activated. SMPs will continue after the spill response has been terminated and until such time as their termination criteria are also reached. A list of criteria is provided in the OSM Framework.

4.7.4 Capabilities, arrangements and performance outcomes and Standards.

The capabilities and arrangement associated with OSM and described in detail within the OSMP. Table 4-25 details the EPOs and EPSs for the implementation of oil spill monitoring.

Table 4-25: EPO, EPS and measurement criteria for Oil Spill Monitoring

Environmental performance outcome	Environmental performance standard	Measurement criteria
The OSMP capability and arrangements will be maintained and implemented to enable an effective response through provision of information related to the spill, the monitoring of risks	Response Preparedness	
	Maintain contracts with third-party providers to provide access to suitably qualified and competent personnel and equipment to assist in the implementation of monitoring	Contract with Monitoring Service Provider/s OSRL Subsea Well Intervention (SWIS) Member
	Obtain quarterly capability reports from Monitoring Service Provider	Quarterly capability reports from Monitoring Service Provider



and impacts from a spill, and to monitor the recovery of the natural environment.	Annual testing of OSMP standby arrangements and activation process with OSMP contractor	Records indicate OSMP standby arrangements and activation process with OSMP contractor tested annually
	Inclusion of OSMP activation and planning into one tabletop or incident management exercise each year	IMT post-exercise reports
	Response Implementation	
	Initiation criteria of OMPs and SMPs will be reviewed during the preparation of the initial Incident Action Plan (IAPs) and subsequent IAPs; and if any criteria are met, relevant OMPs and SMPs will be activated	Incident Action Plan and Incident Log
	Monitoring to be conducted in accordance with the Operational and Scientific Monitoring (OSM) Bridging Implementation Plan (HSE_PRE_16370)	Incident log and monitoring records
	OSMP decision making and implementation to be approved by personnel holding the competencies outlined in Section 10 of the Operational and Scientific Monitoring Bridging Implementation Plan (HSE_PRE_16370)	Incident Log and register of IMT and support personnel
	Monitoring priorities confirmed with key stakeholders (i.e. Jurisdictional Authority for receptor, appointed State/Territory Environmental Scientific Coordinator) and monitoring service providers (including subject matter experts, where available) at the time of the spill	Incident Action Plan and Incident Log
	Incorporate monitoring data (where available) into the Common Operating Picture and operational SIMA to aid in response decision making	Incident Action Plan, Incident Log and Operational SIMA
	Draft SMP reports peer reviewed by an expert panel to be approved by	Monitoring records



	the Commonwealth Department of Agriculture, Water and the Environment (DoAWE) and/or Department of Biodiversity Conservation and Attractions (DBCA) (depending on jurisdiction), as appropriate	
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4.8 Health and safety

Health and safety considerations will be incorporated into any spill response.

Health and safety objectives are to:

- adhere to the Titleholder PEARS philosophy
- 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 Titleholder personnel, assets and information.
- The IMT should develop a Safety Management Plan.

Key reference documents including:

- *National Plan Guidance on Marine Oil Spill Response Health and Safety* (AMSA 2018)
- *Oil spill responder health and safety* (IPIECA-IOGP 2012)
- *AMOSC HSSE Assurance and Management Plan* (AMOSC 2021).

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 contractor or other appointed or responsible personnel, such as the HSE manager or supervisor.

If the response is conducted by a Control Agency other than Titleholder (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 4-26 provides examples of hazards and risks that may be encountered during a response to a spill.

The Browse Island Oil Spill Incident Management Guide 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 at remote locations/offshore islands.



Table 4-26: Examples of health and safety risks from spill response

Hazards	Risks	Prevention and mitigation considerations
<p>Inadequately trained personnel carrying out the response</p>	<p>Lack of appropriate training</p>	<p>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.</p> <p>All personnel must complete the induction/on-the-job training and sign onto the JHA prior to commencing work.</p> <p>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.</p>
<p>Atmospheric risk from evaporating hydrocarbons</p>	<p>Fire and explosion</p> <p>Inhalation, ingestion or contact with skin or eyes leading to dermal irritation or illness.</p>	<p>Firefighting capacity of contracted vessels and their tenders as per flag state requirements and Shell standards.</p> <p>Permit to work (PTW) system and JHAs applied to all activities.</p> <p>Air quality monitoring equipment, to monitor and protect the health of oil spill responder personnel is required for the following activities:</p> <ul style="list-style-type: none"> • Vessel-based dispersant spraying • OSMP vessels (water quality, close to hydrocarbon release site) • Source control vessels (e.g., ROV survey/SSDI etc during well-control event) • SCAT / shoreline clean-up activities <p>The following equipment should be mobilised to each vessel exposed to VOCs;</p> <ul style="list-style-type: none"> • Passive VOC monitoring badges (e.g., ~10 badges per vessel, to cover 3-5 days operations) • Active VOC monitors (e.g., 1 x Ultra-ray 3000 per vessel)



Hazards	Risks	Prevention and mitigation considerations
		<p>Vessels exposed to potential explosion risk (E.g., source control site survey vessel or SSDI vessel) also require;</p> <ul style="list-style-type: none"> Personal Gas monitors (e.g., Drager 5000 / 7000) <p>At the time of preparation of this plan, the following equipment was available:</p> <ul style="list-style-type: none"> FPSO & CPF & Ichthys LNG Plant: Passive VOC monitoring badges Active VOC monitors (E.g., Ultra-ray 3000) Personal gas monitors (E.g., Drager 3000 / 5000) <p>AMOSC equipment</p> <ul style="list-style-type: none"> Geelong, Victoria: <ul style="list-style-type: none"> 6 x Gas Alert Monitors (Microclip) (gas detection) Fremantle, WA <ul style="list-style-type: none"> 2 x Gas Alert Monitors (Microclip) (gas detection) 2 x AreaRae (gas detection) 2 x UltraRae 3000 (personnel VOC monitors) Shell / Prelude – potential additional VOC and gas monitoring equipment – available under best endeavours agreement via INPEX/Shell MoU Additional passive VOC monitoring badges available through routine suppliers including Airmet (Victoria) and AE Solutions (WA). <p>PPE including coveralls, gloves, glasses, boots and barrier gels, to be provided to all personnel working on the response.</p>



Hazards	Risks	Prevention and mitigation considerations
		<p>Clean-up area provided for responders to decontaminate and remove soiled clothing. Ample quantity of clean PPE available.</p> <p>Respiratory protection should be assessed on an activity specific basis, and if required, used in conjunction with passive/active VOC and gas monitoring equipment.</p>
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	<p>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.</p> <p>Designated and separate, clean and contaminated work areas and movement routes in all work areas.</p>
Working over water	Drowning	<p>Mandatory use of lifejackets when working over water and independent sentry posted to monitor activity.</p> <p>“Man overboard” procedures clearly defined and included in personnel inductions and ongoing training.</p> <p>PTW from vessel master to be in place for personnel working over water.</p>
Dangerous marine fauna	Bites, stings and other injury from marine fauna	<p>No personnel are permitted in the water.</p> <p>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.</p> <p>Any personnel retrieving equipment or wildlife from the water will be alert to marine animals.</p>



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 Shell response must meet the Shell minimum aviation standards. Any personnel working from a helicopter over water must have a completed Tropical Basic Offshore Safety Induction and Emergency Training certificate or equivalent.
Excessive working hours	Fatigue	Personnel will work under the applicable working-hour limitations. As a minimum, the Shell fitness-for-work standard will be used as a template for all Shell 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 Shell 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.



Hazards	Risks	Prevention and mitigation considerations
Unexploded Ordnance (Cartier Island)	Vessel damage / fatality	<p>Cartier Island and the surrounding marine area within a 10 km radius was a gazetted Defence Practice Area up to 2011.</p> <p>Although the site is no longer an active weapons range there is a SUBSTANTIAL RISK that UXO remains in the area.</p> <p>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.</p> <p>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@awe.gov.au</p>



5 Oil spill forms register
Table 5-1: Oil Spill Response Forms

Appendix	Form type	Form title	Purpose	Reporting timeframe	Applicable to oil spills in				Document reference (document management system or URL)
					Darwin Harbour	NT	WA	Cwth Waters	
-		NT EPA Pollution Reporting Online Form	<p>Notify the following external parties of an oil spill in NT waters:</p> <p>Darwin Port for spills inside Darwin Port limits</p> <p>NT Department of Transport (NT DoT) – Marine Safety Branch for spills inside Territory waters (but outside Darwin Port limits)</p> <p>NT Environment Protection Authority (NT EPA) for spills inside Territory waters and/or Darwin Port limits</p> <p>(IMT Environment to complete).</p>	< 24hrs	✓	✓			https://ntepa.nt.gov.au/waste-pollution/hotline
-	Notify & Report	NT Incident update report (SITREP) – as per NT OSCP	<p>Notify the following external parties of an oil spill in NT waters:</p> <p>Darwin Port for spills inside Darwin Port limits</p> <p>NT Department of Transport (NT DoT) – Marine Safety Branch for spills inside Territory waters (but</p>	Daily, or as situation changes significantly	✓	✓			https://dipl.nt.gov.au/_data/assets/pdf_file/0006/165462/northern-territory-oil-spill-contingency-plan.pdf (The SITREP is available as NT OSCP Appendix D, Form No. REP 02)



Appendix	Form type	Form title	Purpose	Reporting timeframe	Applicable to oil spills in				Document reference (document management system or URL)
					Darwin Harbour	NT	WA	Cwlth Waters	
			<p>outside Darwin Port limits)</p> <p>NT Environment Protection Authority (NT EPA) for spills inside Territory waters and/or Darwin Port limits</p> <p>(NOTE: The NT SITREP is a modified version of AMSA's Marine Pollution Situation Report (SITREP) available at www.amsa.gov.au)</p>						
-		AMSA harmful substances report (POLREP)	<p>Facility OIM / Vessel master to report marine pollution incidents in Commonwealth waters to the Australia Maritime Safety Authority (AMSA (IMT Environment to obtain copy)</p>	< 2hrs			✓		https://www.amsa.gov.au/forms/harmful-substances-report-polrep-oil
-		<p>WA Department of Transport - POLREP</p> <p>WA Department of Transport - SITREP</p>	<p>Facility OIM / Vessel master to report marine pollution incidents, which may threaten WA waters / lands to WA Department of Transport (WA DoT). (IMT Environment to obtain copies of POLREP/SITREP).</p>	Immediately			✓		<p>https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-PollutionReport.pdf</p> <p>https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-SituationReport.pdf</p>



Appendix	Form type	Form title	Purpose	Reporting timeframe	Applicable to oil spills in					Document reference (document management system or URL)
					Darwin Harbour	NT	WA	Cwlth Waters		
-		WA Department of Environment Regulation (DER) - 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 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			✓			https://www.dmp.wa.gov.au/Documents/Safety/PGS_F_OffshoreOccurrenceReport.pdf
-		Report of a known or suspected contaminated site (Contaminated Sites Act 2003 (WA))	Report to WA DER of a contaminated site on land, shoreline or seabed within WA state waters (within 3 nm). (IMT Environment to complete).	< 21 days			✓			https://www.der.wa.gov.au/your-environment/contaminated-sites
-		NOPSEMA Report of an accident, dangerous occurrence or environmental	Report to NOPSEMA offshore incidents in accordance with BROPEP (only required for Level 2 or 3 spills).	< 3 days				✓		https://www.nopsema.gov.au/assets/Forms/N-03000-FM0831-Report-of-an-Accident-Dangerous-Occurrence-or-Environmental-Incident-Rev-8-Jan-2015-MS-Word-2010.docx



Appendix	Form type	Form title	Purpose	Reporting timeframe	Applicable to oil spills in				Document reference (document management system or URL)
					Darwin Harbour	NT	WA	Cwth Waters	
		incident (FM0831)	(IMT Leader to issue report) NOTE: NOPSEMA must be verbally notified within 2 hours after becoming aware of the Level 2/3 incident (or potential Level 2/3 incident).						
-	Situational Awareness	Oil Spill Observation and Visual Dispersant Guide for Aircraft and Vessels	Provide guidance to vessel and aircraft operators on oil spill observation, slick volume estimate, and dispersant application processes and reporting of oil spill observation and dispersant activities to the IMT. (Field personnel to prepare)	Ongoing during emergency	✓	✓	✓	✓	2014-01-mp-amsa22-identification-oil-on-water.pdf
D	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	✓	✓	✓	✓	IMT W Confidential Phone List



Appendix	Form type	Form title	Purpose	Reporting timeframe	Applicable to oil spills in				Document reference (document management system or URL)
					Darwin Harbour	NT	WA	Cwlth Waters	
E		OSRL notification and mobilisation	To notify and mobilise Oil Spill Response Limited of an incident that may requires support under the terms of the Agreement (IMT Leader to request)	> Level 2 incident	✓	✓	✓	✓	 <p>Emergency Contacts For 24 hr Support</p> <p>Notify immediately in the event of a spill to water from maritime transportation operations or a spill from an Asset that could result in a Tier 3 response:</p> <p>Outside the Americas + 44 - 207 - 934 - 7777 + 44 - 207 - 043 - 1997</p> <p>Within the Americas + 1 - 713 - 241 - 2532</p> <p>(*) The Americas are North America, Central America, the Caribbean and South America</p>
	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	✓	https://www.environment.gov.au/system/files/pages/88de03b0-1a95-427b-9e24-0306b89eeaa2/files/species-application-form.pdf
	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 spill moved into WA Waters	As required, in consultation with WA DoT incident controller.			✓		Appendix 1 of the WA DoT Marine Oil Pollution: Response and Consultation Arrangements Rev5 https://www.transport.wa.gov.au/mediaFiles/marine/MAC_P_Westplan_MOP_OffshorePetroleumIndGuidance.pdf



Appendix	Form type	Form title	Purpose	Reporting timeframe	Applicable to oil spills in				Document reference (document management system or URL)
					Darwin Harbour	NT	WA	Cwlth Waters	
-		IMT Functions and Lead IMT Designations (cross jurisdictional arrangements)	For use by IMT-Leader, and WA DoT IMT-Leader, to define each IMT 'lead' roles, when spill moved into WA Waters and a cross jurisdictional spill response is underway.	As required, in consultation with WA DoT incident controller.			✓		Appendix 2 of the WA DoT Marine Oil Pollution: Response and Consultation Arrangements Rev5 https://www.transport.wa.gov.au/mediaFiles/marine/MAC_P_Westplan_MOP_OffshorePetroleumIndGuidance.pdf



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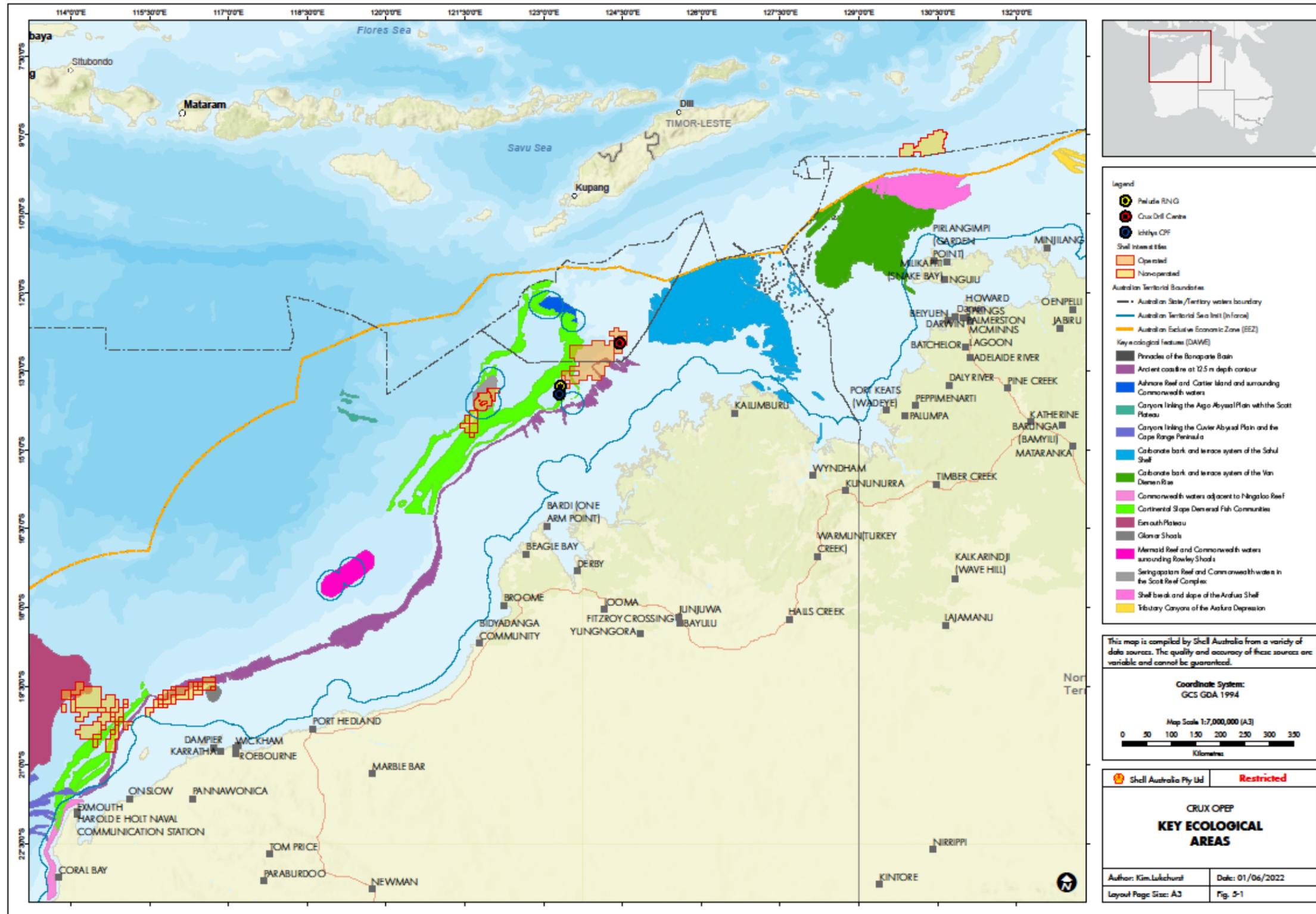


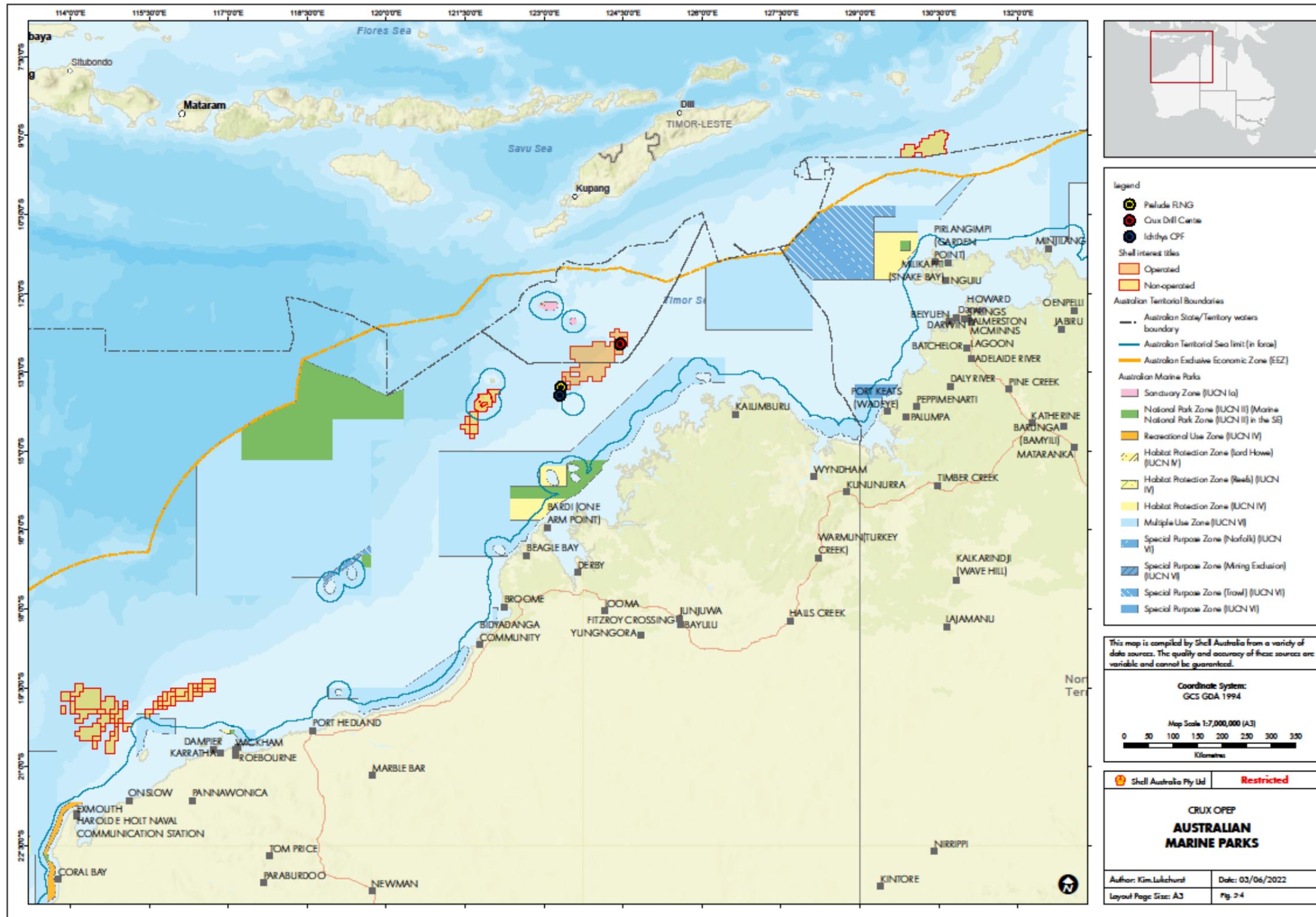
APPENDIX A: ENVIRONMENTAL VALUES AND SENSITIVITIES MAPS

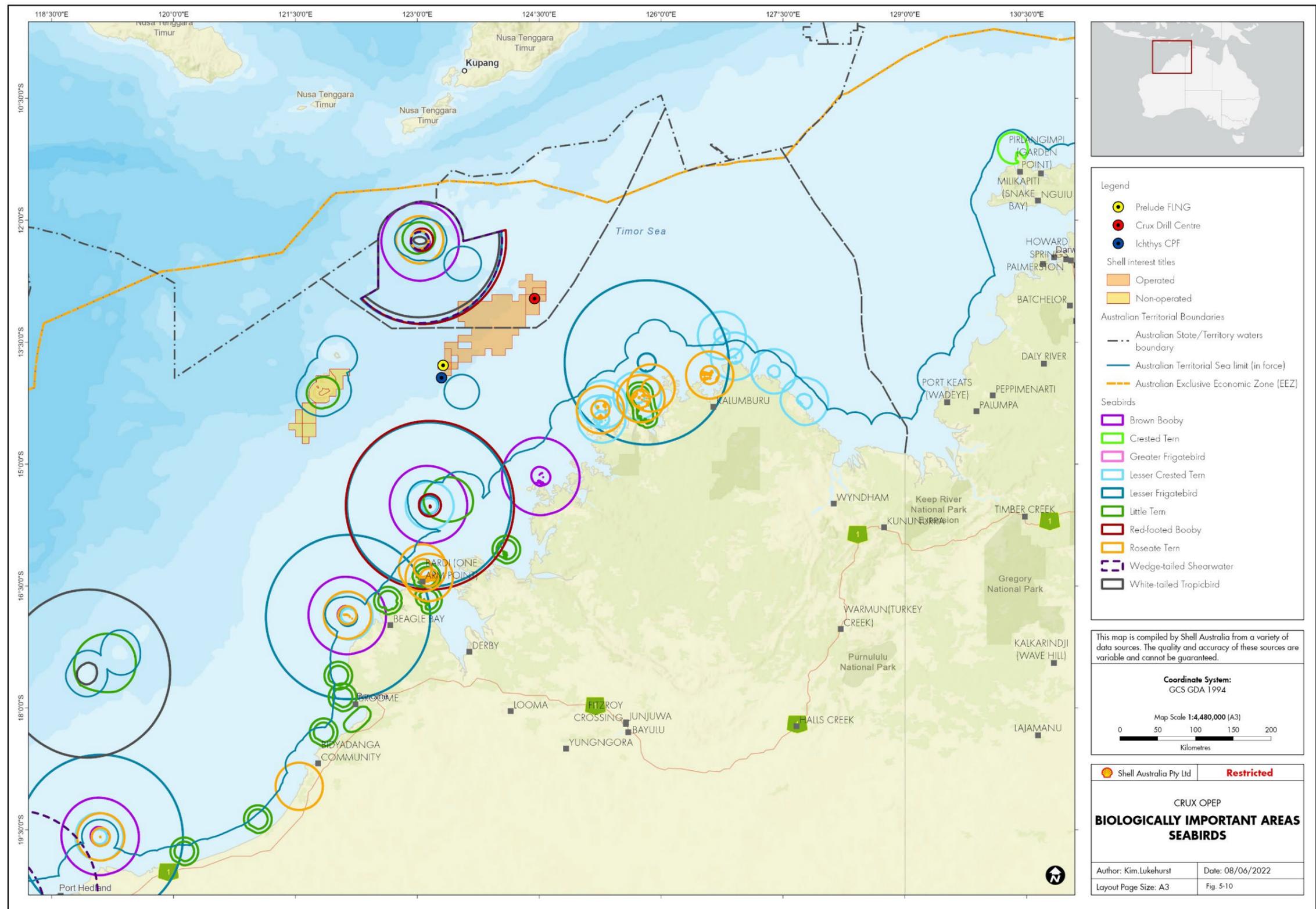
Particular values and sensitivities with the potential to be exposed/impacted by activity oil spill events are provided within Section 7 of each activity specific EP.

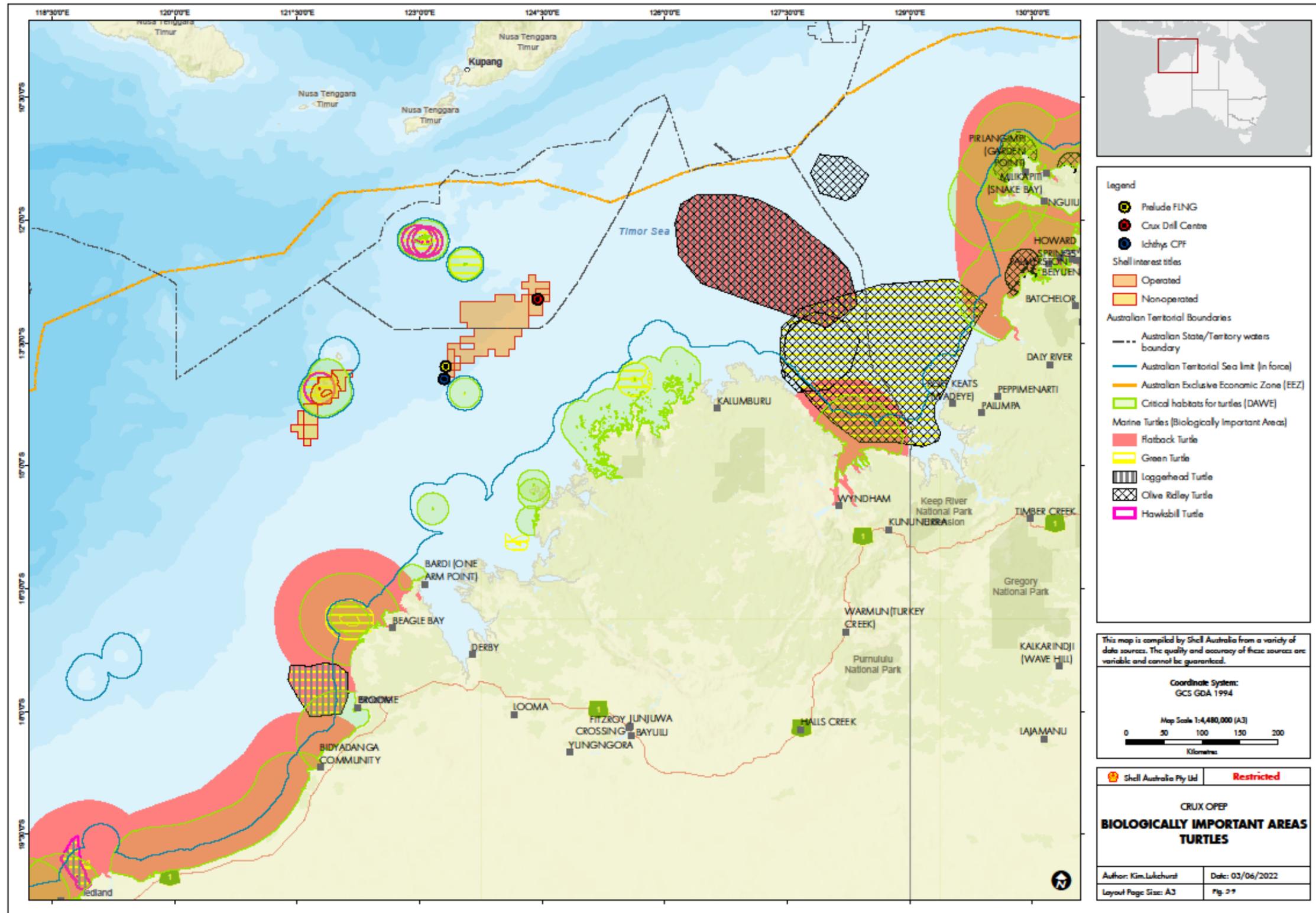
The figures below present the environmental values and sensitivities of the BROPEP region based on the WCSSs presented in the BROPEP Basis of Design and Field Capability Assessment Report (HSE_GEN_016764)

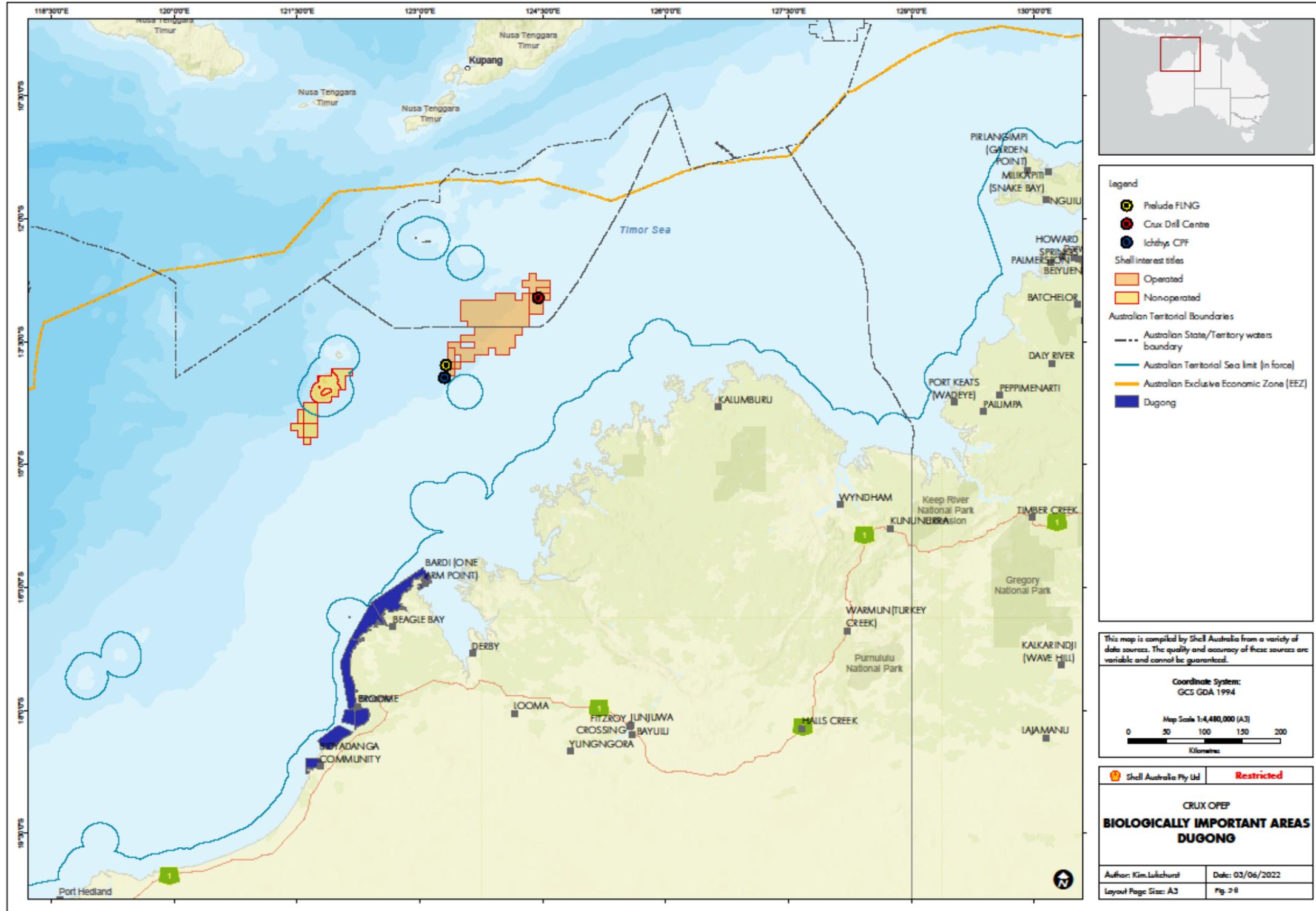
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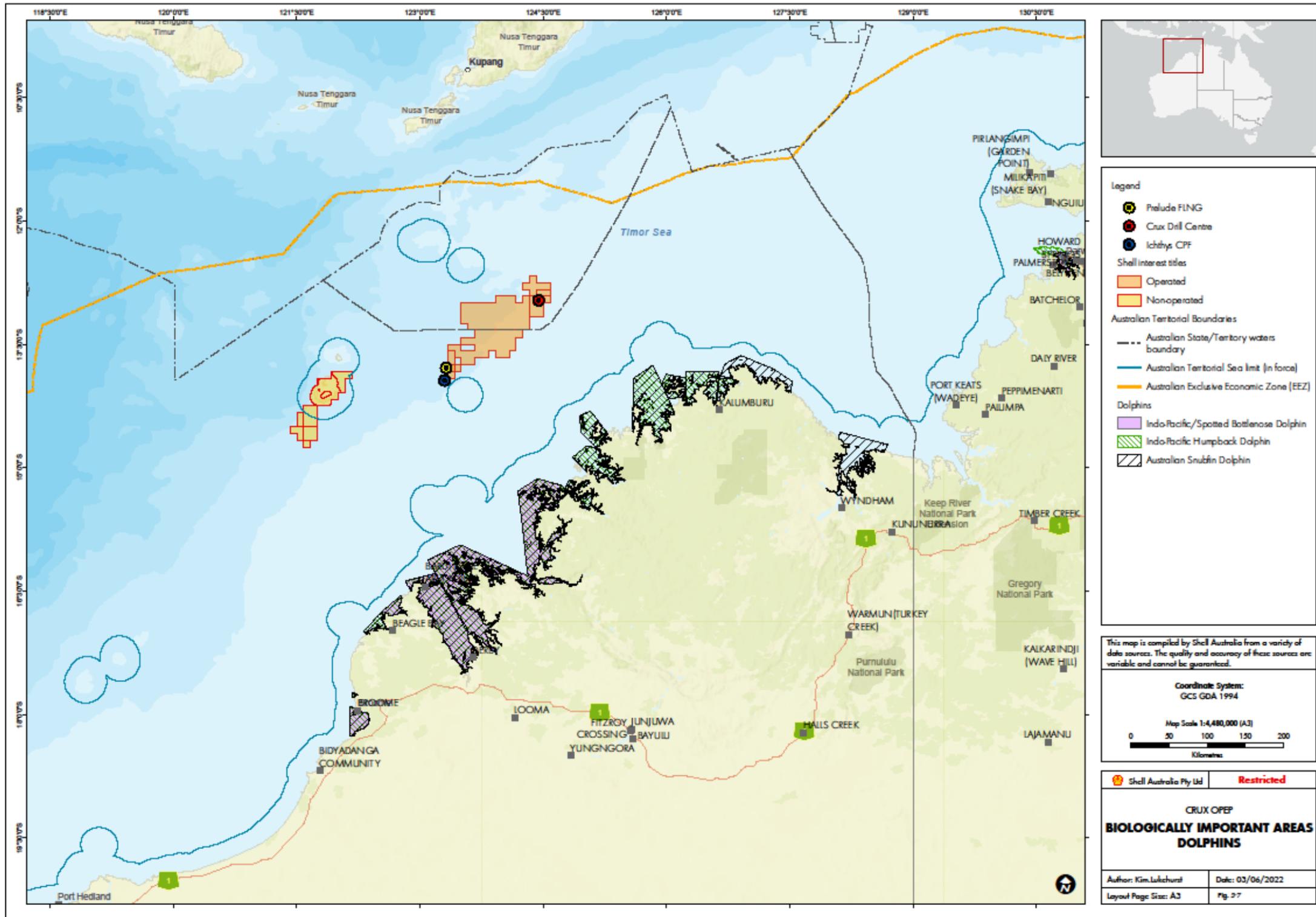


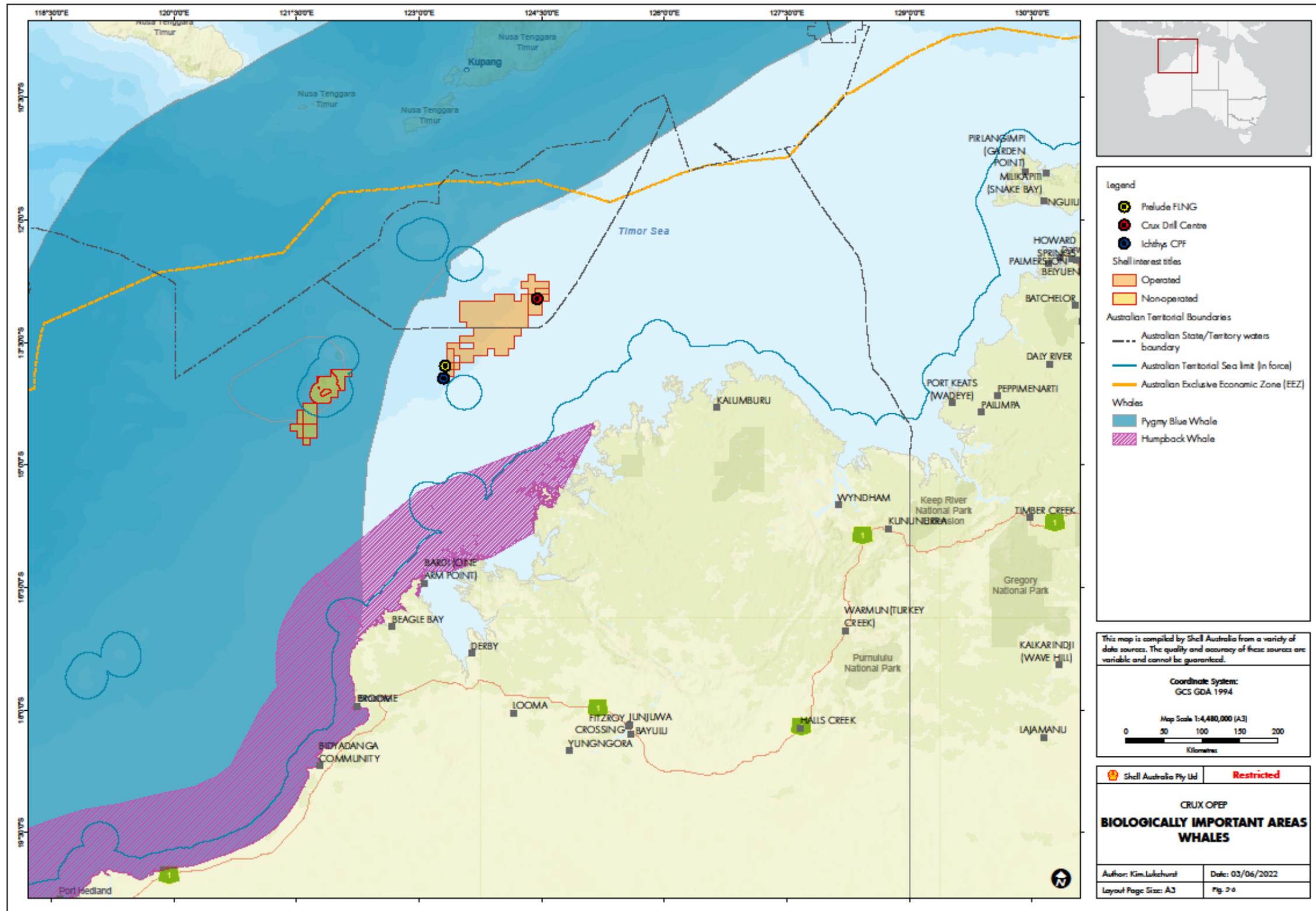


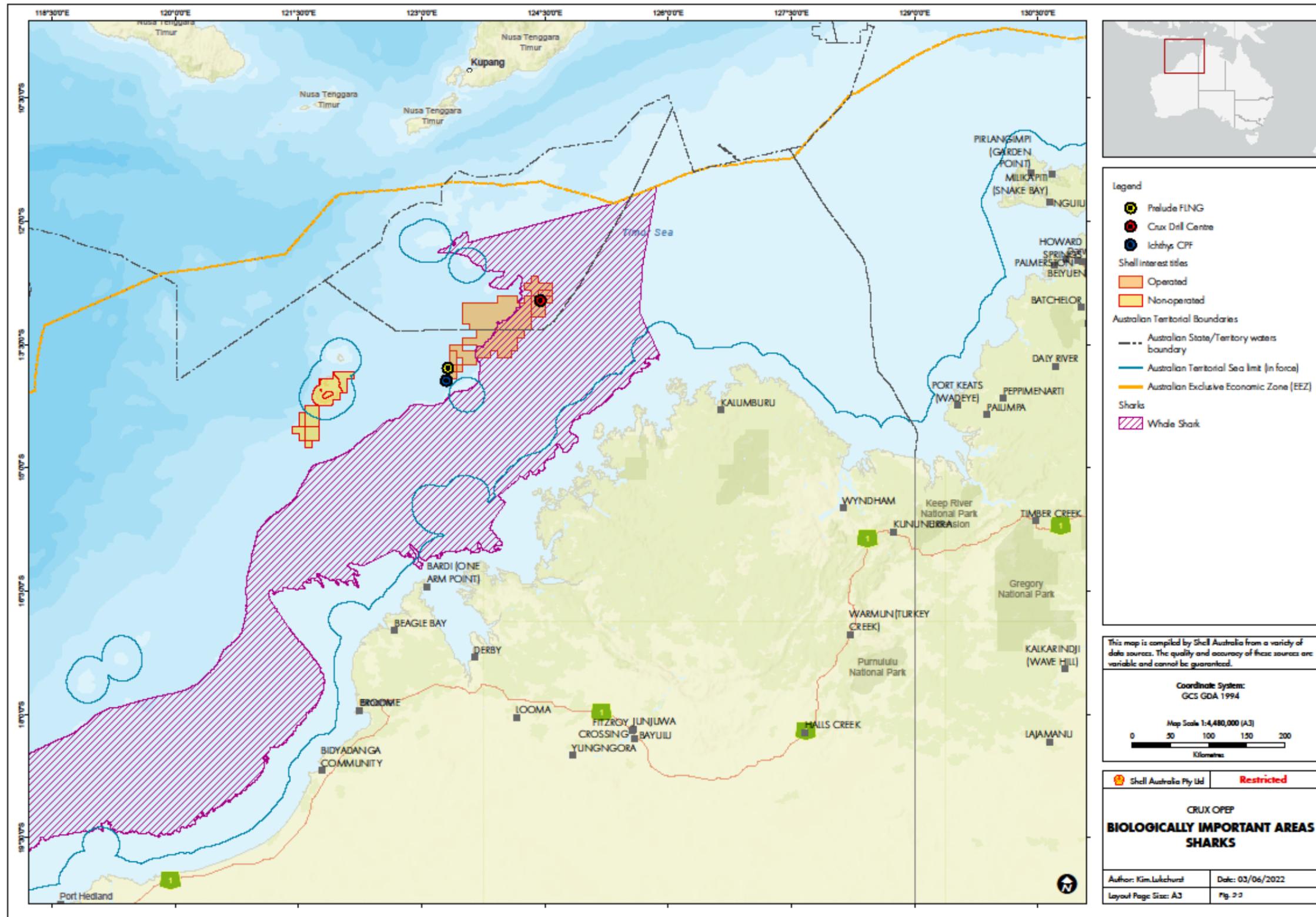














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Attachment 1

- 1 Browse Region Oil Pollution Emergency Plan - Basis of Design and Field Capability Assessment (HSE_GEN_016764)**



Shell Australia

Browse Regional Oil Pollution Emergency Plan – Basis of Design and Field Capability Assessment Report

Document Number	HSE_GEN_016764
PML (SAP) Number	
Revision Number	01
Document Status	Approved for Use
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Cyclical Review Cycle	5 Years (Procedures)
Safety Critical Content	[Not Safety Critical]
Technical Reviewer (TA2 or SME)	n/a
Process Area	HSSE

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Rev	Revision Description	Update	Date Changed	BCD Development Roles Authors, Reviewers, Approvers	
01	Approved for Use		29-Jul-22	Environment Approvals Advisor Crux Environment Lead Environment Manager West Senior Wells Engineer Emergency and Spill Response Advisor Senior Well Engineer Lead HSE Advisor Lead Wells Engineer Environment Advisor Security and ER Advisor Prelude Senior Operations Surveyor Prelude Engineering Manager Crux Project Manager	Author Author Reviewer (IP) Reviewer (IP) Approver (Delegate) Approver (PO)
0.1	Issued for Approval		22-Jul-22	Environment Approvals Advisor Crux Environment Lead Environment Manager West Senior Wells Engineer Emergency and Spill Response Advisor Senior Well Engineer Lead HSE Advisor Lead Wells Engineer Environment Advisor Security and ER Advisor Prelude Senior Operations Surveyor Prelude Engineering Manager Crux Project Manager	Author Author Reviewer (IP) Reviewer (IP) Reviewer (IP) Reviewer (IP) Reviewer (IP) Reviewer (IP) Reviewer (IP) Reviewer (IP) Reviewer (IP) Reviewer (IP) Approver (Delegate) Approver (PO)



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1 Introduction

1.1 Purpose

The purpose of this document is to:

1. Present a summary of titleholder's exploration and production (E&P) activities in Australian Commonwealth waters, between waters offshore (west) of Broome/Dampier Peninsula (Western Australia (WA)) and waters offshore (north and west) of Darwin (Northern Territory (NT)) and out to the boundary of the Australian Exclusive Economic Zone (EEZ) / international maritime boundaries. This includes the Canning, Browse and Bonaparte petroleum basins, hereafter referred to as the Browse Regional Oil Pollution Emergency Plan (BROPEP) region.
2. Present a summary of the worst credible spill scenarios (WCSS) which could occur from the E&P activities and associated spill sources.
3. Provide stochastic modelling outputs for each of the WCSS. This forms the Basis of Design (BOD) to inform the field capability assessment.
4. Provide a summary of the Strategic Spill Impact Mitigation Assessment (SIMA) outcomes for response strategies considered for each of the WCSSs.
5. Assess which WCSSs are appropriate for detailed field response planning and provide the detailed oil spill response field capability analysis, for the selected WCSSs.
6. Define environmental performance outcomes (EPO) and environmental performance standards (EPS) for the oil spill response field capabilities and arrangements (preparedness), and the risk assessment of the implementation of the response strategies.
7. Provide an implementation strategy for this BROPEP BOD and Field Capability Assessment Report (BROPEP BOD/FCA), including management of change processes and compliance reporting requirements. Note, this implementation strategy section is applicable to all other BROPEP documents.

This process is aligned with the oil spill response planning processes defined in IPIECA-IOGP (2013) Oil spill risk assessment and response planning for offshore installations). Specifically, IPIECA-IOGP (2013) requires:

- Oil Spill Risk Assessment context – addressed in Section 2 of this document
- Hazard and consequence identification – addressed in Sections 3 and 5 of this document (as well as activity specific Environment Plans (EPs))
- Identify and describe release scenarios, including release rates/volumes, durations, modelling fate/trajectory, consequences/risk – addressed in Section 4 of this document
- Define release scenarios chosen for response planning – addressed in Section 6 of this document
- Assess response strategies/NEBA/SIMA – addressed in Section 5 of this document
- Define tactics (equipment, personnel, deployment, limitations etc) – addressed in Section 6 of this document
- Define response tiers, response resources, mobilisation/deployment times etc. – addressed in Sections 6, 7 and 8 of this document.

The definition of titleholder within this document refers to Shell Australia and other titleholders within the Browse Basin region.



1.2 Limitations / Out of Scope

This document does not include planning and response capability/arrangements associated with the following:

- Environmental risk assessment and spill prevention/control
 - The following elements are contained within each activity specific EP:
 - detailed activity description
 - activity specific oil spill hazard identification, including potential release rates, volumes, locations, hydrocarbon types etc.
 - activity specific oil spill modelling, used to inform environmental risk assessment
 - description and risk assessment of oil spills on environmental values and sensitivities
 - evaluation of controls to prevent oil pollution from the described activity.
- Operational and scientific monitoring programs (OSMP)
 - The full OSMP capability and arrangements are addressed within the Browse Regional OSMP Bridging Implementation Plan (HSE_PRE_016370), and, because this document forms part of the OSM contract it is based on a Shell WCSS. However, this document does address water quality monitoring, as related to supporting/informing at sea response strategies.
- Evaluation of controls to stop the flow of oil from a spill. For example;
 - Emergency shut-down systems, leak detection systems from production assets, pipelines etc are described in relevant production/operations EPs.
 - Shipboard Oil Pollution Emergency Plans are described/evaluated in all EPs which include vessel activities.
 - Well blowout source control activities, including Incident Management Team (IMT) and field capabilities and arrangements are described/evaluated within the Browse Regional OPEP and East Browse Source Control Emergency Response Plan (SCERP) [TEC_GEN_017694]. The technical availability of the various source control response options are detailed in activity specific EPs (i.e. the Prelude FLNG Operations Environment Plan and the Crux Development Drilling Environment Plan, which can include:
 - site survey
 - debris clearance
 - blow out preventer manual/remote intervention
 - capping stack deployment (including OIE where applicable)
 - relief well drilling.

Note, sub-sea dispersant injection, which can be utilised as both an environmental and safety control is within the scope of this document.

The inter-relationship of this document to other BROPEP documentation is presented in Table 1-1 and displayed in Figure 1-1.

HSE_GEN_016764	Restricted	<i>All printed are to be considered uncontrolled.</i>	Approved	7 of 247
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Table 1-1: BROPEP documentation overview

Document Title	Reference Location	Document Purpose
Titleholder Environment Plans	NOPSEMA Website	<p>All Titleholder EPs contain a detailed activity description, activity specific oil spill hazard identification, including potential release rates, volumes, locations, hydrocarbon types etc, activity specific oil spill modelling, used to inform environmental risk assessments, risk assessment of oil spills on environmental values and sensitivities and evaluations of controls to prevent oil pollution from the described activity.</p> <p>The Worst Credible Spill Scenario (WCSS) from all Titleholder EPs are included in the BROPEP Basis of Design and Field Capability Assessment (HSE_GEN_016764).</p>
Browse Region - Oil Pollution Emergency Plan (HSE_GEN_016765)	N/A	<p>This document is the tool which will be utilised by the Incident Management Team (IMT) during any impending/actual oil spill event. This document assists/guides the IMT through the process of notifications, gaining/maintaining situational awareness, response strategy evaluation and incident action plan (IAP) development, and mobilisation of field response capabilities.</p> <p>The document provides Environmental Performance Objectives (EPOs) and Environmental Performance Standard (EPSs) related to the implementation of response strategies.</p>
Browse Region Oil Pollution Emergency Plan - Basis of Design and Field Capability Assessment (HSE_GEN_016764) – This document	Attachment 1	<p>This document presents an overview of all Titleholder’s offshore (Browse/Bonaparte basin) petroleum activities and associated oil spill risks. This document evaluates modelling outcomes from a series of selected WCSSs and presents an oil spill response field capability analysis. This document also presents</p>



Document Title	Reference Location	Document Purpose
		the EPOs and EPSs associated with the preparedness and environmental risk assessment of field response capability and arrangements.
BROPEP – Incident Management Team Capability Assessment Report	Attachment 2	The document utilises the field capability assessments as inputs to evaluate the size and structure of the IMT necessary to mobilise and maintain the field capability. The document also presents the EPOs and EPSs associated with the IMT capability and arrangements.
Strategic Spill Impact Mitigation Assessment (SIMA)s. Condensate spill – instantaneous surface release MGO/diesel spill – instantaneous surface release Intermediate/heavy fuel oil spill – instantaneous surface release Condensate/gas well or pipeline blowout – long duration subsea release	Attachment 3	The four Titleholder Strategic SIMA documents are pre-spill planning tools used to facilitate response option selection by identifying and comparing the potential effectiveness and impacts of the various oil spill response strategies on a range of environmental values and sensitivities. The Strategic SIMAs utilise a semi-quantitative process to evaluate the impact mitigation potential of each response strategy. This method provides a transparent decision-making process for determining which response strategies are most likely to be effective at minimising oil spill impacts. The SIMA process includes environmental considerations as well as a range of shared values such as ecological, socio-economic and cultural aspects.
Joint Industry Operational and Scientific Monitoring (OSM) Framework (APPEA, 2021)	APPEA Environment Publications Webpage	Operational and Scientific Monitoring (OSM) is a key component of the environmental management document framework for offshore petroleum activities, which also include an Environment Plan (EP) and Oil Pollution Emergency Plan (OPEP). OSM and its supporting documents are instrumental in providing situational awareness of a hydrocarbon spill, enabling Incident Management Teams/Emergency Management Teams (IMT/EMTs) to mount a



Document Title	Reference Location	Document Purpose
		timely and effective spill response and continually monitor the effectiveness of the response. OSM is also the principle tool for determining the extent, severity and persistence of environmental impacts from a hydrocarbon spill and resultant remediation activities.
Browse Regional Operational and Scientific Monitoring Bridging Implementation Plan (HSE_PRE_016370)	NOPSEMA Website	This Plan is presented in two parts. Part A outlines the relationship between the Shell Australia Pty Ltd.'s (Shell) environmental management document framework and the Joint Industry Operational and Scientific Monitoring (OSM) Framework (APPEA, 2021). Part B provides operationally focussed guidance for Titleholder personnel and OSM Service Providers to coordinate the implementation of monitoring plans.

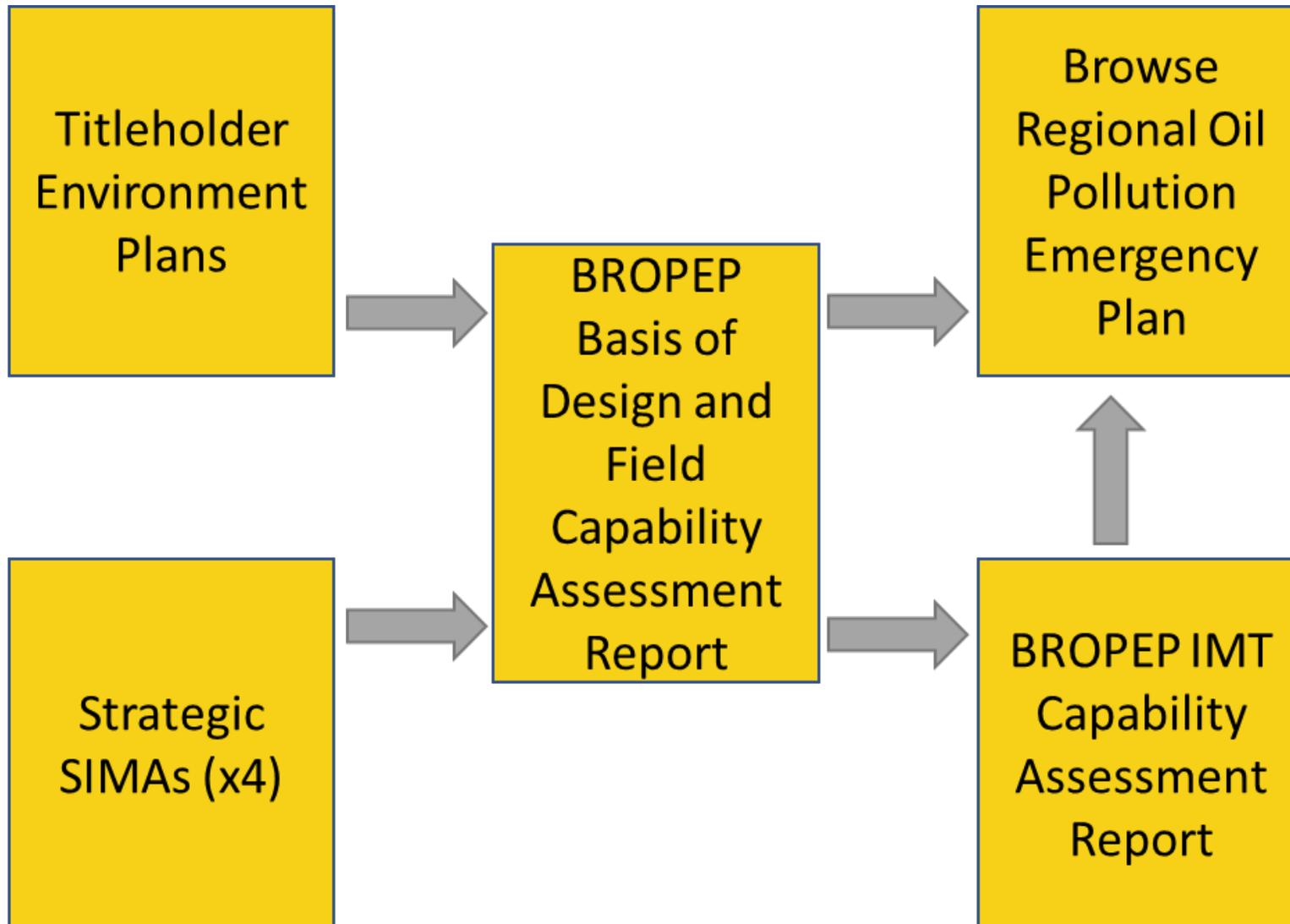


Figure 1-1: BROPEP document structure



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2 Exploration and Production Activities Overview - BROPEP Region

The Browse region has various exploration and production activities from various titleholders, including Shell Australia and INPEX. Shell Australia Pty Ltd (Shell Australia), on behalf of the Joint Venture Participants, is producing and developing the Prelude and Crux gas fields in the Browse Basin off the north west coast of Western Australia to produce condensate offshore.

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 to produce condensate offshore for export to markets in Japan and elsewhere, and export gas for further processing at the Ichthys liquefied natural gas (LNG) plant in Darwin.

Shell Australia and INPEX's offshore exploration activities (seismic and drilling) are focused on identification of additional petroleum reserves to tie-back into the Prelude and Ichthys Project. Therefore, exploration activities are generally located within the same geographic area as the Prelude/Crux/Ichthys Project in Commonwealth waters between Broome and Darwin.

Typical petroleum activities undertaken by titleholders in the Commonwealth waters offshore of northern WA and the NT may include:

- 2D / 3D seismic exploration surveys
- exploration, appraisal and production drilling, including completions and plug and abandonment of wells
- geophysical and geotechnical surveys
- subsea/topside infrastructure installation, commissioning, maintenance and repair
- operation and maintenance of topside/floating production facilities including condensate offtakes to tankers in the Prelude Field
- operation of subsea production systems and pipelines

A map of Shell Australia's operated and non-operated petroleum permits/licence areas and petroleum activities (current at the time of preparation of this document, Rev0, July 2022) are displayed in Figure 2-1.



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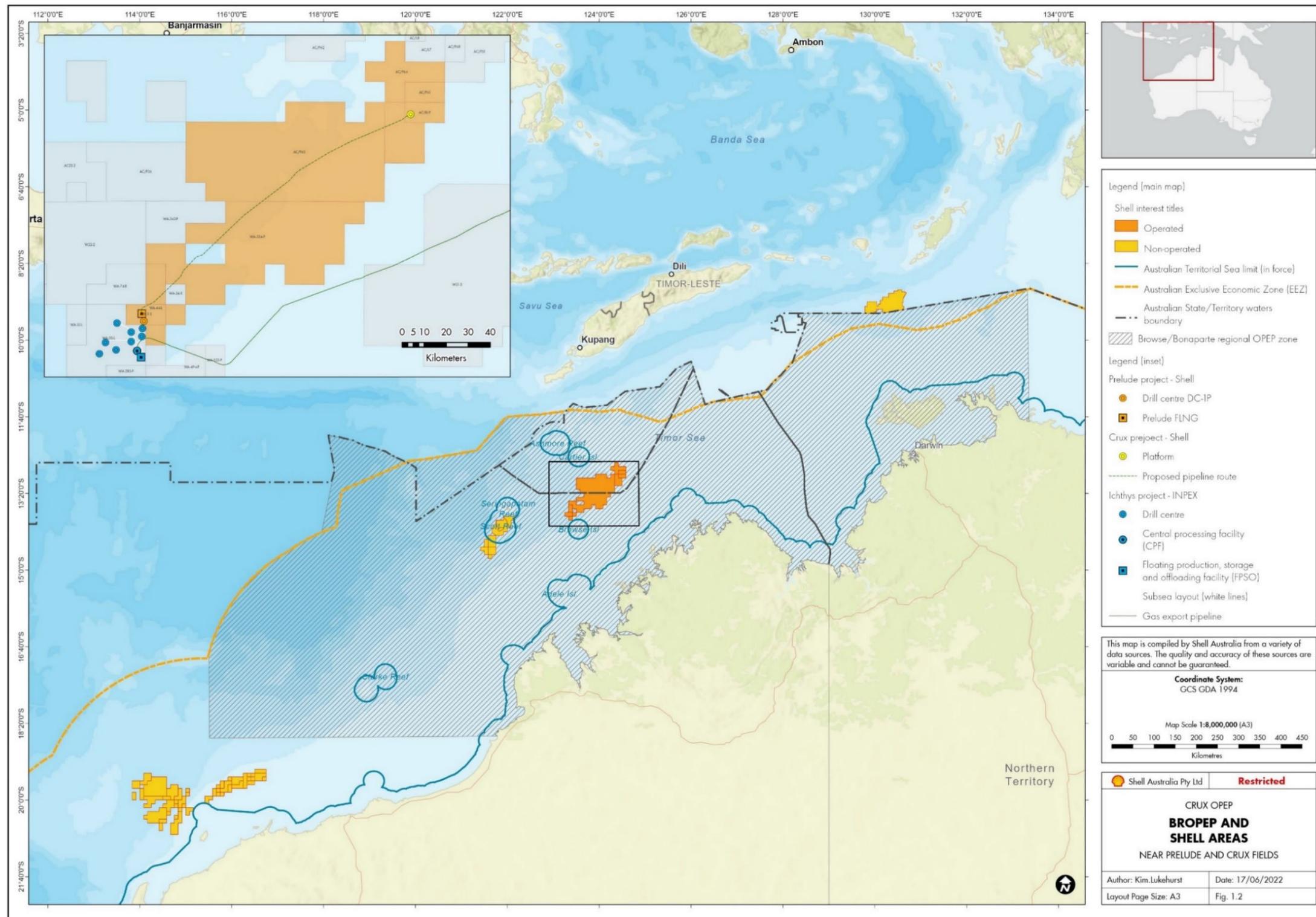


Figure 2-1: Geographical coverage of this BROPEP and Shell Australia's operated and non-operated offshore petroleum activities



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3 Worst Credible Spill Scenarios (WCSS)

To facilitate regional response planning, an evaluation of Shell Australia and INPEX's petroleum activities were undertaken in the Browse region, and the associated potential Level 2/3 spill sources were identified for comparison (refer to Section 6.5 for definitions of 'tiers/levels').

Once all potential Level 2/3 spill sources were identified, a process was undertaken to evaluate and determine the WCSS for each Level 2/3 spill source.

For each WCSS, parameters were defined include:

- spill source (facility/vessel)
- oil/hydrocarbon type
- release volume
- release rate & duration
- spill location(s)

The parameters are then used as inputs to spill modelling for the WCSSs. The spill modelling outputs are presented and evaluated in Section 4, to inform regional response planning.

Justifications have been provided to demonstrate why the WCSSs parameters are representative of the WCSS for the spill sources/activities in the region. For example, simple metrics include the most persistent oil type, largest release volume or fastest release rate etc.

Where a spill source may be mobile (e.g. seismic survey or pipeline inspection vessels), modelling of multiple vessel spill scenarios at a variety of locations close to sensitive receptors may be warranted. This allows a titleholder, to acquire sufficient data to characterise worst credible oil spill outcomes across the range of values and sensitivities of the region.

Where activities such as exploration/production and drilling are focused on a specific reservoir, modelling of a well blowout at a location within the reservoir closest to sensitive receptors will likely provide the worst-case spill outcome. However, comparison with other well blowout data from other titleholders in the region to verify the worst-case impact prediction may also be appropriate.

Table 3-1 presents a matrix of titleholder's petroleum activities in Commonwealth waters/Browse region, and the associated potential sources of Level 2/3 spill scenarios for each petroleum activity type.

Table 3-2 presents the WCSSs parameters and justifications.

Note, smaller spills, such as loss of day-tanks on topside infrastructure, hydraulic line releases or bunkering spills are not considered Level 2/3 spills. These spills are all smaller in volume than the selected WCSS's and therefore are not described within Table 3-1. Risk assessments and associated controls for these types of smaller spills are described within relevant activity specific EPs.



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Table 3-1: Titleholder’s Petroleum Activities within Commonwealth Waters– Potential Level 2/3 spill sources

Activity Type	Potential Level 2/3 Spill Sources				
	Well blowout	Vessel collision (MDO)	Vessel collision (IFO/HFO)	Topside facility (FLNG/CPF/FPSO etc) loss of containment (condensate)	Pipeline / flowline rupture (condensate)
2D / 3D seismic exploration surveys		X			
Exploration/appraisal/production drilling, including well workovers, plug and abandonment.	X	X			
Geophysical/geotechnical survey		X			
Subsea/topside infrastructure installation & commissioning		X	X		
Operation of production facility including production wells	X	X	X	X	
Operation of subsea production systems & pipelines		X	X		X
Decommissioning of Pipelines, subsea infrastructure or production facilities.	X	X	X	X	X



Table 3-2: BROPEP WCSS Details and Justifications

WCSS	Release parameters	Justification
Well blowout	<p>Oil Type Group I - Brewster reservoir condensate</p> <p>Release rate and volume 3193 m³/day over 80 days. Total release volume of 255,475 m³</p> <p>Release location Location 38 km west-north-west of Browse Island, Figure 4-1.</p>	<p>For a WCSS well-blowout, Brewster and Plover condensates are similar in composition. However, Brewster reservoir has approximately twice the condensate flowrate compared to the Plover reservoir. Therefore, Brewster scenarios are considered to represent the WCSS.</p> <p>A location on the south-east corner of the Brewster reservoir, known as the Holonema-B location, was selected as this is the closest location of that reservoir to the nearest shoreline receptor (Browse Island). The selection of this location should result in the fastest time to shoreline contact and greatest volume of oil ashore, during the wet season, which is dominated by westerly wind-flow.</p> <p>The Holonema-B location is therefore considered to be the WCSS for any exploration/production drilling activities of the Brewster and Plover reservoirs within the Ichthys Field and other Permit Areas with Brewster/Plover reservoir in the Browse Basin.</p> <p>For comparative/regional planning purposes, a comparison of other Brewster and Plover well-blowout data modelling in the region has also been conducted. The location of all well blowout modelling data and well blowout modelling inputs parameters is presented in Figure 4-1. The well blowout spill model output data is presented in Table 4-4.</p>



	<p>Oil Type Group I - Prelude condensate</p> <p>Release rate and volume 3,180 m³/day over 80 days. Total release volume of 254,400 m³</p> <p>Release location Location 40 km north-west of Browse Island, Figure 4-3.</p>	<p>Shell Australia’s exploration and production drilling activities are centred within the Browse Basin. Exploration drilling’s focus is to identify additional reserves to tie-into the existing production infrastructure are ongoing.</p> <p>The modelled well fluids flow rate is considered to be highly conservative because it is based on using the flow rates from the Upper Limit rather than the Base Case or High Case for a blowout through 9 5/8" casing and does not allow for the additional frictional pressure drop from having a completion in the well.</p> <p>The actual worst credible discharge during operations (blowout through the 7" production tubing) is predicted to be 10,138 bbl (~1,611 m³) per day, yielding a total release volume of 811,040 bbl (128,944 m³) over 80 days.</p>
	<p>Oil Type Group I - Crux condensate</p> <p>Release rate and volume 2,578 m³/day over 80 days. Total release volume of 206,225 m³</p> <p>Release location Location 105 km north-west of Cartier Island, Figure 4-3.</p>	<p>Shell has developed a detailed understanding of the Crux field through historical seismic surveys and drilling. This scenario is a complete well blowout of a Crux production well during development drilling. This scenario consists of an 80-day uncontrolled release of 206,225 m³ of condensate (2,578 m³ per day). The duration is based on the credible worst-case time required to control the well (either by capping or drilling of a relief well) and the volume is based on the maximum credible rate of release derived from the proposed well design and reservoir characteristics. The release location is at the seabed at the Crux platform.</p>
<p>Loss of containment during product offloading (collision)</p>	<p>Oil Type Group I - Prelude condensate</p> <p>Release rate and volume</p>	<p>There are six pressure storage tanks on Prelude with each tank having a capacity of 21,054 m³ at 95% full and is supplied with two offloading pumps. During offloading mode all twelve offloading pumps are expected to be in operation, delivering condensate at a rate of 5,000m³/hr to the condensate tanker. This allows offloading of up to 120,000 m³ of</p>



	<p>2-hour release of 42,000m³ at surface</p> <p>Release location</p> <p>Location 40 km north-west of Browse Island, Figure 4-3.</p>	<p>condensate (net total pumpable condensate tanks storage capacity) in 24 hours.</p> <p>Condensate containment losses from FLNG operations have been estimated as follows:</p> <ul style="list-style-type: none"> • Up to 10 m³ from inadvertent disconnection of a coupling or flange at the topsides process modules and failure to contain by spill trays and the drain system; • Up to 1000 m³ for condensate offloading operation by floating hose. At a loading rate of 5,000 m³ per hour, these quantities reflect a major loss of containment from rupture of loading hose and failure to respond within 15 minutes; or • Release of cargo due to a high impact vessel collision and breach of hull and storage tank containment. A 42,000 m³ release of condensate released over a period of 2 hours has been considered. <p>The last scenario is considered the prelude worst-case credible scenario and has been modelled as the worst credible spill scenario for loss of containment during product offloading.</p>
	<p>Oil Type</p> <p>Group I - Brewster condensate processed on FPSO</p> <p>Release rate and volume</p> <p>2-hour release of 5,700 m³ at surface</p> <p>Release location</p>	<p>With respect to the Ichthys Venturer FPSO condensate tank spill volume, the AMSA (2015) guidance recommends for an ‘oil tanker non-major collision’ that either 100% of largest wing tank or 50% if protected by double hull is an appropriate spill volume.</p> <p>All FPSO cargo tanks are arranged inboard of ballast tanks.</p> <p>The largest condensate cargo tank immediately inboard of a ballast tank is 11,353 m³; 50% of this volume is 5,677 m³. This volume was rounded up to 5,700 m³ for the WCSS modelling purposes.</p>



	<p>Location 35 km west of Browse Island, Figure 4-2.</p>	
<p>Vessel collision Loss of containment of heavy fuel oil</p>	<p>Oil Type Group IV - Heavy fuel oil (HFO), Intermediate Fuel Oil (IFO)</p> <p>Release rate and volume 1-hour release of 1,000m³ at surface</p> <p>Release location Prelude is located 40 km north-west of Browse Island Crux is located 105 km north-west of Cartier Island Figure 4-3</p>	<p>The product offtake tankers could potentially carry heavy fuel oil (HFO)/ Intermediate Fuel Oil (IFO) as fuel.</p> <p>Given the average volume of HFO/IFO stored in LNG carriers (up to 5,000 m³) and the low energy collision credible during berthing/unberthing, a 1,000 m³ HFO spill was modelled. This is considered highly conservative given impact energy is highly unlikely to result in a HFO/ IFO tank breach.</p>
	<p>Oil Type Group IV - Heavy fuel oil (HFO), Intermediate Fuel Oil (IFO), or Low Sulphur Heavy Fuel Oil (LSHFO)</p> <p>Release rate and volume 2-hour release of 776 m³ at surface</p> <p>Release location Location - Ichthys Field near CPF/FPSO. Refer to Figure 4-2</p>	<p>There are only two vessel-based activities where Group IV oils may be utilised. There are:</p> <ul style="list-style-type: none"> condensate offtake tankers, which potentially have Group IV oils as bunker fuel onboard medium/heavy lift vessels, used to install a Pig-Launcher-Receiver (PLR) at the GERB, (adjacent to the CPF). <p>As traditional HFO is considered the most persistent oil, this oil has been selected for the scenario.</p> <p>The WCSS is based on the general arrangements of an Aframax tanker (100% of largest wing tank) and acknowledged the distance between the Ichthys Field and the nearest bunkering port in Singapore as well as the</p>



		<p>ability for fuel to be transferred from a damaged wing tank in the event of a breach. Due to the uncertainty and variability in tanker specifications potentially arriving, the spill volume modelled (776 m³) is considered to adequately provide an indication of a WCSS from a collision involving an offtake tanker.</p> <p>Large installation vessels may operate near the CPF/FPSO in the Ichthys Field, e.g., installing additional modules on the CPF/FPSO, or installing a PLR on the GERB. DNV (2015) – Clean Design requirements for double-hull / fully protected internal tanks, allow for a maximum tank size of 1500 m³. Combined with AMSA (2015) vessel collision guidance of 50% loss of tank protected by double hull, this defines a WCSS from an installation vessel which is compliant with DNV (2015) as 750 m³. Therefore, the 776 m³ HFO spill volume is considered appropriate.</p>
Vessel collision Loss of containment of marine diesel	<p>Oil Type Group II - marine gas oil (MGO) or marine diesel oil (MDO)</p> <p>Release rate and volume Instantaneous release at surface 284 m³ total release volume</p> <p>Release location Various locations, refer to Refer to Figure 4-3.</p>	<p>There may be other construction/installation vessel which could conduct activities in the Ichthys Field which have larger tanks and use Group II oils. These large construction/installation vessels may be DNV 2015 compliant and have up to 1500 m³ of Group II oil/fuel in double wall tanks. These scenarios are addressed by the 776m³ HFO WCSS, presented above.</p> <p>All other planned/foreseeable vessel activities outside the Ichthys Field are anticipated to use Group II fuels, with smaller vessels, which generally have unprotected wing tanks.</p> <p>A review of the expected tank sizes associated with seismic surveys, support vessel activities, geophysical/geotechnical activities and inspection, maintenance and repair (IMR) vessels indicated the largest tank size to be approximately 284 m³ (from a 2D seismic survey vessel). 250 m³ spill scenarios have also been modelled, as typical largest individual wing tank size for most other typical offshore support, survey or IMR vessels.</p>



		<p>AMSA guidance (AMSA 2015) recommends that the maximum credible volume spill for a vessel collision scenario be based on the volume of the largest single fuel tank - if not protected by a double hull.</p> <p>Therefore, 284 m³ is considered the WCSS for vessels using Group II fuels operating outside of the Ichthys Field.</p>
	<p>Oil Type Group II - marine gas oil (MGO) or marine diesel oil (MDO)</p> <p>Release rate and volume 1-hour release of 750m³ at surface</p> <p>Release location Location 40 km north-west of Browse Island, Figure 4-3.</p>	<p>A diesel spill to the Operational Area could occur as outcome from:</p> <ul style="list-style-type: none"> • LOC during diesel transfer from the supply vessel to the FLNG facility; or during refuelling of the pilot tugs; or • following a collision between any marine vessels, including the FLNG facility, operating in the field. <p>The worst-case scenario is where one of the vessels is 'hit' from the broadside by another vessel moving at near full speed resulting in a puncture of the diesel tanks below the waterline. Prelude marine support vessels have diesel storage capacities of around 1,000 m³, spread in multiple tanks. Pilot tugs carry similar or smaller diesel inventories onboard.</p> <p>The largest diesel volume spill scenario is considered to be from a supply vessel collision with the FLNG facility of magnitude such that a breach of the hull and damage to its biggest diesel storage tank would occur. The tank is located in the FLNG facility substructure and has a capacity of 750 m³. It has been conservatively assumed for the purposes of spill modelling that in the remote chance of this happening, the whole inventory of this tank would be lost to sea.</p> <p>Therefore, 750 m³ is considered the WCSS for vessels using Group II fuels operating outside of the Prelude field.</p>
	<p>Oil Type</p>	



<p>Loss of containment from export pipeline</p>	<p>Group I – Crux condensate</p> <p>Release rate and volume</p> <p>2,037m³ over <6 hours (199 m water depth)</p> <p>Release location</p> <p>Near Heywood Shoal- export pipeline, Figure 4-3.</p>	
	<p>Oil Type</p> <p>Group I - Brewster gas and condensate, post-processing on the CPF</p> <p>Release rate and volume</p> <p>250 m water depth - 4-day release at seabed (exponentially decreasing release rate, ranging from 3,030 to 0.225 m³/hour</p> <p>70 m water depth - 2-day release at seabed. Exponentially decreasing release rate, ranging from 3,804 to 0.003 m³/hour.</p> <p>Total condensate release volume of ~12,600 m³ (250m depth) to ~9,700 m³ (70m water depth)</p> <p>Release location</p>	<p>INPEX operate the Ichthys Gas Export Pipeline (GEP). When production is occurring on the CPF and at the onshore Ichthys LNG Plant, gas/condensate flows from the CPF toward the onshore plant, resulting in a pressure gradient between the CPF (higher pressure end of the GEP) and the onshore plant (lower pressure end of the GEP). The GEP inventory during operation is up to 5800 MMscf.</p> <p>However, prior to a planned maintenance shut-downs, the GEP will be allowed to 'settle-out', where the pressure between the CPF and I-LNG beach-valve become effectively equal. The GEP inventory at maximum settle-out pressure is up to 6200 MMscf.</p> <p>Therefore, the spill scenario modelled for the GEP was conducted based on a situation when the GEP is at 'settle-out' pressure and has maximum gas/condensate inventory.</p> <p>OLGA modelling was conducted for a GEP full-bore rupture at three water depths: -250 m (Ichthys Field water depth), -150 m and -70 m (Commonwealth/NT waters boundary water depth). The outcomes of the OLGA modelling calculated total condensate release volumes of ~12,600 m³ (-250m water depth) to ~9,700 m³ (-70m water depth).</p> <p>A full-bore rupture of the GEP at the CPF end (-250 m water depth) is considered a worst-case spill, due to the greatest condensate release</p>



	Various release locations along the GEP route (refer Figure 4 2) Figure 4-2	volume, but also due to the additional 25 bar of pressure at seabed, which results in a slower rise-time for the gas/condensate from the GEP to the ocean surface, resulting in the greatest level of entrainment of condensate in the water column during the release event. A shallower depth of the release will result in less condensate entrainment in the water column.
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Shell Australia

4 Modelling Summary of Worst Credible Spill Scenarios (WCSS)

This section presents the details and outputs of spill modelling which has been undertaken and utilised to inform regional spill response planning.

Section 4.1 provides a summary of all the WCSS stochastic modelling scenarios which have been utilised for regional response planning.

Section 4.2 discusses the various response strategy planning thresholds which have been selected to inform response planning/field capability assessments.

Section 4.3 presents the outputs of the WCSS stochastic modelling against the response planning thresholds. For each WCSS stochastic modelling set, the stochastic runs have been analysed to identify the individual worst-case stochastic run, as related to each individual response planning threshold. This data set is then termed the 'Basis of Design' (BOD) for each WCSS. The BOD is used to inform the Field Capability Assessments, which are presented in Section 6.

4.1 Overview of WCSS modelling

Shell Australia and INPEX have selected a range of oil spill modelling scenarios which align with the WCSSs for each spill source. Some model scenarios have been modelled previously, as part a previously submitted EPs. Other scenarios have been selected specifically for this regional response plan. In addition, where specific response strategy planning thresholds were not included in some previously developed model outputs, for several WCSSs, the stochastic modelling data has been retrieved from archive and re-processed to acquire the relevant data required for regional response planning.

Table 4-1 provides a summary and references to the various oil spill modelling reports.

The geographic locations of the selected modelled spill scenarios are presented in Figure 4-1, Figure 4-2. and Figure 4-3.

Table 4-1: WCSS modelling reports

WCSS	Modelling Report References
Shell Australia	
Prelude Condensate Well Blowout	RPS Asia-Pacific Applied Science Associates (APASA). 2013. Prelude FLNG Quantitative Oil Spill Exposure Modelling. Report prepared by Asia-Pacific Applied Science Associated. Prepared for Shell Australia, Perth, Western Australia.
Crux Condensate Well Blowout	RPS. 2018. Crux Project Oil Spill Modelling. Report prepared by RPS for Shell Australia, Perth, Western Australia
Prelude Loss of containment during FLNG product storage and offloading (LNG, LPG or condensate)	RPS Asia-Pacific Applied Science Associates (APASA). 2014. Prelude FLNG Spill Modelling- Condensate Results. Report prepared by Asia-Pacific Applied Science



	Associated. Prepared for Shell Australia, Perth, Western Australia.
Prelude Vessel collision 1,000 m³ HFO spill	RPS Asia-Pacific Applied Science Associates (APASA). 2014. Prelude FLNG Spill Modelling- HFO Results. Report prepared by Asia-Pacific Applied Science Associated. Prepared for Shell Australia, Perth, Western Australia.
Crux Vessel collision 1,000 m³ HFO spill	RPS. 2018. Crux Project Oil Spill Modelling. Report prepared by RPS for Shell Australia, Perth, Western Australia
Prelude Vessel collision 750 m³ MDO spill	RPS Asia-Pacific Applied Science Associates (APASA). 2014. Prelude FLNG Spill Modelling- Diesel Results. Report prepared by Asia-Pacific Applied Science Associated. Prepared for Shell Australia, Perth, Western Australia.
Crux subsurface release of Crux condensate from a pipeline rupture near Heywood Shoal	RPS. 2018. Crux Project Oil Spill Modelling. Report prepared by RPS for Shell Australia, Perth, Western Australia
INPEX	
Ichthys Phase 1 Production Drilling - Brewster condensate well blowout	Asia-Pacific Applied Science Associates (APASA). 2013. Brewster Development Wells WA 285: Quantitative Oil Spill Exposure Modelling. J0203. Report prepared by Asia-Pacific Applied Science Associated. Prepared for INPEX Operations, Perth, Western Australia.
Phase 2A – Plover condensate well blow-out	RPS. 2019a. INPEX Ichthys Phase 2 Development WA-50-L Oil Spill Risk Assessment. MAW0796J. Report prepared by RPS for INPEX Operations Australia, Perth, Western Australia.
Bassett Deep Exploration Well – Plover condensate well blow-out	RPS. 2018. INPEX WA-343-P Quantitative Spill Risk Assessment. MAW0730J. Report prepared by RPS for INPEX Operations Australia, Perth, Western Australia.
Holonema-B Exploration Well – Brewster condensate well blow-out	RPS. 2021a. INPEX Holonema Quantitative Spill Risk Assessment Report.



	MAW1003J.000. Prepared by RPS Group. Prepared for INPEX, Perth, Western Australia.
FPSO 5700 m³ condensate tank rupture	<p>RPS APASA. 2014a. Ichthys Offshore Operations Gap Analysis – Quantitative Spill Risk Assessment. J0312. Prepared by RPS ASAPA PTY LTD. Prepared for INPEX Operations Australia Pty.</p> <p>Subsequent reprocessing:</p> <p>RPS 2021b. Spill Risk Assessment for INPEX Ichthys FPSO. Reassessment of spill scenario – release of Brewster Condensate onto the water surface. Report MAW1003J.000. Prepared by RPS Group. Prepared for INPEX, Perth, Western Australia.</p>
Vessel collision 776 m³ HFO spill	RPS APASA. 2014b. Ichthys Offshore Operations Gap Analysis – Quantitative Spill Risk Assessment. Scenario OSC 31 – Offtake Tanker Fuel Inventory – Loss of Containment at 250 m from the FPSO Stochastic Modelling Results. J0312. Prepared by RPS ASAPA PTY LTD. Prepared for INPEX Operations Australia Pty.
Vessel collision 284 m³ MGO spill	RPS. 2019b. WA-532-P, WA-533-P and WA-50-L. Oil Spill Risk Assessment. MAW0757J. Prepared by RPS Australia West Pty Ltd. Prepared for INPEX Operations Australia Pty Ltd.
Vessel collision 250 m³ MGO spill	RPS APASA. 2015. INPEX – Ichthys GEP vessel spills. Scenario 2 Results Summary. Quantitative Oil Spill Risk Assessment. J0285. Prepared by APASA. Prepared for INPEX Operations Australia Pty Ltd.
Ichthys GEP full bore rupture 12,600 m³ condensate spill	RPS. 2021f. Spill Risk Assessment for INPEX Ichthys GEP. Report MAW1003J.000. Prepared by RPS Group. Prepared for INPEX, Perth, Western Australia.



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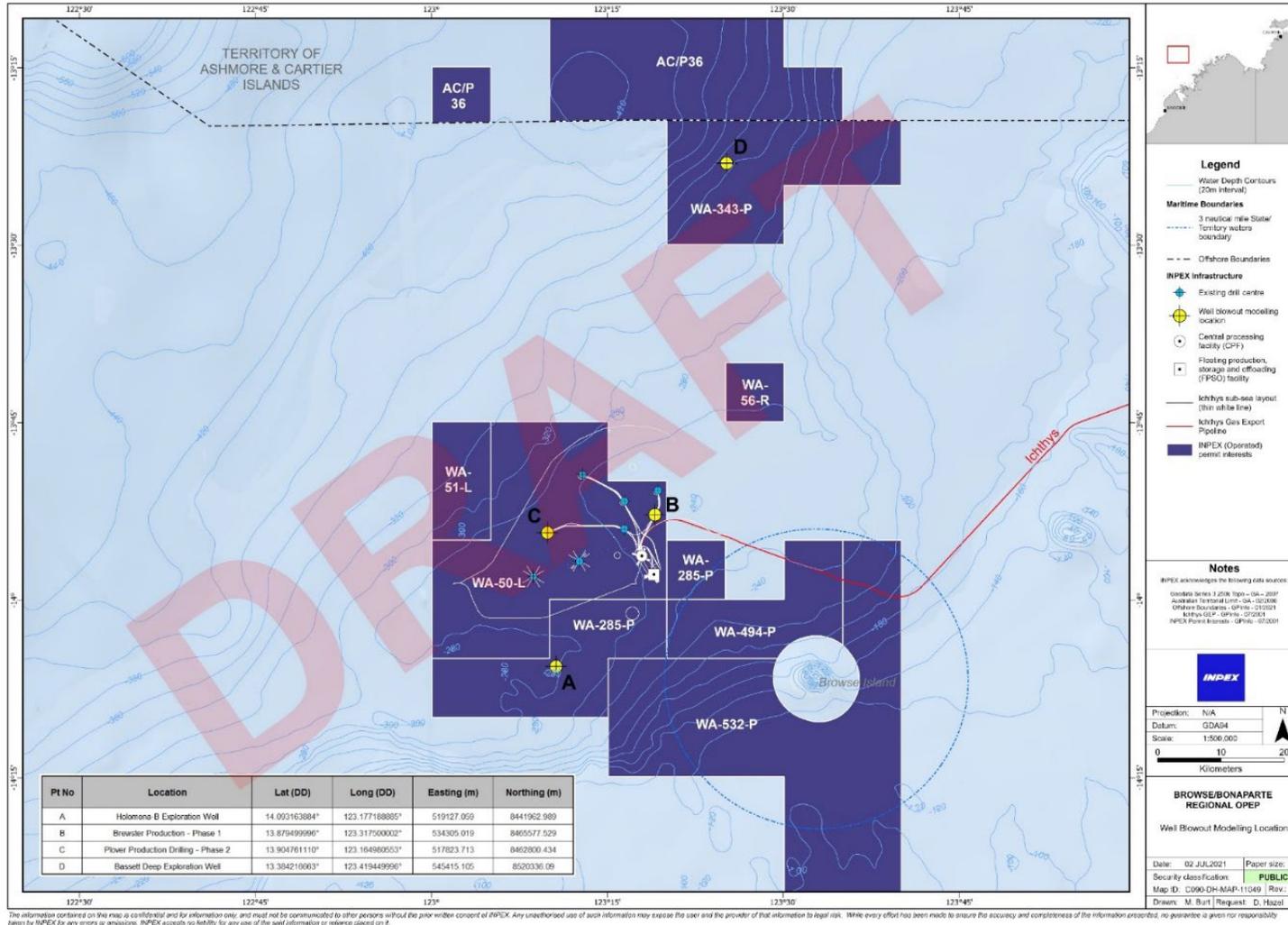


Figure 4-1: Inpex Well blowout WCS Locations

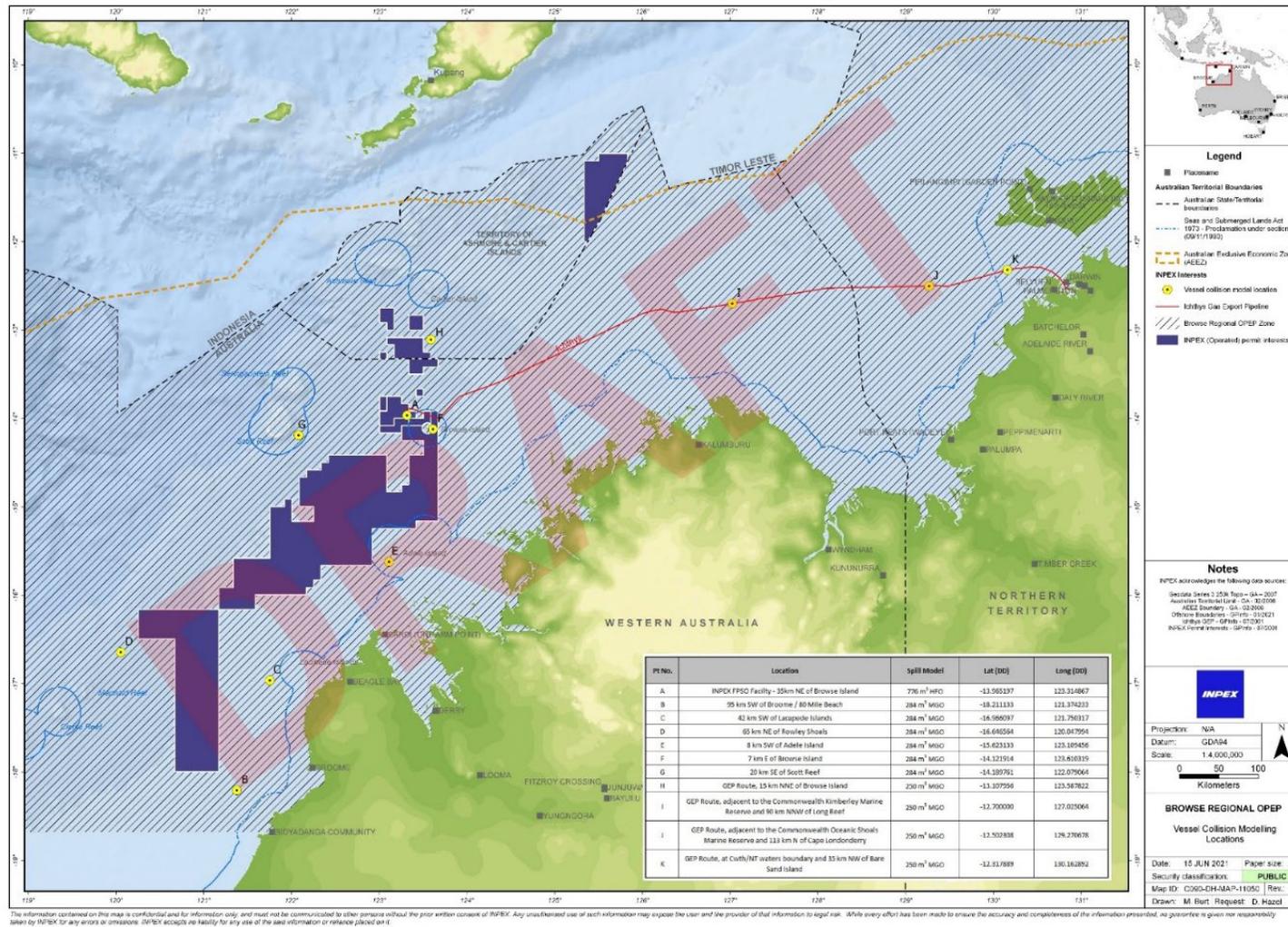


Figure 4-2: Inpex Vessel collision and GEP rupture WCSS locations

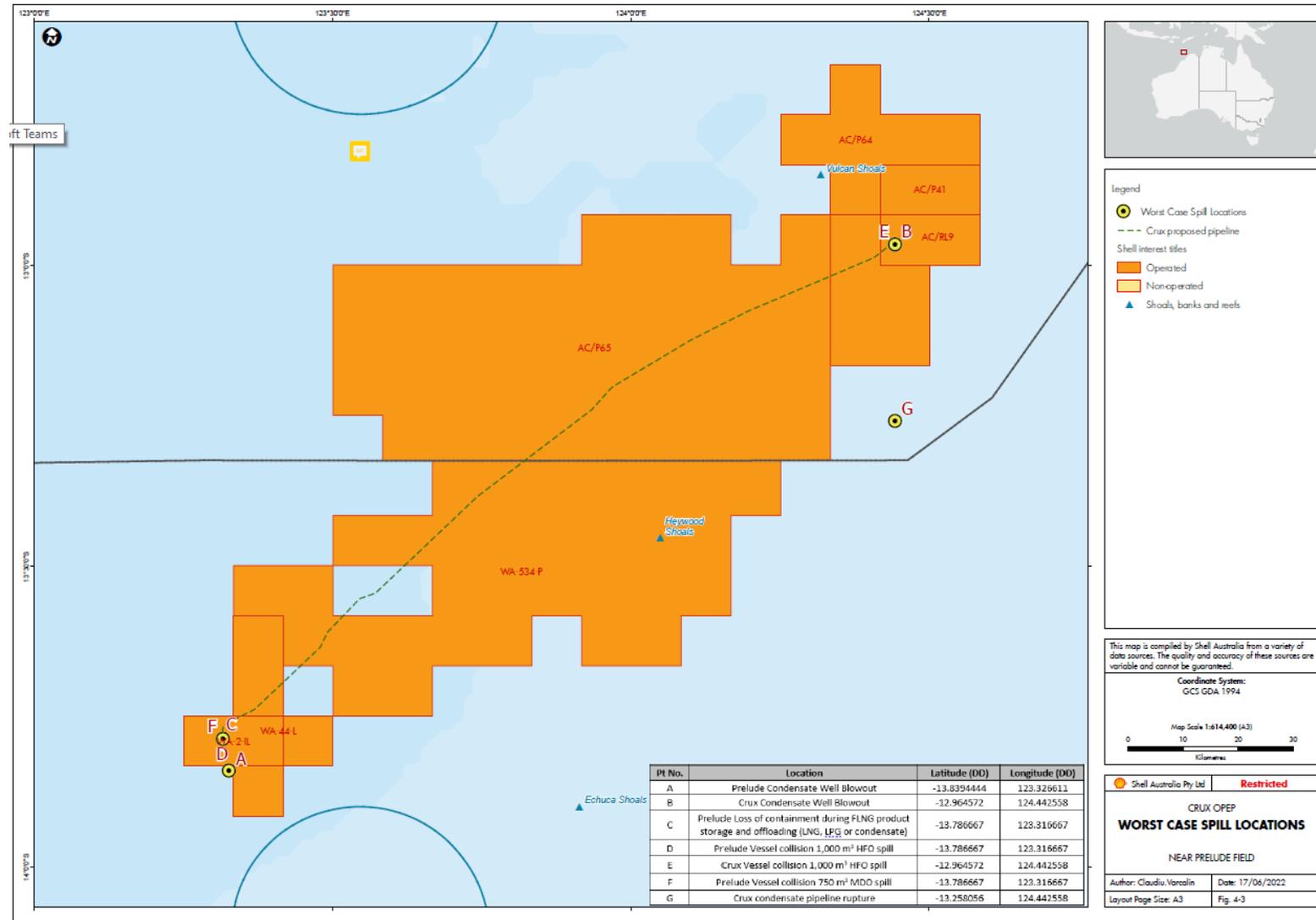


Figure 4-3: Shell vessel collision, GEP rupture and well blowout WCSS locations



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4.2 Response Strategy Planning Thresholds

Spill model outputs can be utilised to inform spill response strategy planning. Whilst IPIECA-IOGP (2013) doesn't provide any specific response strategy planning thresholds, several suitable thresholds have been identified and utilised in oil spill planning within the Australian upstream petroleum industry for a number of years.

The thresholds generally assist with WCSS response strategy planning, by either providing an indication of the minimum timeframe that should be planned for the activation of a certain response strategy, or the size/tier of field capability required for a certain response strategy.

Table 4-2 presents a literature review of various response strategy planning thresholds and discusses how each threshold can be used to inform response strategy planning.

Note, the response planning thresholds presented are not the actual response strategy activation triggers, which would be used in an actual oil spill event by the IMT. The response strategy planning thresholds are utilised during the development of the BOD, presented in Section 4.3 and this information is then used to inform the field capability assessments presented in Section 6.

Response strategy activation triggers to be utilised as decision making tools by an IMT during a real spill event are detailed in the BROPEP (HSE_GEN_016765).

The thresholds used to evaluate the environmental risk associated with an oil spill event are defined within the activity specific EP.



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Table 4-2: Response Strategy Planning Thresholds for Browse Basin scenarios

Response strategy planning threshold	Response strategy planning considerations	Reference / justification
<p>Max lineal distance (km) where floating oil >1g/m²</p>	<p>Used to inform response planning regarding the:</p> <ul style="list-style-type: none"> • maximum range of surveillance, monitoring and visualisation (SMV) (E.g., aerial surveillance, satellite imagery etc) <p>(Note, this floating oil threshold and entrained/dissolved thresholds can also be used to inform the potential extent of Operational and Scientific Monitoring programs, however these parameters aren't primary consideration for OSMP capability planning).</p>	<p>The Bonn Agreement Oil Appearance Code (BAOAC) is a series of five categories or 'codes' that describe the relationship between the appearances of oil on the sea surface to the thickness of the oil layer. Bonn-Code 1 refers to silver/grey sheens of floating oil and Bonn Code 2 includes rainbow sheen (thickness of 0.0003mm to 0.005mm, or 0.3 /m² to 5 g/m²). 1 g/m² is therefore at the lower end of Bonn Code 2.</p> <p>Therefore, >1 g/m² has been selected as an appropriate minimum thickness to be used during oil spill modelling, to inform the geographic area which may potentially be impacted by oil, causing effects to socio-economic values, and at which water quality within a marine protected area may have been altered (NOPSEMA 2019).</p> <p>Therefore, during WCSS response planning, aerial/satellite surveillance capability/arrangements should be evaluated against this threshold.</p>
<p>Area (km²) where floating oil >50g/m²</p>	<p>Used to inform response planning regarding the:</p> <ul style="list-style-type: none"> • geographic area in which to undertake surface chemical dispersant (aerial/vessel) • geographic area in which to undertake containment & recovery (C&R) (booms and skimmers) • geographic area in which to undertake in-situ burning (ISB). 	<p>Generally, oil needs to be >100 g/m² (>0.1 mm, which equates to Bonn Code 4/5) to feasibly corral oil with a boom and achieve any significant level, or operationally efficient level, of oil recovery with skimmers during an offshore C&R operation (O'Brien 2002; IPIECA-IOGP 2015a). In addition, as the capture/containment and corralling of oil with booms is required for ISB, this threshold is considered appropriate for that response strategy.</p>



	<ul style="list-style-type: none"> • note; emulsification and changes in viscosity are factors potentially limiting the effectiveness of C&R, and more significantly, changes in viscosity and/or emulsification can reduce dispersant effectiveness. Therefore consideration of these factors may be required during evaluation of modelling outcomes for response planning. • note; this threshold is not relevant for protection of sensitive resources response strategy. This response strategy typically uses booms to deflect/corral oil, the same as at sea containment and recovery. However, unlike at sea containment and recovery (which requires >100g/m² floating oil thickness for operational efficiency), when conducting protection of sensitive resources, nearshore protection booms can be effective at deflecting low concentrations of floating oil, over a long duration, to prevent long-term accumulation of oil in a sensitive receptor. Therefore, there is no specified response planning threshold defined for the protection of sensitive resources response strategy. • note; whilst this threshold is relevant for surface dispersant application, it's not relevant for subsea dispersant injection (SSDI). Planning for SSDI should be based on consideration of the reservoir oil properties, flowrates and the effectiveness of selected dispersants on the oil type. 	<p>IPIECA-IOGP (2015b) and the National Research Council (2005) state that generally oil slicks need to be >100 g/m² (>0.1mm, which equates to Bonn Code 4/5) to feasibly achieve a successfully dispersant operation.</p> <p>Whilst 100 g/m² may be the threshold for on water response strategy effectiveness stated in the literature, when evaluating oil spill modelling outputs, a lower response strategy planning threshold is considered appropriate.</p> <p>The effects of winds, currents etc. cause oil to spread, and it often forms into windrows with a range of oil thicknesses across a given area. During oil spill modelling, the oil thickness within a grid-cell is averaged. Therefore, for a grid-cell reporting an average thickness of 50 g/m², there will be range of thicknesses, due to oil behaviour, including patches/windrows/streamers of oil, of which some will be >100 g/m².</p> <p>50 g/m² is aligned with the recommendation of NOPSEMA (2019).</p> <p>Therefore, during WCSS response planning, on water response strategies including C&R, surface dispersant application and in-situ burning capability and arrangements should be evaluated against this threshold.</p>
Longest length (km) or number of segments of	<p>Used to inform response planning regarding the:</p> <ul style="list-style-type: none"> • number of segments, and likely tier/size of shoreline clean-up assessment technique (SCAT) teams, 	<p>IPIECA-IOGP (2015c) classify oil on shorelines based on oil thickness. Stain is classified as <0.1mm (100g/m²), and film as 'iridescent sheen', i.e., less than stain, with no minimum thickness.</p>



shoreline oiled > 10 g/m²	including oiled wildlife response (OWR) and protection of sensitive resources assessments.	<p>If film was considered an order of magnitude lower than stain, the thickness would be 0.01 mm (10 g/m²). For comparative purposes, 0.01 mm thickness is equivalent to ~2 teaspoons oil/m².</p> <p>Oil is just visible at this thickness on a shoreline and there is potential for some socio-economic impacts at this thickness. Therefore, 0.01mm (10 g/m²) is considered an appropriate threshold to understand the potential length of shoreline/number of shoreline sectors for which SCAT may be required.</p> <p>This is aligned with the recommendation of NOPSEMA (2019).</p> <p>Therefore, during WCSS response planning, SCAT capability and arrangements should be evaluated against this threshold.</p>
Minimum time to shoreline contact for oil >10g/m²	<p>Used to inform response planning regarding the:</p> <ul style="list-style-type: none"> • timeline for mobilisation of SCAT, OWR and P&D assessment teams. 	<p>Understanding the shortest possible timeline between the spill event, and oil arriving on a shoreline at >10 g/m² provides a metric to consider, for the arrangements required for the mobilisation of a SCAT capability.</p>
Longest length (km) or number of segments of shoreline oiled > 100 g/m²	<p>Used to inform response planning regarding number of segments, and likely tier/size of:</p> <ul style="list-style-type: none"> • shoreline clean-up • OWR • protection of sensitive resources (or protect and deflect/P&D) 	<p>100 g/m² is often used as minimum thickness for effective shoreline clean-up (Owens and Sergy. 2000), and French-McCay (2009) conclude that 100 g/m² is the minimum oil thickness for effects on marine fauna and invertebrates on a shoreline.</p> <p>This is aligned with the recommendation of NOPSEMA 2019.</p> <p>Therefore, during WCSS response planning, shoreline clean-up, P&D and OWR capability and arrangements should be evaluated against this threshold.</p>
Minimum time to shoreline contact for oil >100g/m²	Used to inform response planning regarding:	<p>Understanding the shortest possible timeline between the spill event, and oil arriving on a shoreline at >100 g/m² provides a metric to consider, for the arrangements required for the</p>



	<ul style="list-style-type: none">• timeline for mobilisation of shoreline clean-up, OWR, P&D and waste management capabilities.	mobilisation of a shoreline clean-up/OWR capability, and associated waste management capability that will be required by these response strategies.
Worst-case volume (m³) of oil on shoreline >100 g/m² at any time	Used to inform response planning regarding the: <ul style="list-style-type: none">• volume of waste likely to be generated during P&D, OWR and shoreline clean-up.	<p>100 g/m² often used as minimum thickness for effective shoreline clean-up (Owens and Sergy., 2000; French-McCay., 2009) conclude that 100 g/m² is the minimum oil thickness for effects on marine fauna and invertebrates on a shoreline, and therefore triggers potential for OWR cleaning operations and associated waste generation.</p> <p>Therefore, during WCSS response planning, the volume of oily waste potentially generated during shoreline clean-up, P&D and OWR and the associated waste management capability and arrangements should be evaluated against this threshold.</p>



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4.3 Basis of Design

This section presents the outputs of the WCSS stochastic modelling runs against the response planning thresholds. These spill model outputs, assessed against each individual response planning threshold has been termed the 'Basis of Design' (BOD).

Table 4-3 presents various well blow-out parameters which were used as inputs into well blowout stochastic modelling.

Table 4-4 presents the well blow-out and other Group I hydrocarbon WCSSs stochastic modelling outputs (all seasons), against the response planning thresholds.

Table 4-5 presents the vessel collision WCSSs stochastic modelling outputs (all seasons), against the response planning thresholds.

The BOD tables are used to inform the Field Capability Assessments, which are presented in Section 6.



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Table 4-3 Comparison of well blowout modelling inputs

Model	Prelude Production Well (Shell)	Crux Development Well (Shell)	Holonema-B Exploration Well (Inpex)	Brewster Production Phase 1 (Inpex)	Plover Production Drilling Phase 2 (Inpex)	Bassett Deep Exploration Well (Inpex)
Release location (coordinates)	13°50' 22"S 123°19' 35.8"E Approximately 40 km north-west of Browse Island	12° 57' 52.46"S 124° 26' 33.21"E Approximately 105 km north-west of Cartier Island	14 05' 35.39"S 123 10' 37.88"E Approximately 38 km west north west of Browse Island.	13° 52' 46.2" S 123° 19' 3.0" E Approximately 35 km north west of Browse Island.	13° 54' 17.14" S 123° 09' 53.93" E Approximately 47 km north west of Browse Island.	13° 23' 3.18" S 123° 25' 10.02" E Approximately 80 km north north west of Browse Island, and 94 km south south east of Cartier Island.
Oil type	Prelude Condensate	Crux Condensate	Brewster condensate	Brewster condensate	Plover condensate	Plover condensate
Reservoir pressure (psia)	*	*	6020	6020	6683	11688
Gas flowrate (MMscf/day)	556	737	583	577	735	1006
Oil flowrate (m³/day)	3,180	2,578	3193	3193	1082	2178
Release duration (days)	80	80	80	80	108	130
Total release volume (m³)	254,380	206,225	255,475	255,475	116,856	283,198
Well bore size - internal diameter (inches)	9 5/8"	12 1/4"	8.5"	8.5"	8.5"	8.5"

*commercially sensitive information.



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Table 4-4: Comparison of stochastics modelling results against spill response planning thresholds – Group I WCSS – WCSS highlighted red

Worst Credible Spill Scenario	Basis of Design – Modelling Parameter Outcomes						
	Max lineal distance (km) floating oil >1g/m ²	Maximum area (km ²) floating oil >50g/m ²	Minimum time (days) to shoreline oil accumulation >10 g/m ²	Minimum time (days) to shoreline oil accumulation >100 g/m ²	Longest length (km) or number of segments of shoreline oiled > 10 g/m ²	Longest length (km) or number of segments of shoreline oiled > 100 g/m ²	Worst-case volume (m ³) of oil on shoreline >100 g/m ² at any time
INPEX Group I WCSS							
Well blow-out - Holonema-B Exploration Well	883 (refer Figure 4-3 and Figure 4-4)	5 (refer Figure 4-5)	3 (Browse Island)	3 (Browse Island)	158 (refer Figure 4-6)	27 (refer Figure 4-7)	433 (Refer Figure 4-8)
Well blow-out – Brewster Phase 1 Production Drilling	50	N/A ¹	N/A ¹	N/A ¹	N/A ¹	N/A ¹	2
Well blow-out – Plover Phase 2 Production Drilling	548	N/A ¹	4 (Browse Island)	6 (Browse Island)	N/A ¹	9	120
Well blow-out – Bassett Deep Exploration Well	1145	N/A ¹	N/A ¹	N/A ¹	N/A ¹	N/A ¹	34
FPSO condensate tank rupture	633	12	1 Browse Island (30 hours)	1 Browse Island (30 hours)	8	3	63
Ichthys GEP full bore rupture	102	1.3	11	No contact above threshold	1.6	0	0
Shell Group I WCSS							
Well blow out – Prelude Production Well	875	N/A ¹	No Contact (NC)	NC	N/A ¹	N/A ¹	1.1 (ex. Indonesian Boundary – 50.8)
Well blow out – Crux Development Well	577	N/A ¹	14 (Browse Island)	42.5 (Indonesia)	11 (Darwin Coast)	N/A ¹	10 (Kakadu Coast)

¹ These parameters were not calculated/reported as part of modelling reports.



Loss of containment during product offloading (collision) at Prelude	820	N/A ¹	2 (Browse Island)	N/A ¹	N/A ¹	N/A ¹	13.69(ex. Indonesian Boundary 1,393)
Loss of containment from Crux export pipeline	581	N/A ¹	6 (Browse Island)	6 (Browse Island)	4 (Cassini Island)	N/A ¹	48



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4.3.1 Basis of Design Summary

4.3.1.1 INPEX Group 1 WCSS

When examining the modelling results of the various well blowout simulations presented in Figure 4-4 to Figure 4-9, it can be seen that the Holonema-B well blowout results present an absolute worst-case scenario, with by far the highest modelled volumes of oil ashore, lengths of shoreline oiled compared with other scenarios. Holonema-B WCSS also has relatively fast time to shoreline contact for both the $>10 \text{ g/m}^2$ and $>100 \text{ g/m}^2$ thresholds. The reasons for the Holonema-B results being 'worst-case' regarding greatest volumes of oil ashore is because it is the highest volume oil release scenario, with the release location selected as the closest point of the Brewster reservoir to Browse Island, when considering wet-season wind conditions.

The absolute shortest time to contact was predicted from the FPSO collision WCSS resulted in shoreline contact $>10 \text{ g/m}^2$ and $>100 \text{ g/m}^2$ in 29 hours for Browse Island, compared to 3 days for the Holonema-B WCSS. Also, the FPSO collision also resulted in the highest instantaneous area of floating oil $>50 \text{ g/m}^2$ at 12 km^2 .

Whilst the Bassett Deep spill modelling used a higher total volume of oil released, the release rate was slower and the proposed Bassett Deep well location was far further away from sensitive receptors, which resulted in lower shoreline accumulation volumes. However, due to the larger release volume, the maximum linear distance floating oil $>1 \text{ g/m}^2$, for Bassett Deep modelling was 1145 km, compared to 883 km from the Holonema-B model outputs.

There were very large differences between the Brewster Phase 1 and the Holonema-B modelling outputs. Both scenarios used the same reservoir characteristics, however resulted in vastly different model outcomes, with Brewster Phase 1 modelling presenting far smaller floating oil and shoreline accumulation volumes. These differences were as a result of the different models used for the two scenarios. The Brewster Phase 1 modelling was conducted using an older near-field modelling program with simplified assumptions. The key difference was the older modelling was undertaken under the assumption that for any well blowout, the oil would be 'atomised' at the release point, resulting in very small droplet sizes. During the far-field modelling, these small droplet sizes resulted in very high entrainment rates, and very limited floating oil, therefore limiting shoreline contact and shoreline accumulation. However the newer model used for Holonema-B produced a broader distribution of droplet sizes is generated by the nearfield modelling, which takes into account reservoir pressures and a range of other factors. This provides a more realistic representation of the range droplet sizes that would be expected. When applied to the far-field modelling, this larger range of droplet sizes results in larger volumes of surface/floating oil, which in turn results in greater floating oil concentrations over larger distances and consequently greater volumes of shoreline contact and shoreline accumulation of oil. Therefore, the outcomes of the Holonema-B modelling present a worst-case from a spill response planning perspective.

The modelling results from the GEP rupture WCSS and FPSO 5700 m^3 condensate tank rupture WCSS both predicted very short lengths of shoreline accumulation at $>10 \text{ g/m}^2$ and $>100 \text{ g/m}^2$ compared to the Holonema-B scenario. Also, the FPSO 5700 m^3 condensate tank rupture WCSS maximum shoreline accumulation was 60 m^3 , far smaller than the predicted 433 m^3 maximum shoreline accumulation from the Holonema-B well blowout WCSS, and the was no shoreline accumulation predicted from the GEP WCSS.

As there are some small differences on a few parameters, the consequences of these differences are analysed as part of the Strategic SIMA and field capability assessment of the well blow-out WCSS, presented .



4.3.1.2 Shell Group 1 WCSS

A comparison was undertaken between Shell's Group 1 WCSS and those presented by Inpex, to establish if the SIMA and field capability assessment required updating. This comparison concluded that the WCSS selected by Inpex remained the actual WCSS for both the well blowout and Condensate release scenarios. It is noted that there are many similarities across these scenarios that make this comparison difficult, however, it was concluded that on a worst case replicate basis, Inpex's scenarios should continue be used to inform the SIMA process and Field Capability Assessments.

When comparing the modelling results of the various scenarios presented in Table 4-4, it is noted that the modelling reports data outputs were not consistent across all scenarios. This limits the ability to make direct comparisons for establishing the WCSS, however, where data was available, this was considered to be the most reliable information to base this judgement on.

4.3.1.3 Group 1 WCSS Scenario Results

As the data in Table 4-4 indicates that Holonema-B is considered the worst of the well blow-out WCSS for this BROPEP, Table 4 3 through to Figure 4 8 are provided as worst-case spill scenario outputs from the Holonema-B modelling report (RPS 2021a).

Figure 4 3 displays the results of the stochastic run (summer/wet-season 062) which produced the greatest lineal distance for floating oil $>1 \text{ g/m}^2$. This figure shows the total swept area of floating oil $>1 \text{ g/m}^2$. The maximum range was 883 km and was driven by a small patch of oil exceeding the 1 g/m^2 threshold, north west of Darwin. Several other stochastic runs showed contiguous streams of oil $>1 \text{ g/m}^2$ for approximately 700 km. (Note, the term 'Zone of Consequence' is utilised by INPEX in EPs to describe areas contacted by oil $>1 \text{ g/m}^2$, but less than a defined environmental impact threshold of 10 g/m^2).

Figure 4 4 displays the results of the same stochastic run (summer/wet-season 062) as Figure 4 3, however as a series of instantaneous moments in time during the scenario, showing the floating oil $>1 \text{ g/m}^2$. It should be noted the limited surface oil on day 79 (the second last day of the well blowout) is due to the increased wind speed during this period, resulting in very high entrainment and very limited surface/floating slicks.

Figure 4 5 displays the results of the stochastic run (summer/wet-season 002) which produced the worst-case instantaneous area (5 km^2) for floating oil $>50 \text{ g/m}^2$. For comparative purposes, the total swept area (40 km^2) for the same stochastic run is also presented.

Figure 4 6 produced the maximum length of shoreline oiled at $>10 \text{ g/m}^2$, at the worst-case moment in time for the run, which happened to be day 100, 20 days after the well-blowout simulation had stopped introducing more oil into the marine environment. This figure shows the wide range of locations at which could be simultaneously contacted above the threshold. During this particular stochastic run, first shoreline contact $>10 \text{ g/m}^2$ was as follows; Browse Island - day 18, Rowley Shoals and Scott Reef – day 33, Cartier Island – day 57, Kimberley coastline - day 60.

Figure 4 7 displays the results of the stochastic run (summer/wet-season 097) which produced the maximum length of shoreline oiled at $>100 \text{ g/m}^2$, at the worst-case moment in time for the run, which happened to be day 93, 13 days after the well-blowout simulation stopped introducing more oil into the marine environment. During this particular stochastic run, first shoreline contact $>100 \text{ g/m}^2$ was as follows; Sandy Islet - day 11, Browse Island - day 30 and Kimberley Coastline - day 60. Peak volume oil ashore across all receptors was approximately 120 m^3 in this run.



Figure 4 8 displays the results of the stochastic run (summer/wet-season 028) which produced the maximum volume of oil ashore at >10 g/m2 and >100 g/m2, at the worst-case moment in time for the run. This figure shows >50 m3 at Browse Island. The peak instantaneous volume ashore at Browse Island from this run was 433 m3. During this particular stochastic run, first shoreline contact >10 g/m2 was as follows; Browse Island initial oil on shore on day 18 (14 m3), Browse Island peak volume ashore on day 87 (433 m3) and Rowley Shoals on day 88 (<1 m3).

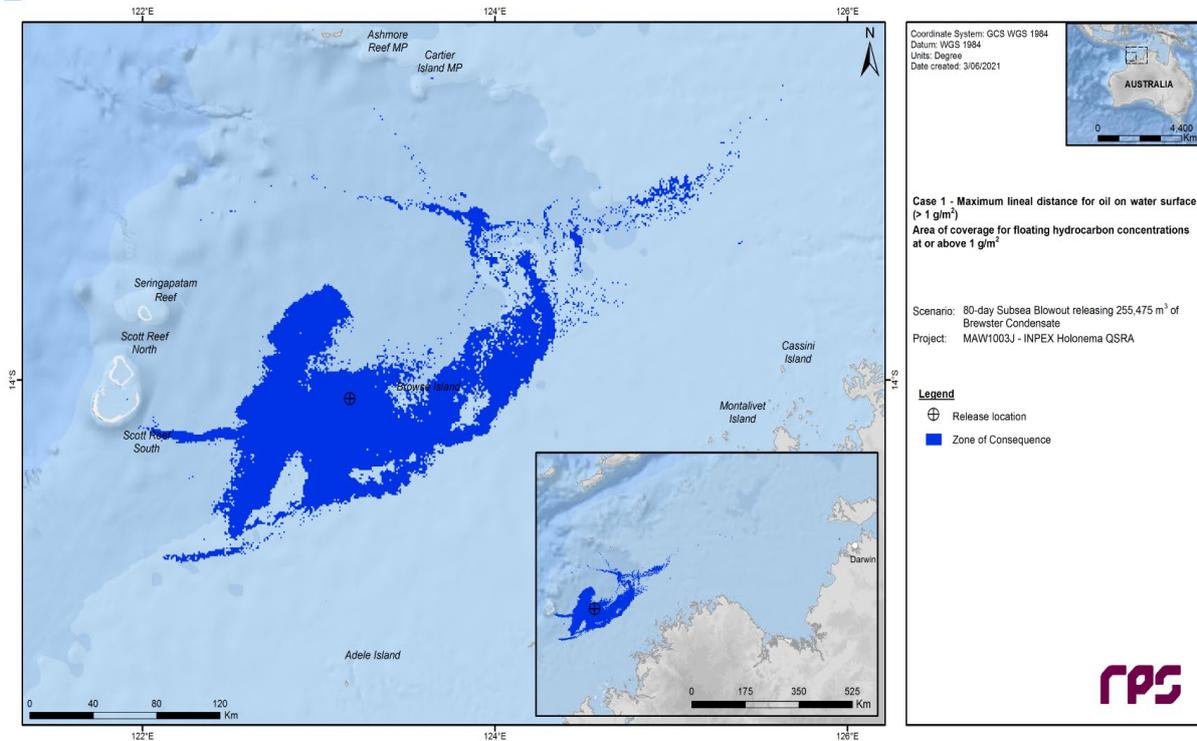


Figure 4-4: Well blowout maximum lineal distance for floating oil >1g/m²

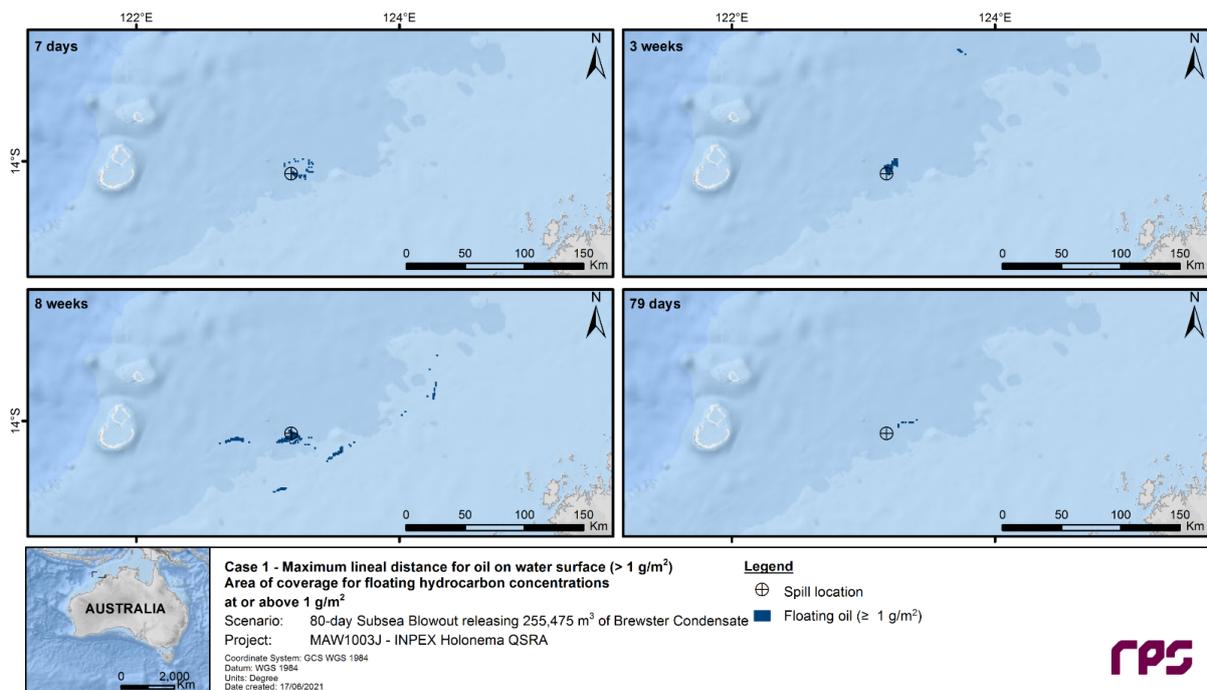


Figure 4-5: Well blowout maximum lineal distance for floating oil >1g/m² time series

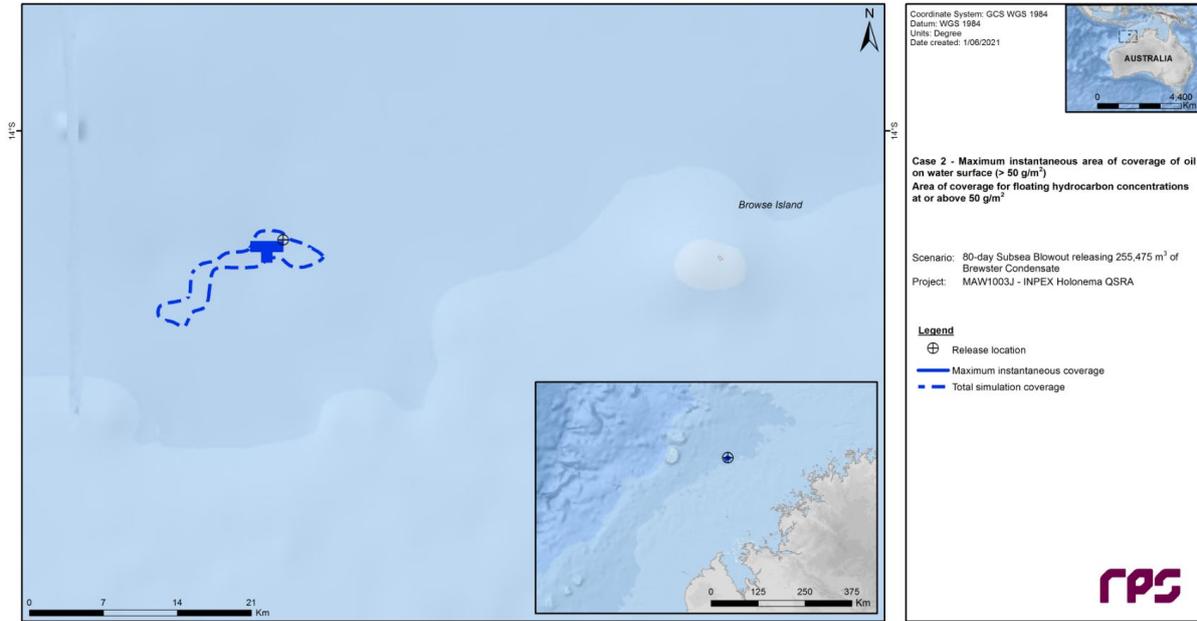


Figure 4-6: Well blowout maximum instantaneous, and total swept area floating oil >50g/m²

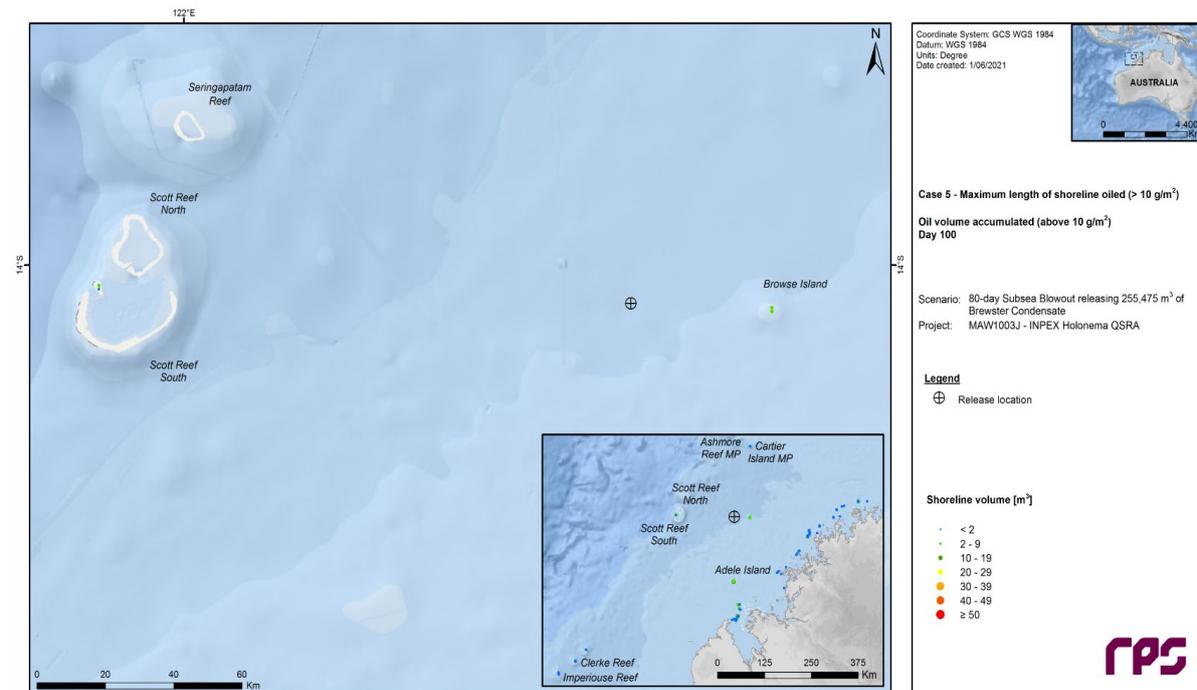


Figure 4-7: Well blowout instantaneous maximum length (km) of shoreline oiled at >10g/m², showing instantaneous volumes oil ashore (m³)

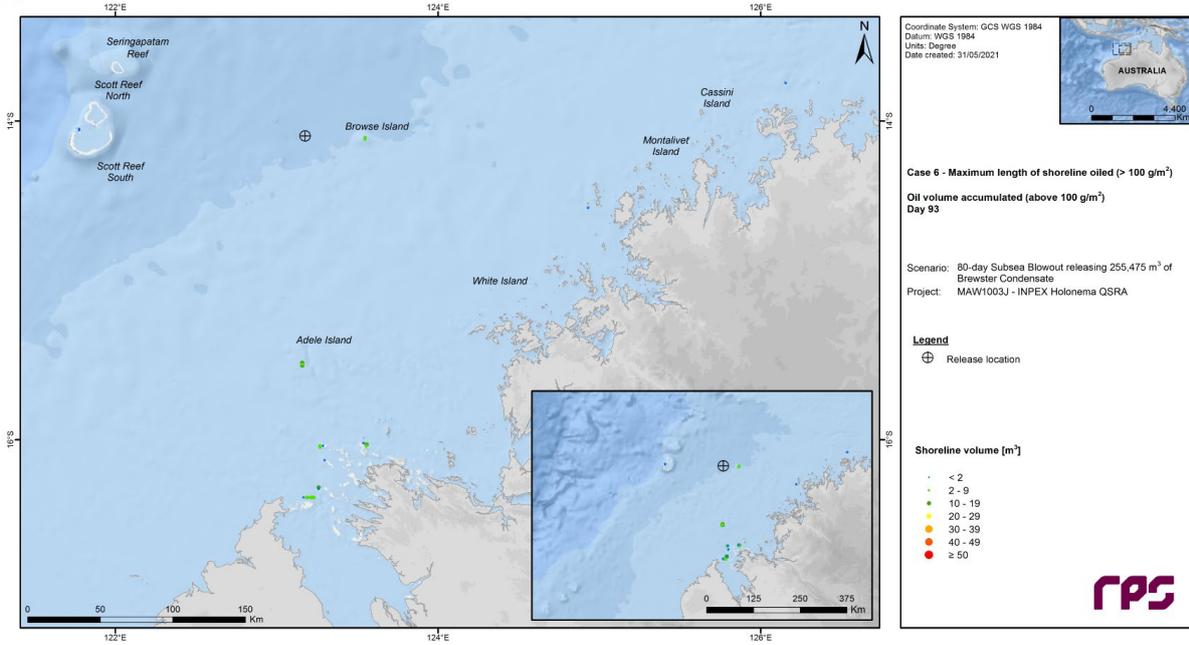


Figure 4-8: Well blowout instantaneous maximum length (km) of shoreline oiled at >100g/m², showing instantaneous volumes oil ashore (m³)

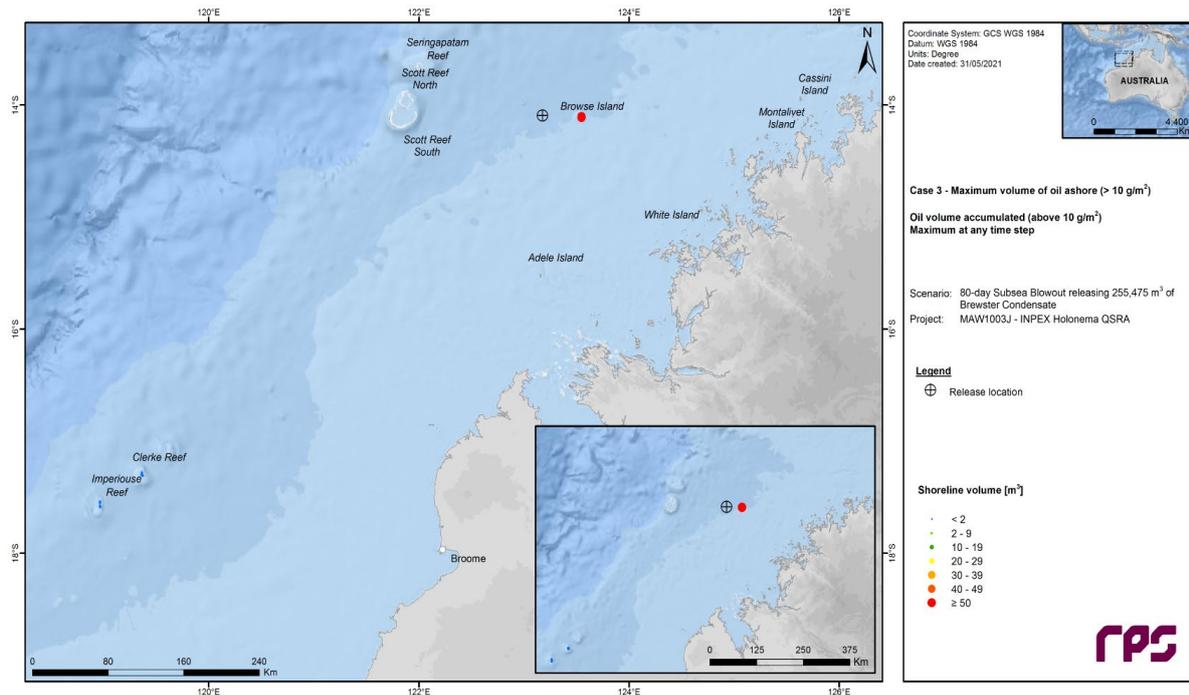


Figure 4-9: Well blowout maximum volume oil ashore >10g/m² and 100g/m²

The stochastic run which produced the minimum time to shoreline contact >10 g/m² was run summer 014. Results from this run show:

- Browse Island contacted >10 g/m² on day 4.
- Kimberley coastline contacted >10 g/m² on day 35.

The stochastic run which produced the minimum time to shoreline contact >100 g/m² was run transition run 095. Results from this run show:



- Browse Island contacted $>100 \text{ g/m}^2$ on day 4.
- no other shorelines contacted $>100 \text{ g/m}^2$ during this run.

In summary, the analysis of these shoreline contact results from the well-blowout simulations show:

- under worst-case conditions, one shoreline could be contacted at $>10 \text{ g/m}^2$ and $>100 \text{ g/m}^2$ within the first week (minimum time 4 days for well blowout scenario)
- additional shoreline sectors could be contacted above thresholds within the next three to four weeks.
- significantly more shoreline sectors contacted above thresholds between days 30-60



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Table 4-5: Comparison of stochastic modelling results against spill response planning thresholds – Group II and Group IV WCSSs for Browse Basin scenarios – WCSS highlighted red

Worst Credible Spill Scenario	Basis of Design – Modelling Parameter Outcomes						
	Max lineal distance (km) floating oil >1g/m ²	Maximum area (km ²) floating oil >50g/m ²	Minimum time (hours) to shoreline oil accumulation >10 g/m ²	Minimum time (hours) to shoreline oil accumulation >100 g/m ²	Longest length (km) or number of segments of shoreline oiled > 10 g/m ²	Longest length (km) or number of segments of shoreline oiled > 100 g/m ²	Worst-case volume (m ³) of oil on shoreline >100 g/m ² at any time
INPEX Group II and IV WCSS							
Vessel collision 776 m ³ HFO spill at FPSO Location 35 km north east Browse Island	1157 (refer Figure 4-11)	7.6 (refer Figure 4-12)	29	29	295 (refer Figure 4-13)	75 (refer Figure 4-14)	267 (Refer Figure 4-15)
Vessel collision 284 m ³ MGO spill Coordinates: 18° 12' 40.08" S 121° 22' 27.24" E 95 km south west of Broome / 80 Mile Beach	194	1.8	No contact above threshold	No contact above threshold	4	No contact above threshold	No contact above threshold
Vessel collision 284 m ³ MGO spill Coordinates: 16° 57' 57.95" S 121° 45' 1.14" E 42 km south west of Lacapede Islands	167	1.9	39	39	18	10	48 (Lacapede Islands)
Vessel collision 284 m ³ MGO spill Coordinates: 16° 38' 47.63" S 120° 2' 52.78" E 65 km north east of Rowley Shoals	357	1.9	58	103	6	5	48 (Clerke Reef, Rowley Shoals)
Vessel collision 284 m ³ MGO spill Coordinates: 15° 37' 23.28" S 123° 6' 34.04" E	195	1.7	5	8	13	6	119 (Adele Island)



Worst Credible Spill Scenario	Basis of Design – Modelling Parameter Outcomes						
	Max lineal distance (km) floating oil >1g/m ²	Maximum area (km ²) floating oil >50g/m ²	Minimum time (hours) to shoreline oil accumulation >10 g/m ²	Minimum time (hours) to shoreline oil accumulation >100 g/m ²	Longest length (km) or number of segments of shoreline oiled > 10 g/m ²	Longest length (km) or number of segments of shoreline oiled > 100 g/m ²	Worst-case volume (m ³) of oil on shoreline >100 g/m ² at any time
8 km south west of Adele Island							
Vessel collision 284 m ³ MGO spill Coordinates: 14° 7' 18.89" S 123° 36' 37.15" E 7 km east of Browse Island	392	1.9	1	5	3	3	100 (Browse Island)
Vessel collision 284 m ³ MGO spill Coordinates: 14° 11' 23.14" S 122° 4' 44.63" E 20 km south east of Scott Reef	305	1.9	36	36	2	2	55 (Sandy Islet / Scott Reef)
Vessel collision 250 m ³ MGO spill Coordinates: 13° 58' 21.886" S, 123° 35' 16.161" E. GEP Route, 15 km north north east of Browse Island	573	1.6	17	17	1.6	1.6	50 (Browse Island)
Vessel collision 250 m ³ MGO spill Coordinates: 13° 6' 28.641" S, 125° 22' 53.455" E GEP Route, adjacent to the Commonwealth Kimberley Marine Reserve and 90 km north north west of Long Reef	298	1.8	235 (10 days)	No contact above threshold	1.6	No contact above threshold	<1
Vessel collision 250 m ³ MGO spill Coordinates: 2° 42' 0.000" S, 127° 1' 30.239" E	204	1.6	No contact above threshold.	No contact above threshold	No contact above threshold	No contact above threshold	<1



Worst Credible Spill Scenario	Basis of Design – Modelling Parameter Outcomes						
	Max lineal distance (km) floating oil >1g/m ²	Maximum area (km ²) floating oil >50g/m ²	Minimum time (hours) to shoreline oil accumulation >10 g/m ²	Minimum time (hours) to shoreline oil accumulation >100 g/m ²	Longest length (km) or number of segments of shoreline oiled > 10 g/m ²	Longest length (km) or number of segments of shoreline oiled > 100 g/m ²	Worst-case volume (m ³) of oil on shoreline >100 g/m ² at any time
GEP Route, adjacent to the Commonwealth Oceanic Shoals Marine Reserve and 113 km north of Cape Londonderry							
Vessel collision 250 m ³ MGO spill Coordinates: 12° 30' 8.311" S, 129° 16' 14.442" E GEP Route, adjacent to Flat Top Bank and 125 km west of Bare Sand Island	214	1.8	290 (12 days)	334 (14 days)	3.2	0.4	<1
Vessel collision 250 m ³ MGO spill Coordinates: 12° 19' 4.400" S, 130° 9' 46.416" E GEP Route, at Cwth/NT waters boundary and 35 km north west of Bare Sand Island	185	1.6	67	67	27	12	47
Ichthys GEP full bore rupture	102	1.3	11	No contact above threshold	1.6	0	0
Shell Group I and IV WCSS							
Vessel collision 750 m ³ of Marine Diesel Oil (MDO)	500	N/A ²	44 (Browse Island)	NC	N/A ²	N/A ²	76.8 (Scott Reef)
Vessel collision 1,000 m ³ of Heavy Fuel Oil (HFO)	1,700	N/A ²	48 (Browse Island)	N/A ²	N/A ²	N/A ²	575 ³ (Indonesian Boundary)

² These parameters were not calculated/reported as part of modelling reports

³ Accounts all oiling rates >1g/m². Not limited to oiling >100g/m². Therefore, its value is considered conservatively higher than what the actual value would have represented.



Worst Credible Spill Scenario	Basis of Design – Modelling Parameter Outcomes						
	Max lineal distance (km) floating oil >1g/m ²	Maximum area (km ²) floating oil >50g/m ²	Minimum time (hours) to shoreline oil accumulation >10 g/m ²	Minimum time (hours) to shoreline oil accumulation >100 g/m ²	Longest length (km) or number of segments of shoreline oiled > 10 g/m ²	Longest length (km) or number of segments of shoreline oiled > 100 g/m ²	Worst-case volume (m ³) of oil on shoreline >100 g/m ² at any time
Pipelay vessel collision at Crux End of the Export Pipeline of IFO-180	1,853	N/A ⁴	164 (Montalivet Island)	165 (Montalivet Island)	99 (Joseph Bonaparte Gulf Northern Territory)	N/A ²	625 ⁵ (Bonaparte Archipelago)

⁴ Given the high maximum lineal distance (km) floating oil >1g/m², it is considered likely that this scenario would represent the highest for >50g/m² also.

⁵ Accounts all oiling rates >1g/m². Not limited to oiling >100g/m². Therefore, its value is considered conservatively higher than what the actual value would have represented.



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4.3.1.4 Group I and IV WCSS

The 776 m³ HFO spill results present an absolute worst-case scenario, with third highest predicted maximum lineal distance of floating oil (>1 g/m² and >50 g/m²), between 1st and 3rd highest volume of oil ashore and longest lengths of shoreline oiled at >10 g/m² and >100 g/m². Given the Crux 1000 m³ IFO scenario has lower maximum length of shoreline oiled and a comparable maximum volume of oil ashore to the 776 m³ HFO, it was still not considered the overall absolute worst case scenario.

Certain MGO vessel spill scenarios did have faster time to shoreline contact, due to the proximity of the selected/modelled release location, in relation to a shoreline receptor. When MGO vessel collision scenarios were located close to a shoreline, and contact was within <10 hours, the HFO spill scenario resulted in a higher maximum volume oil ashore and higher total length of shoreline oiled at >10 g/m² and >100 g/m². Additionally, the HFO scenario provides simulations where a significant number of shoreline receptors are contacted above thresholds, whereas the MGO scenarios did not result in multiple shoreline segments/multiple shoreline receptor contacts above >100 g/m² from individual stochastic runs.

As the data in Table 4 5 indicates that the 776 m³ HFO WCSS is considered the worst of the vessel collision WCSSs for this BROPEP, Figure 4 9 through to Figure 4 14 are provided as worst-case spill scenario outputs from the 776 m³ HFO modelling report (RPS 2021c).

Figure 4 9 displays the results of the stochastic run (summer/wet season 057) which produced the greatest lineal distance for floating oil >1 g/m². This figure shows the total swept area of floating oil >1 g/m². The maximum range was 1157 km.

Figure 4 10 displays the results of the same stochastic run (summer/wet season 057) as Figure 4 9, however as a series of instantaneous moments in time during the scenario, showing the floating oil >1 g/m².

Figure 4 11 depicts the results of the stochastic run (transition 050) which produced the worst-case instantaneous area (7.6 km²) for floating oil >50 g/m². For comparative purposes, the total swept area (75 km²) for the same stochastic run is also presented. An analysis of all 300 runs was completed, and the range for maximum instantaneous area >50 g/m² was 5.75km to 7.6km.

Figure 4 12 displays the results of the stochastic run (summer/wet season 042) which produced the maximum length of shoreline oiled at >10 g/m², at the worst-case moment in time for the run, which happened to be day 41. This figure shows the wide range of locations at which could be simultaneously contacted above the threshold. During this particular stochastic run, first shoreline contact >10 g/m² was as follows: Browse Island - day 6 and then the Bonaparte Archipelago/North Kimberley Marine Park locations- days 33-40.

Figure 4 13 displays the results of the stochastic run (summer/wet season 059) which produced the maximum length of shoreline oiled at >100 g/m², at the worst-case moment in time for the run, which happened to be day 27. During this particular stochastic run, first shoreline contact >100 g/m² was as follows: Browse Island - day 9, with peak oil ashore 41 m³ on day 12. Then the Bonaparte Archipelago/North Kimberley Marine Park shoreline locations- days 21- 24. Peak volume oil ashore across all receptors was approximately 267 m³ on day 26 of this run.

Figure 4 14 displays the results of the stochastic run (summer/wet season 059) which also produced the maximum volume of oil ashore at >10 g/m² and >100 g/m², at the worst-case moment in time for the run. The first contact >10 g/m² was Browse Island on day 10. The peak instantaneous volume ashore at Browse Island from this run was 41 m³ on day 12. Another ~225 m³ oil arrive



ashore around days 25-28 across the Bonaparte Archipelago/North Kimberley Marine Park shorelines. Peak oil ashore was 276 m³ in this run.

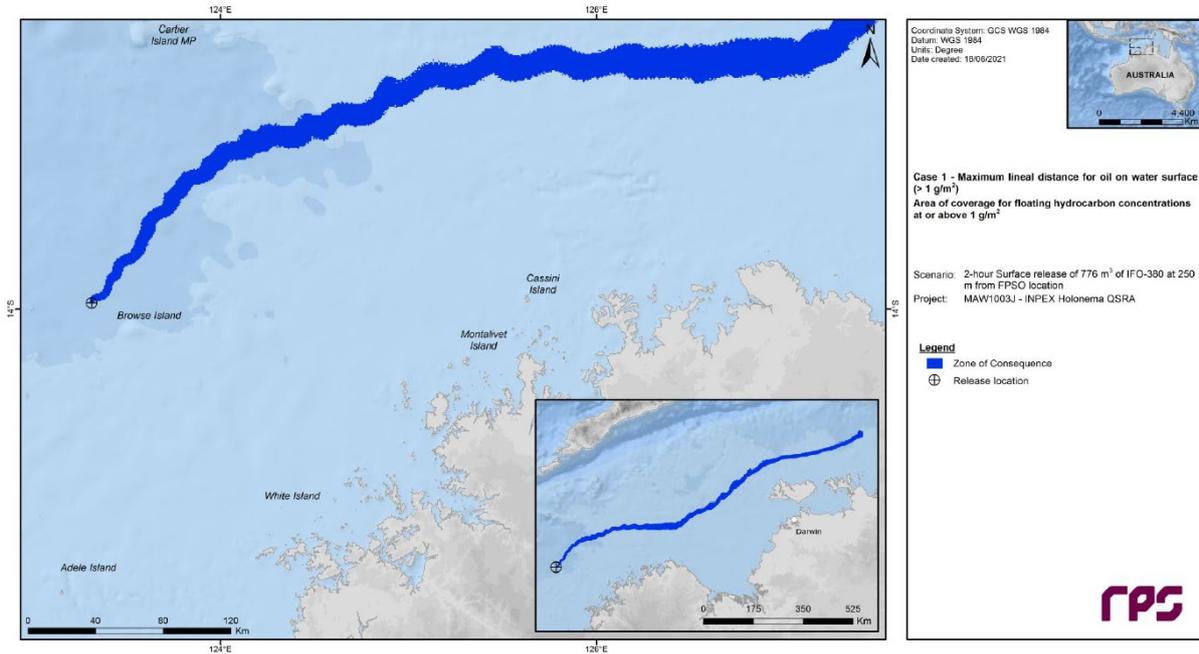


Figure 4-10: 776 m³ HFO spill maximum lineal distance for floating oil >1g/m²

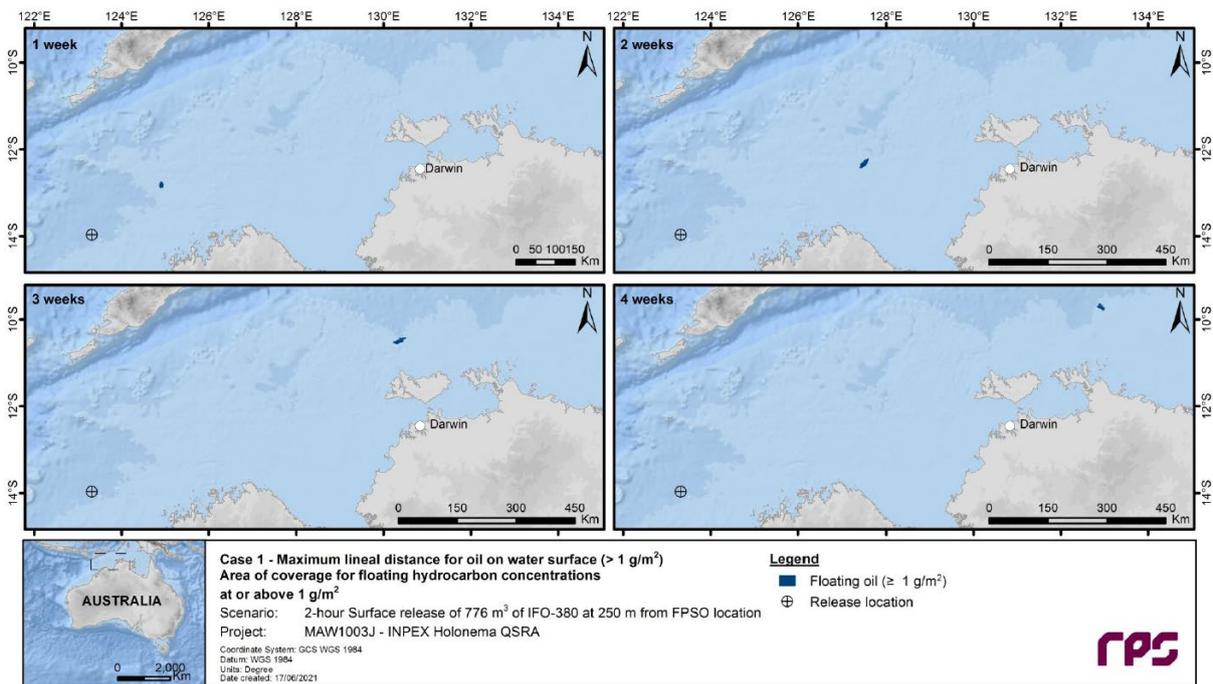


Figure 4-11: 776 m³ HFO spill 3rd highest lineal distance for floating oil >1g/m² time-series

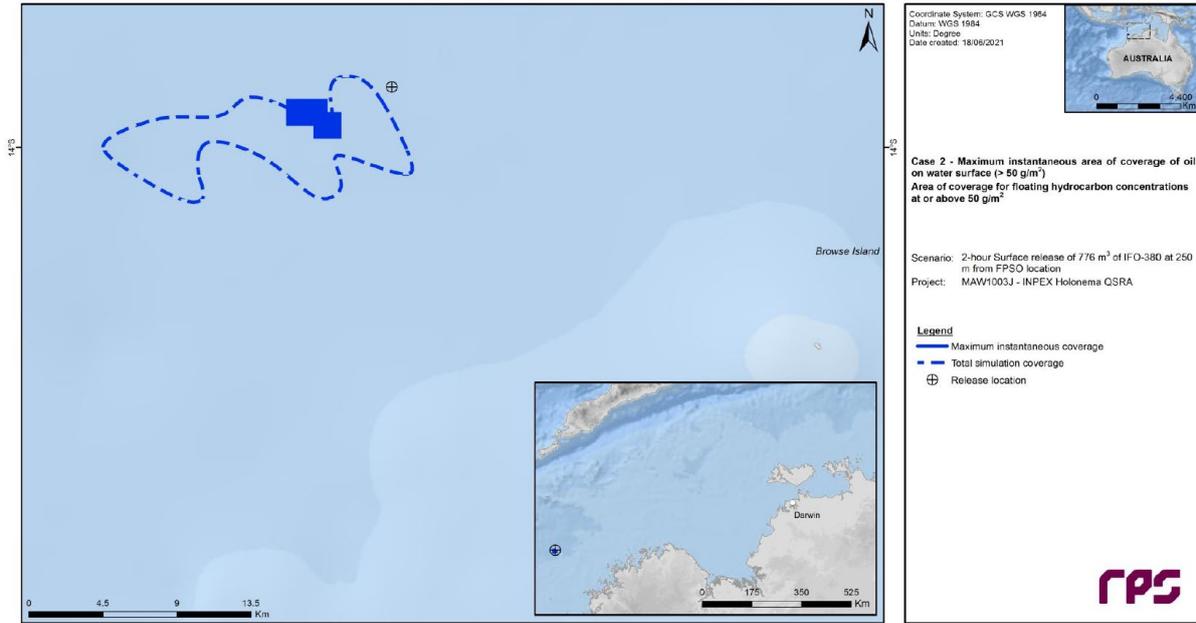


Figure 4-12: 776 m³ HFO spill maximum instantaneous, and total swept area floating oil >50g/m²

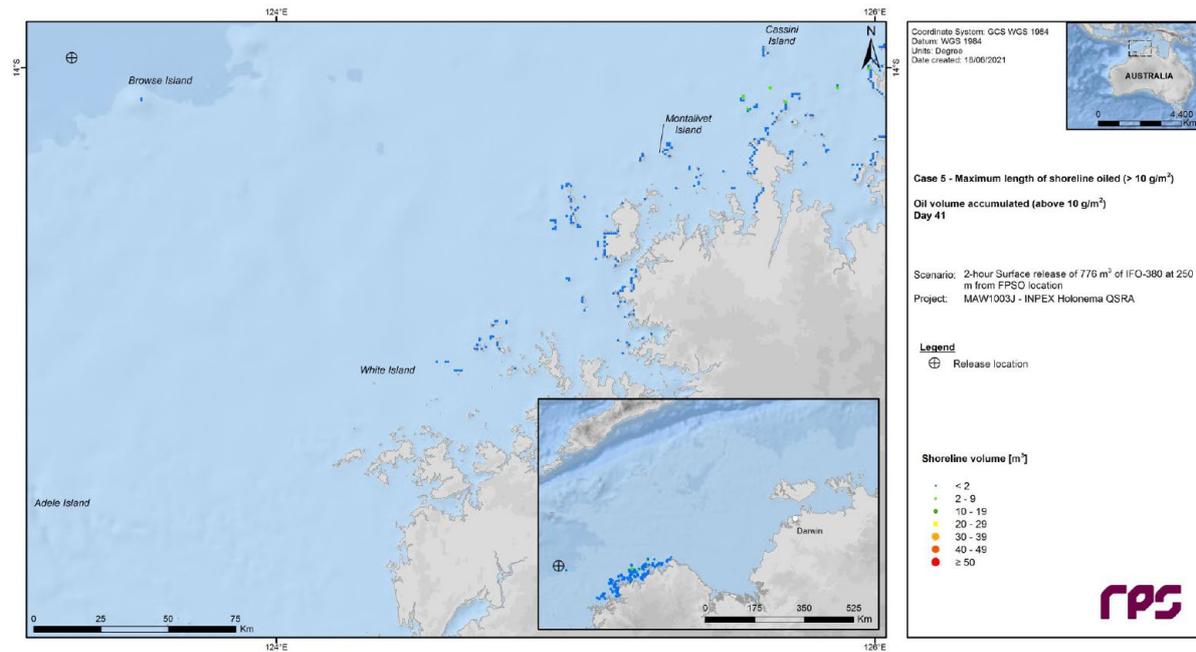


Figure 4-13: 776 m³ HFO spill instantaneous maximum length (km) of shoreline oiled at >10 g/m², showing instantaneous volumes oil ashore (m³)

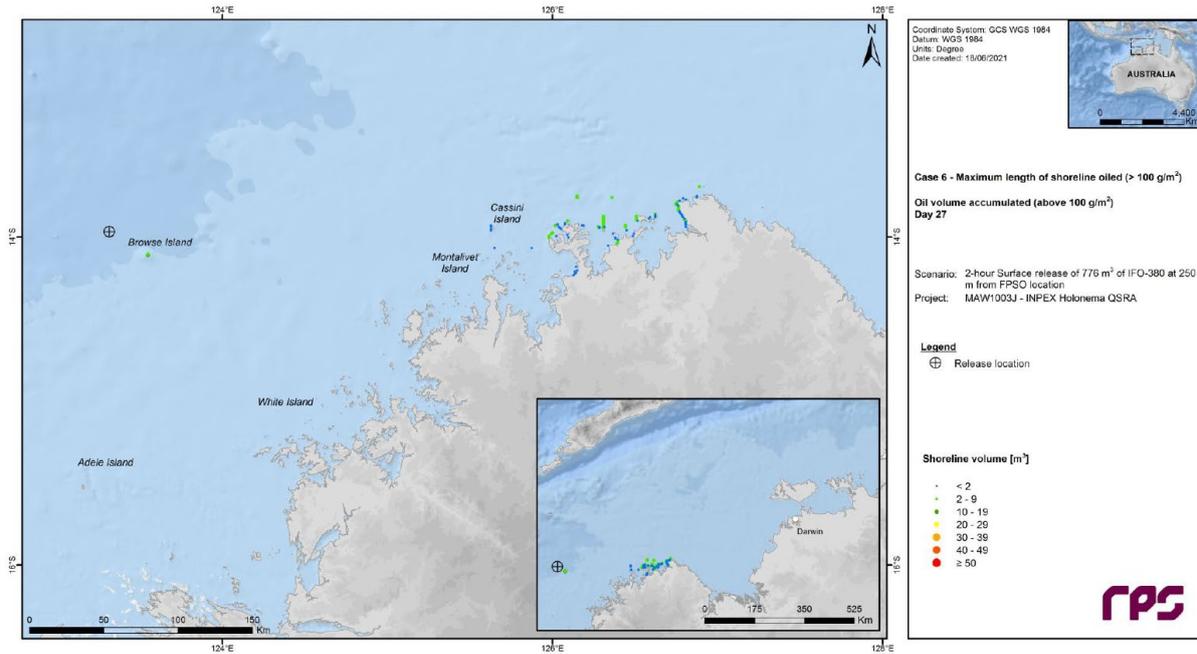


Figure 4-14: 776 m³ HFO spill instantaneous maximum length (km) of shoreline oiled at >100 g/m², showing instantaneous volumes oil ashore (m³)

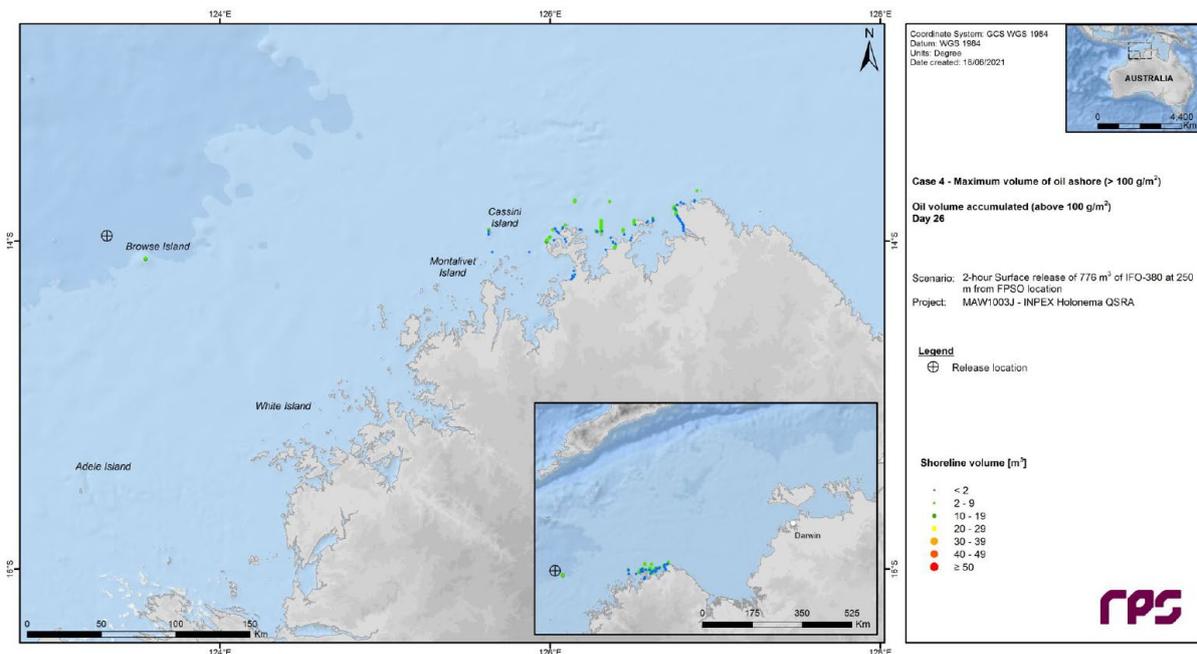


Figure 4-15: 776 m³ HFO spill maximum volume oil ashore >10 g/m² and >100 g/m²

The stochastic run which produced the minimum time to shoreline contact >10 g/m² was run summer 058. Results from this run show:

- Browse Island contacted >10 g/m² on day 1 (29 hours).
- Kimberley coastline contacted >10 g/m² on day 45.

The stochastic run which produced the minimum time to shoreline contact >100 g/m² was also summer run 058. Results from this run show:



- Browse Island contacted $>100 \text{ g/m}^2$ on day 1 (29 hours), with 73 m^3 oil ashore by day 3.
- Other Kimberley shorelines were contacted $>100 \text{ g/m}^2$ during this run around days 47-50.

In summary, the analysis of these shoreline contact results from the 776 m^3 simulations show:

- under worst-case conditions, one shoreline could be contacted at $>10 \text{ g/m}^2$ and $>100 \text{ g/m}^2$ within one day (minimum time 29 hours), with significant oil accumulation within 3 days.
- additional shoreline sectors could be contacted above thresholds within the next three to four weeks.
- significantly more shoreline sectors contacted above thresholds from days 25 onwards.

4.4 Comparison of the BOD outcomes to other petroleum activities

It should be noted that similar results would be expected for condensate well blowouts or vessel collisions within most other offshore permits (both Shell, Inpex and other petroleum titleholders) in the BROPEP region.

For example, for condensate drilling or production activities in closer proximity to Rowley Shoals, Scott Reef, or Ashmore Reef/Cartier Island (i.e. Crux), the spill scenario would result in shoreline contact with the near-by receptor within a few days, followed by potential shoreline contact at another offshore island or along the Kimberley or NT coastline within a few weeks during the wet season/transition season, or limited/no other shoreline contacts during the dry season.

Therefore, this BOD can be considered as a reasonable representation of the types of spill scenarios that could be expected for the majority of upstream petroleum activities associated with condensate exploration/production, in the region.

If light/medium crude wells were drilled/produced in the region, the associated WCSS's would be expected to result in increases in the floating oil concentrations and total volumes of oil ashore, however time to contact will always be dependent on the spill location and season. The process for evaluation other petroleum activities how they would be bridged to this BROPEP BOD/FCA report is presented in Section 8.2.

5 Spill Impact Mitigation Assessment

5.1 Spill Impact Mitigation Assessment

A series of strategic Spill Impact Mitigation Assessments (SIMA) for each WCSS relevant to Shell Australia's E&P activities in the Browse Basin have been developed and are presented in Attachment 3.

The strategic SIMAs are:

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

The SIMA process developed by IPIECA (2017a) is a pre-spill planning tool to facilitate response option evaluation/selection and support the development of the overall response plan by identifying and comparing the potential effectiveness and impacts of oil spill response strategies. The 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).

5.1.1 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 appropriate 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.

Predictive oil spill modelling (including the modelling outputs summarised in Section 4 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 titleholders’ activity specific 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). Where a resource compartment also supports/provides habitat for protected species, such as seabird or turtle etc, additional resource compartments (identified as habitats supporting EPBC listed/protected species) have been included, to capture these ‘high value resources’, in accordance with IPIECA (2017a).

Within each of the four Strategic SIMAs, 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 Strategic SIMAs.

For each strategic SIMA, nine oil spill response strategies were considered, including SMV, C&R, P&D, SCAT & shoreline clean-up, surface chemical dispersant, subsurface chemical dispersant, pre-contact OWR, post-contact OWR and in-situ burning.

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 on a particular compartment (balance trade-offs). A supporting justification for each impact modification score for each response strategy against each resource compartment is also presented in the Strategic SIMAs.

Each impact mitigation score was evaluated with no timing or resource limitations or weather constraints on the response strategy effectiveness.

Those response strategies with an overall positive score, and therefore represent the potential or mitigation of impact from the spill, are then selected for further assessment of the relevant capability. Those response options with an overall negative score have been discounted and are not further evaluated (refer to Section 6).



It should be noted that a higher or lower positive score does not necessarily indicate an absolute better outcome will be achieved by one response strategy compared to another, as the scores are influenced by the number of compartments an individual response strategy can affect (e.g. there are limited number of compartments which can be affected by oiled wildlife response yet this is a critical response strategy). Also, the Strategic SIMA process presented has not used averaging of individual impact mitigation scores for similar groups of habitats; an option discussed in IPEICA (2017a). Averaging impact mitigation scores across similar resource compartments (e.g. average score for the five intertidal habitats) should be considered, if developing additional Strategic SIMAs (e.g. for a ROPEP in a new region), it appears that the total impact mitigation score may becoming disproportionately biased towards or against a specific outcome. In effect, whilst the Strategic SIMA process is a semi-quantitative process to record and justify why a response strategy should or should not be considered for use under a specific spill scenario, a high level review of the outcome should still be conducted, to ensure an appropriate response strategy has not been incorrectly discounted.

A summary of the Strategic SIMA outcomes against each WCSS is presented in Table 5-1.

A more detailed summary of the Strategic SIMA outcomes is provided in Table 5-2. Table 5-2 also presents some high-level discussion of logistics and weather constraints which may affect the practicality of implementing certain response strategies.

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 WCSS.



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Table 5-1: Strategic SIMA outcomes for each WCSS

WCSS	Response strategy								
	Surveillance, monitoring and visualisation	At-sea containment and recovery (C&R)	Chemical dispersant (surface)	Chemical dispersant (subsurface)	Protection of sensitive resources (P&D)	SCAT & shoreline clean-up	Pre-contact OWR	Post-contact OWR	In-situ burning
Prelude condensate well blow out	Y	N	N	Y	Y	Y	Y	Y	N
Crux condensate well blow out	Y	N	N	N ⁶	Y	Y	Y	Y	N
Brewster condensate well blow-out	Y	N	N	Y	N	Y	Y	Y	N
Prelude loss of 42,000 m ³ condensate during	Y	N	N	N	N	Y	Y	Y	N

⁶ The primary reason dispersant application is not planned here is because it is outside the acceptable dispersant application zone which is applied due to buffers (<20km, <-30m depth) around the nearby shoals to the Crux location. It is noted that for operational reasons (i.e., platform access by oil spill response personnel) Shell may, via the operational SIMA process, select this as a necessary action to support an oil spill response.



product offloading									
FPSO 5700 m ³ condensate tank rupture	Y	N	N	N	N	Y	Y	Y	N
Crux loss of 2,037 m ³ condensate from export pipeline	Y	N	N	N	N	Y	Y	Y	N
Ichthys GEP rupture 12,600 m ³ condensate spill	Y	N	N	N	N	Y	Y	Y	N
Crux Vessel collision 1,000 m ³ HFO spill	Y	Y	Y ⁷	N	Y	Y	Y	Y	N
Vessel collision	Y	Y	Y	N	Y	Y	Y	Y	N

⁷ As long as the location is within the acceptable dispersant application zone.



776 m ³ HFO spill									
Vessel collision 750 m ³ MDO spill	Y	N	N	N	Y	Y	Y	Y	N
Vessel collision 284 m ³ MGO spill	Y	N	N	N	Y	Y	Y	Y	N



Table 5-2: Strategic SIMA outcomes summary

Response Strategy	Likelihood of success
Surveillance, monitoring and visualisation (SMV)	<p>The Strategic SIMA evaluations found that SMV should always be implemented in the event of any level 2/3 spill. As such, a combination of some or all of the following should always be implemented.</p> <ul style="list-style-type: none">• oil spill trajectory modelling• aerial and/or vessel surveillance• oil spill tracker buoys• satellite surveillance. <p>The field capability assessments to implement this response strategy are presented in Table 6-4 and Table 6-5.</p>
At-sea containment and recovery (C&R)	<p>The SIMA evaluations (which did not consider weather and logistical constraints) found that contain and recover was appropriate for Group IV - IFO/HFO spills only, and not relevant for condensate or MGO/diesel spills.</p> <p>Generally, oil needs to be $>100 \text{ g/m}^2$ (O'Brien 2002) to feasibly corral oil with a boom and achieve any significant level of oil recovery (reasonable level of efficiency) with the skimmers.</p> <p>The initial, gravity-dominated release and spreading of diesel is generally complete within minutes to hours after a release (O'Brien 2002), and as demonstrated via the various MGO and condensate modelling scenarios presented in Section 4. In the context of the region, which has high sea surface and air temperatures in all seasons, the spreading of any condensate and diesel spills would be very rapid, and therefore make this response strategy highly unlikely to be applicable. In addition, in the early stages of a condensate and diesel spill, in locations where concentrations are expected to be $>100 \text{ g/m}^2$, 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 condensate or diesel spill is not considered an appropriate strategy for implementation.</p> <p>For an IFO/HFO spill, where the slick is more persistent, less volatile, and likely to be present on the sea surface at appropriate concentrations ($>100 \text{ g/m}^2$) for an extended period of time (refer Table 4-5), a contain and recovery operation may be possible.</p>



	<p>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 strategies effectiveness may sometimes be limited by the prevailing sea state conditions of the North West Marine Region (NWMR).</p> <p>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). Other limitations including reduced effectiveness at >0.7 to 1 knot current speeds (IPIECA-IOGP 2015a) (these current speeds are often experienced in the region); ineffectiveness in adverse sea states (>20 knots / 1.8m wave height) routinely experienced during dry season and monsoonal conditions in the NWMR, skimmer reduced effectiveness in open ocean and with emulsified oils, and logistical issues associated with recovered waste at sea (ITOPF 2011a). As such, containment and recovery will remain a challenging response strategy against Group IFO/HFO oil spills in the NWMR.</p> <p>Weather conditions permitting, if SMV data indicates a positive outcome could be safely achieved it may be possible undertake a containment and recovery operation.</p>
Surface chemical dispersant (vessel/aerial)	<p>The SIMA evaluation found that chemical dispersant (surface application) was potentially an appropriate strategy for an IFO/HFO/LSHFO surface release only. It is not appropriate for surface condensate slicks or MGO/diesel spills.</p> <p>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 surface marine fauna and shoreline/intertidal sensitivities. Depending on sea-state, atmospheric conditions, weathering and emulsification of Group IV spills the 'window of opportunity' for effective dispersant application is generally limited – from a few hours, to a few days (ITOPF 2013). Dispersant is less likely to be effective against HFO, however more likely effective against IFO and LSHFO. In addition, due to the warm temperatures of northern Australian waters, the likely window for successful dispersant application may be extended, compared to colder climates. If a spill is ongoing, (i.e., leaking from a vessel over several days), the window of opportunity for dispersant application will likely be significantly extended, due to the ongoing release of fresh oil.</p>
Subsea chemical dispersant (subsea injection)	<p>The Strategic SIMA evaluations found that subsea dispersant injection (SSDI) was potentially an appropriate strategy a condensate well blowout within the acceptable dispersant application zone, but no other WCSS.</p>



	<p>Atmospheric modelling (RPS 2019c) of several worst-case well-blowout scenarios indicates that VOC concentrations would routinely be expected to exceed the 500 ppm VOC 15-minute short-term exposure threshold, resulting in the shut-down of any vessel activities near the well blowout location. This VOC risk would therefore potentially stop 'source control' activities, such as debris clearance or capping stack installation, potentially prolonging the duration of a well blowout and associated surface and entrained oil exposures. If SSDI were used during a well blow-out, for the time that SSDI was applied, modelling (RPS 2019c) indicates the rates of entrainment would increase and rates of evaporation would decrease. With SSDI application, during light wind conditions, ~70% of the condensate would entrain in the shallow water column (top 3m), with evaporation (and associated atmospheric VOC exposure) reducing to ~30%. Under increased wind conditions (>6 knots), evaporation becomes close to zero (RPS 2019c). Therefore, SSDI will cause a reduction in atmospheric VOC concentration, enabling a safe debris clearance/capping stack installation. Any impacts associated with the use of SSDI to achieve a successful well-kill using a capping stack are offset by the significant reduction in the overall duration of the blow-out (and net reduction in entrained hydrocarbons) compared to a relief well-kill scenario.</p> <p>The increase in entrainment from SSDI is similar to normal levels of entrainment expected to occur under higher wind conditions, and the effects of increased entrainment due to SSDI are partially offset due to a reduction in oil droplet size, resulting in a significant increase in biodegradation rates (up to 50%).</p>
<p>Protection of sensitive resources (P&D)</p>	<p>The SIMA evaluations found that protection of sensitive resources (or protection and deflection/P&D) was appropriate for Group IV/HFO spills and potentially appropriate for Group II/diesel spills, however most likely to be not appropriate/technically feasible for Group I spills.</p> <p>The outcome of the spill modelling (refer Table 4-5) indicated that significant volumes of oil could accumulate on an offshore island/shoreline if a vessel collision occurred in close proximity.</p> <p>Booms could potentially be used to protect and deflect spills away from sensitive habitats, and whilst oil needs to be >100 g/m² (O'Brien 2002) to achieve a reasonable level of recovery efficiency during a C&R operation, booms can be effective at deflecting oil away from a sensitive receptor, or into a natural collection point, at lower concentrations, preventing long-term oil accumulation on sensitive receptors.</p> <p>Given the size of the offshore island shorelines (e.g., Browse Island intertidal zone is 3 km in diameter, Scott Reef, Adele Island, Ashmore Reef, Lacapede Islands etc. are much larger), 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</p>



	<p>place by vessels, however due to widths of shorelines requiring protection, this would most likely require an unfeasibly large number of vessels and levels of equipment (e.g., 10 large offshore vessels, plus several kms of offshore boom, moving configuration every 6 hours). Anchored 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.</p> <p>If a slick were potentially reaching a more sheltered location such as the Kimberley or NT coastlines, shoreline booming may be a more appropriate strategy, on sheltered sandy beaches (not mangrove systems or rocky headlands), however the extreme tidal ranges (+7m) and presence of estuarine crocodiles in all Kimberley/NT sheltered coastal waters present very significant challenges. Therefore, if a tangible, positive outcome could be demonstrated and with the right weather conditions a resource protection operation may be possible.</p> <p>In the event of a spill, the IMT, in consultation with AMOSC and WA/NT Control Agency, would consider resource protection response options, based on the outcome of real-time evaluation of available SMV data.</p> <p>It should also be noted that for shorelines, the WA/NT Control Agencies, would make the ultimate decision on the response strategies to be implemented, with support provided by the responsible titleholder.</p> <p>For Ashmore Reef and Cartier Island, the responsible titleholder will be the Control Agency for shoreline response.</p>
SCAT & Shoreline Clean-up	<p>The SIMA evaluations found that SCAT & shoreline clean-up was potentially appropriate for all WCSSs.</p> <p>The outcome of the spill modelling indicated that for a well blowout, >400 m³ of weathered condensate (Table 4 4), or >100 m³ of weathered diesel could accumulate on an offshore island. For an HFO spill, a maximum volume of >250 m³ weathered HFO could accumulate at Browse Island, Tiwi Islands, Buccaneer Archipelago or other distant and remote island for the worst-case replicate (Table 4 5). Several other locations were also predicted to accumulate volumes of oil onshore >100 m³ in different HFO modelled simulations.</p> <p>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-IOGP 2015a).</p>



	<p>The clean-up of Group I or II spills on a shoreline is likely to be difficult, generating high volumes of waste in comparison to the volume of oil recovered.</p> <p>Most offshore island shorelines would be expected to 'self-clean' any accumulated Group I or II oils, due to the lack of adhesiveness of these oil types, the coarse substrate, the high wave energy and high tidal regime, and generally high temperatures and UV exposures.</p> <p>Group IV oils however are more persistent, and shoreline clean-up is more likely to be required.</p> <p>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 be left to self-clean.</p> <p>In the event of a spill, the IMT, in consultation with AMOSC and WA/NT Control Agencies, would consider SCAT & shoreline clean-up as a response strategy based on the outcome of real-time SMV data evaluation.</p> <p>It should also be noted that for shorelines, the WA/NT Control Agencies, would make the ultimate decision on the response strategies to be implemented, with support provided by the responsible titleholder.</p> <p>For Ashmore Reef and Cartier Island, the responsible titleholder will be the Control Agency for shoreline response.</p>
Pre-contact OWR (hazing and translocation)	<p>The SIMA evaluations found that wildlife hazing was potentially appropriate for all WCSS.</p> <p>The outcome of the spill modelling indicated that for all WCSS, weathered condensate, MGO or IFO/HFO could accumulate on offshore islands and/or mainland shorelines (refer Table 4-4 and Table 4-5 for various shoreline oiling volumes), all of which would present a risk of wildlife oiling.</p> <p>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 condensate or 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 IFO/HFO. Additionally, hazing isn't considered an effective measure against volatile spills which rapidly evaporate, such as condensate.</p> <p>IPIECA-IOGP (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</p>



	<p>a captured population back into a wild population could result in more significant impacts to overall population viability.</p> <p>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.</p> <p>In the event of a Group I, II or IV spill, the titleholder's IMT, in consultation with relevant WA/NT Control Agencies would consider pre-contact wildlife response as a response strategy based on the outcome of real-time SMV 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.</p> <p>It should also be noted that for shorelines and wildlife response, the relevant WA/NT Control Agency would make the ultimate decision on the response strategies to be implemented, with support provided by the responsible titleholder.</p> <p>For Ashmore and Cartier, the responsible titleholder will be the Control Agency for shoreline response.</p>
Post-contact OWR	<p>The SIMA evaluations found that post-contact wildlife response was potentially appropriate for all WCSS.</p> <p>The outcome of the spill modelling indicated that for all WCSS, weathered condensate, MGO or IFO/HFO could accumulate on offshore islands and/or mainland shorelines (refer Table 4-4 and Table 4-5 for various shoreline oiling volumes), all of which would present a risk of wildlife oiling.</p> <p>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-IOGP 2014). Given the predicted weathering of any Group I, II or IV spill, most wildlife exposure is</p>



	<p>expected to be weathered hydrocarbons, with lower associated levels of toxicity (Stout et al. 2016). Group I and 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 a Group IV spill.</p> <p>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-IOGP (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.</p> <p>ITOPF (2011b) note that there are many cases where oiled turtles have been cleaned successfully and returned to the water.</p> <p>In the event of a Group I, II or IV spill, the IMT would consider, in consultation with WA/NT Control Agency, post-contact wildlife response as a response strategy based on the outcome of the real-time SMV 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.</p> <p>It should also be noted that for shorelines and wildlife response, the WA/NT Control Agency would make the ultimate decision on the response strategies to be implemented, with support provided by the responsible titleholder.</p> <p>For Ashmore and Cartier, the responsible titleholder will be the Control Agency for shoreline response.</p>
Controlled in-situ burning (ISB)	The SIMA evaluations found that ISB was not an appropriate response strategy for any of the WCSS evaluated in this report.



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6 Field Capability Assessment

This section presents the completed field capability assessments.

It also includes other supporting information related to following:

- selection of WCSSs for detailed field capability assessment
- cone of response model
- oil spill budgets
- summary of environmental values and sensitivities of the BROPEP region
- summary of tiered preparedness models

6.1 Selection of WCSS for Field Capability Assessment

In accordance with the processes described in IPIECA-IOGP (2013) Part 2, two scenarios have been selected for detailed Field Capability Assessment, due to their BOD and Strategic SIMA outcome.

Justification for the selection of the two WCSS is provided in Table 6-1.



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Table 6-1: Selection of WCSS for Field Capability Assessment

WCSS	Selected (Yes / No)	Justification
Prelude condensate well blowout	No	The Brewster condensate full bore well blow-out scenario is worse than this scenario.
Crux condensate well blowout	No	The Brewster condensate full bore well blow-out scenario is worse than this scenario.
Brewster condensate full bore well blow-out	Yes	<p>Brewster well blow-out WCSS presents the largest volume of condensate release of the three condensate release scenarios.</p> <p>Subsurface dispersant injection is considered an appropriate response strategy.</p> <p>The duration and release volume result in multiple shorelines being contacted >100 g/m², potentially requiring multiple SCAT, shoreline clean-up and OWR activities in remote locations.</p>
Loss of Prelude condensate (42,000 m ³) during product offloading	No	This scenario, although the greatest instantaneous loss, is still significantly less than the Brewster condensate full bore well blow-out.
FPSO 5700 m ³ condensate tank rupture	No	<p>The FPSO collision WCSS total release volume is several orders of magnitude lower than the well-blowout WCSS.</p> <p>Table 4 5 demonstrate that risk of impacts to shoreline values and sensitivities from the FPSO collision WCSS is far lower than the potential level of impact from the well blow-out WCSS.</p> <p>Therefore, the field capability assessment conducted for a well blow-out WCSS will determine a capability requirement which is in excess of the FPSO collision WCSS.</p>
Loss of 2,037 m ³ Crux condensate	No	The Brewster condensate full bore well blow-out scenario is worse than this scenario.



<p>from pipeline export</p>		
<p>Ichthys GEP full bore rupture 12,000 m³ condensate spill</p>	<p>No</p>	<p>The GEP rupture WCSS total release volume is several orders of magnitude lower than the well-blowout WCSS. Table 4.5 demonstrate that risk of impacts to values and sensitivities from the GEP rupture WCSS is far lower than the potential level of impact from the well blowout WCSS. Therefore, the field capability assessment conducted for a well blow-out WCSS will determine a capability requirement which is in excess of the GEP rupture WCSS.</p>
<p>Crux Vessel collision 1,000 m³ IFO spill</p>	<p>No</p>	<p>Comparable in many respects to the Vessel collision 776 m³ HFO spill. It is worse in some respects, however for consistency of application is considered similar to the 776 m³ scenario, therefore it will remain for the now WCSS of a group II and IV oil.</p>
<p>Prelude Vessel collision 1,000 m³ HFO spill</p>	<p>No</p>	<p>Comparable in many respects to the Vessel collision 776 m³ HFO spill. It is worse in some respects, however for consistency of application is considered similar to the 776 m³ scenario, therefore it will remain for the now WCSS of a group II and IV oil.</p>
<p>Vessel collision 776 m³ HFO spill</p>	<p>Yes</p>	<p>The HFO WCSS presents the 3rd largest volume of a fuel oil release of the HFO/IFO and MGO vessel collision scenarios. This scenario considers surface chemical dispersant as an appropriate response strategy, and also has a high likelihood of requiring containment and recovery activities. This scenario also has the 3rd longest lineal distance >1 g/m² floating oil, longest length shoreline oiled at >10 g/m² and possibly >100 g/m² of any WCSS, and the second or third highest volume of oil on shoreline >100 g/m². When considering the emulsification factor associated with a HFO/IFO spill, this WCSS would likely exceed the well blowout total volume of oil ashore. Combined with the persistency of Group IV oils, this would subsequently result in the largest shoreline clean-up, OWR and shoreline waste management program of any scenario, and comparable with the Prelude and Crux 1000 m³ HFO/IFO scenarios.</p>



Vessel collision 750 m³ MDO spill	No	Comparable in many respects to the Vessel collision 776 m ³ HFO spill, however it is a group II oil, therefore not as persistent. It is worse in some respects, however for consistency of application is considered similar to the 776 m ³ scenario, therefore it will remain for the now WCSS of a group II and IV oil.
Vessel collision 284 m³ MGO spill	No	<p>The vessel collision MGO WCSS total release volume is approximately one third of the volume compared to the vessel collision HFO WCSS.</p> <p>Both the HFO WCSS and MGO WCSS present potential for impacts at remote offshore islands as well as Kimberley/NT coastal islands and shorelines.</p> <p>However, the BOD results (Table 4 5) demonstrate that the scale/magnitude of impacts both on the open ocean and on shorelines is generally significantly less for an MGO WCSS compared to the HFO WCSS.</p> <p>An evaluation of the stochastic modelling results demonstrated that a MGO WCSS typically only impacts an individual shoreline sector, where-as the modelling showed that a HFO WCSS has potential to impact a larger volume/length/greater number of shoreline sectors.</p> <p>MGO WCSS typically only impact a single shoreline location. From an oiled wildlife perspective, a location such as the Lacapede Islands (turtle nesting) or Adele Island (seabird nesting) are likely to have larger numbers of wildlife present, compared to Browse Island (being the closest shoreline location from the HFO spill risk). However due to the volumes calculated ashore, emulsification (increasing total volume of HFO oil ashore), significantly increased persistency of HFO, and widespread area of potential shoreline contact from the HFO WCSS, it is considered that the HFO WCSS has the potential to result in a greater oiled wildlife impacts, compared to any modelled MGO scenario.</p> <p>Maximum volumes of oil ashore presented in Table 4 5 are 'neat oil', not accounting for emulsification. Group IV oils emulsification typically result in larger total oil volumes arriving ashore, and in combination with bulking factors, also result in larger oily waste volumes being generated during shoreline clean-up. Group IV oils are also more persistent on shoreline (higher pour-point and less susceptible to UV degradation) and are likely more recoverable. Therefore, a larger shoreline clean-up team would typically be required compared to an equivalent volume of 'neat' MGO oil arriving ashore. Also, Group IV persistency likely results in higher number/consequence of OWR response, for the same volume of oil ashore.</p>



		<p>The Strategic SIMA outcome identifies the potential for the activation of the same response strategies as for the MGO WCSS and the HFO WCSS scenario, with two exceptions. The HFO WCSS scenario also includes the use of at-sea containment and recovery, and surface chemical dispersant, which are not appropriate during an MGO spill scenario.</p> <p>Therefore, the field capability assessment conducted for the HFO WCSS will determine a capability requirement which is in excess of the field capability required for the MGO WCSS.</p>
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6.2 Cone of response

To maximise the effectiveness of the overall response effort, the most effective and advantageous options should be deployed as close to the source as possible, (depending on safety and operational limitations). Supplementary actions should then radiate out from this location. This approach is known as the 'cone of response' model and is displayed in Figure 6-1. Optimising the response in this way can help to maximise the removal of oil from the water's surface (IPIECA-IOGP 2015a).

IPIECA-IOGP (2015b) have developed a similar cone of response model (refer to Figure 6-2); however, this only considered the at sea response strategies.

Figure 6-1 provides the layout of at-sea response strategies with Zone A for C&R located closest to the spill source, followed by Zone B for FWAD and Zone C for vessel dispersant at increasing distances from the spill source. In contrast, the IPIECA-IOGP (2015b) model (Figure 6-2), shows dispersant operations closest to the spill source and C&R used adjacent to a shoreline sensitivity.

Another 'cone of response' model, which commences from the start of the spill has been developed by AMOSC, provided as Figure 6-3.

These various models have been provided, as an indication of the potential variety of configurations in which the various response strategies can be deployed, to achieve specific response objectives.

The field capability assessment process is used to assess and determine the most suitable capabilities and arrangements for the various response strategies for each WCSs. Where relevant, the field capability assessment should take into consideration the various 'cone of response' models available, and different outcomes which can be achieved by varying how and where each response strategy is implemented.

Whilst subsea dispersant injection is within the scope of this document, other source control activities such as capping stack deployment, debris clearance and relief wells are not. Source control capabilities and arrangements are addressed in relevant activity specific EPs.

Remote shoreline operations are not typically addressed in spill response literature and the cone of response models. Remote shoreline operations are a significant consideration for the BROPEP. The BROPEP encompasses a region with incredibly low levels of infrastructure along the mainland coastline between Broome and Darwin, several thousand islands within State/Territory coastal waters, and a significant number of very remote offshore islands/reef systems. Therefore, some response activities such as SCAT, P&D, shoreline clean-up and OWR are highly likely to require the use of a floating/vessel-based logistics platform. This is similar to having a floating offshore command post/staging area, as shown in Figure 6-1. However, additional logistical support such as smaller vessels, landing barges and possibly light utility helicopters are required to facilitate response logistics.

Techniques to facilitate remote shoreline oil spill response in northern Australia have been significantly researched by titleholders, with a primary focus on Browse Island. However, the principles, logistics plans, safety plans, etc. that have been developed for a response at Browse Island are broadly applicable to any remote northern Australian location. This is because the hazards are similar including:

- extreme remoteness of most locations (>1 hour flight time to any town/city, no/minimal local services available)
- lack of any infrastructure (i.e. roads, ports, airfields) at virtually every shoreline location



- large tidal ranges and challenging met ocean conditions making shoreline landing via vessel difficult at times
- estuarine crocodiles and other marine fauna hazards, especially for islands closer to the mainland
- intense heat/humidity

Detailed remote response planning documentation is available via the Browse Island Oil Spill Response Guideline. The Shell Australia/INPEX offshore/remote response techniques have been tested as part of several desktop exercise, including with NOPSEMA, AMSA and WA DoT during spill response planning (APPEA 2020).

Whilst Shell Australia's focus has been remote response at offshore islands, remote response can also be facilitated at remote shorelines with road access, by establishing remote accommodation camps/forward operating bases (FOBs).

A summary of remote response requirements is provided in Figure 6-2.



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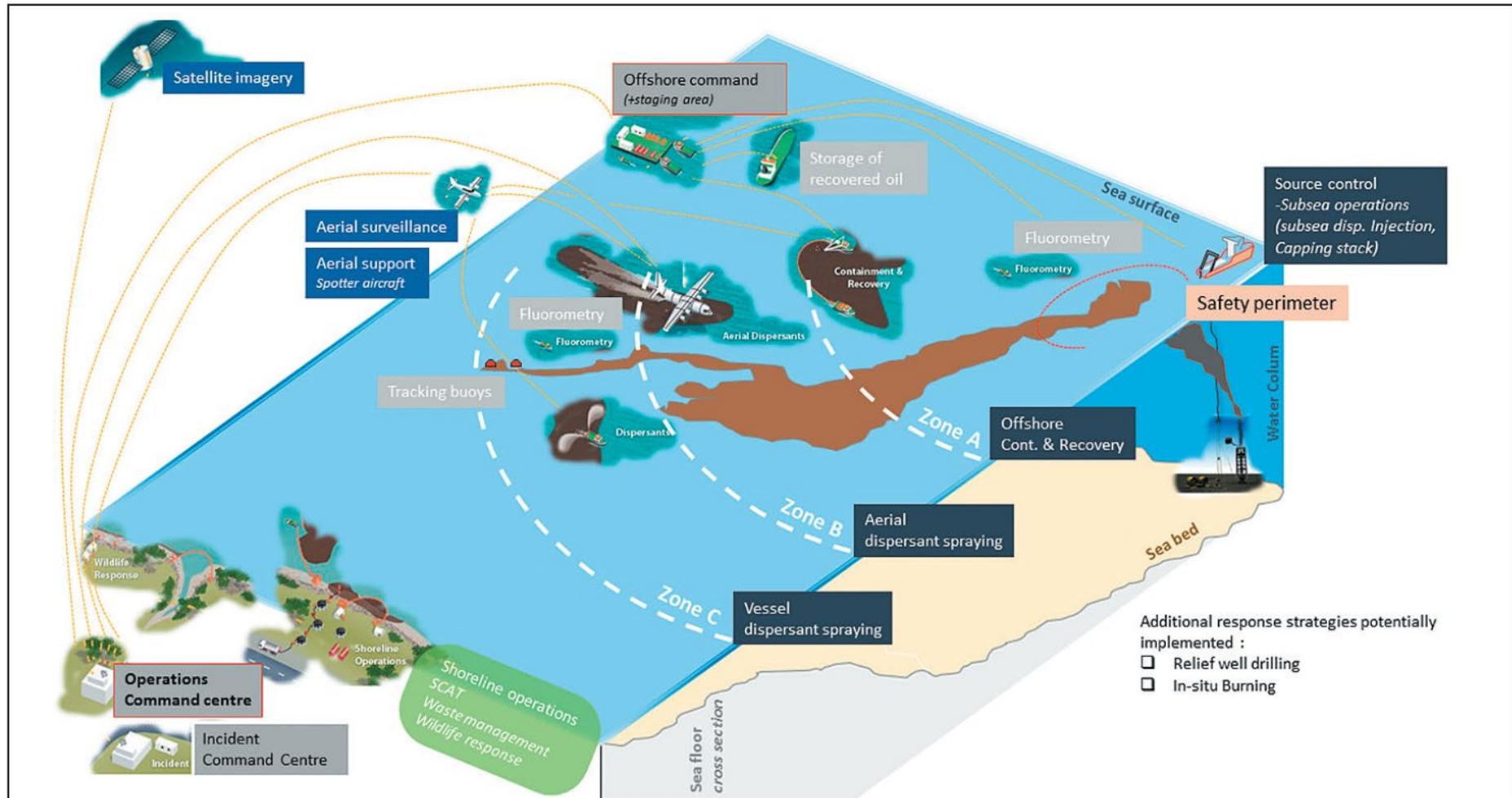


Figure 6-1: Cone of Response Model (Source: EOSP, 2012)

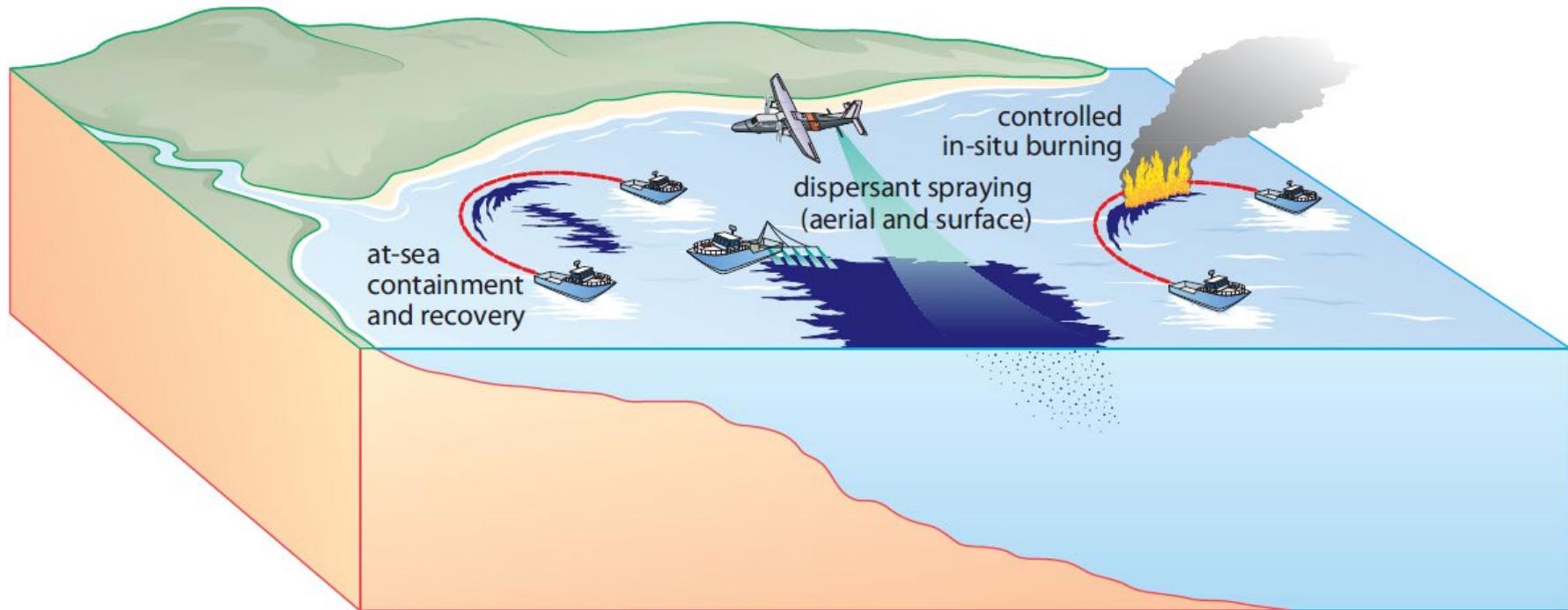


Figure 6-2: At sea response techniques for responding to a surface spill (Source: IPIECA, 2015b)

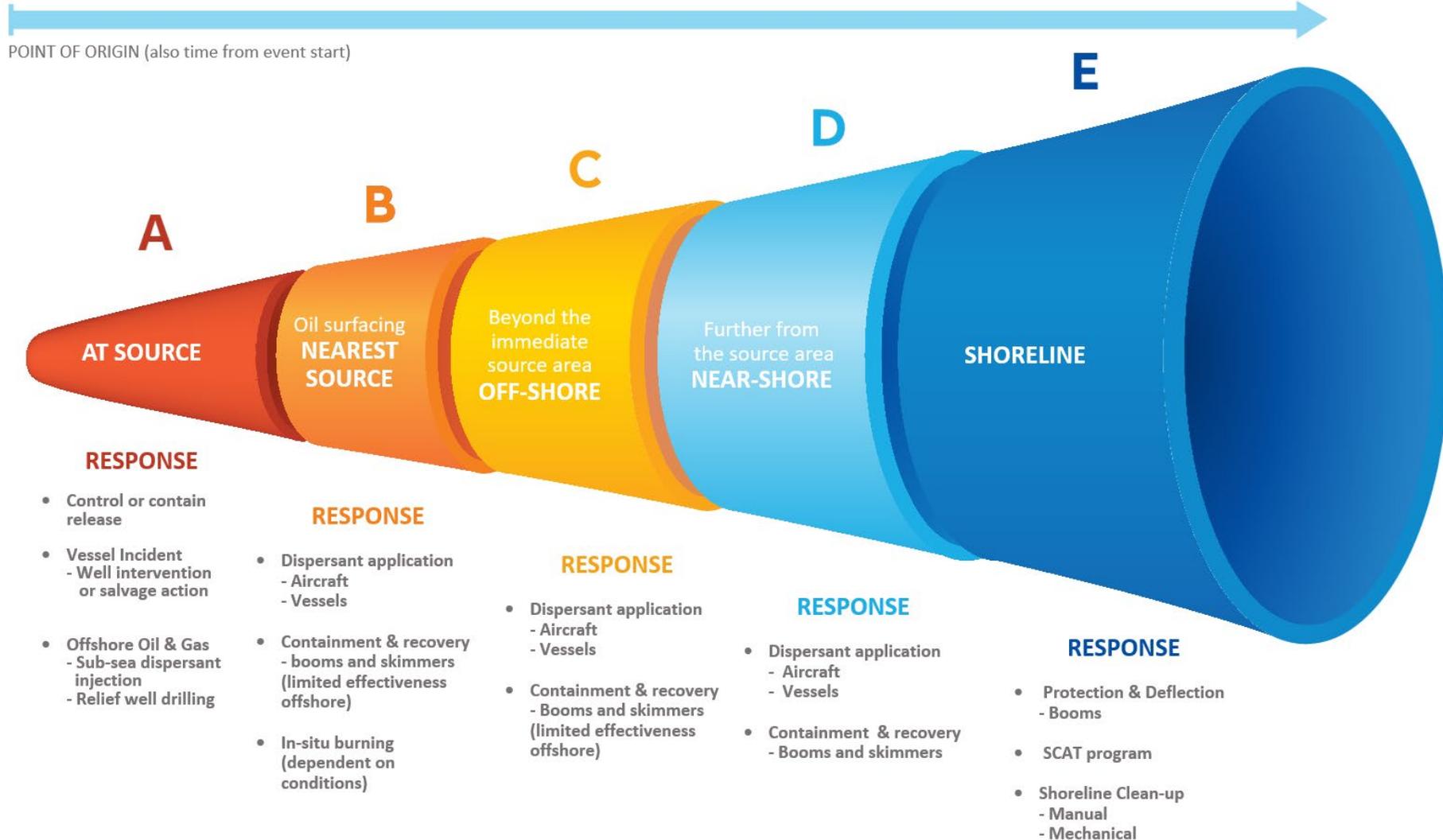


Figure 6-3: Cone of response- AMOSC model



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6.3 Oil Spill Budget

An oil spill budget is a process used to assist in the evaluation of the field response capability, based on the volume/thickness of oil within a certain area, weathering and behaviour of the oil over time in the environment, and the effectiveness of the various response strategies.

Oil spill budgets are used as part of the field capability assessments, presented in Section 6.5.

The below sub-sections describe factors affecting an oil spill budget for the various response strategies.

Generation of an oil spill budget can provide an early indication of a number of response parameters including:

- potential waste volumes
- scale of response
- duration of response
- likely efficacy of specific response strategies

6.3.1 At Sea Containment and Recovery

At sea containment and recovery is the controlled collection and recovery of floating oil from the water's surface. The response typically involves the deployment of booms and oil skimmers from suitable vessels, as well as the collection, transfer and disposal of oil and oily water recovered during the response.

A traditional U-sweep or J-sweep configuration involved two vessels (or one vessel using a paravane to hold the boom mouth open). The width of the mouth of the boom is typically one third the boom length, therefore ~120 m wide mouth if 400 m of boom was deployed.

Advanced booming techniques require up to 3 to 5 vessels per strike team with advanced booming equipment such as current-busters & speed-sweep systems. These configurations and equipment can operate at higher speeds (up to 5 knots), however have a narrower swath width, typically only 15 - 22 meters (IPIECA-IOGP 2015a). Advanced booming techniques are useful in scenarios when the slick has spread and fragmented, however targeted operations will typically require some form of air or drone support due to the difficulty of oil on water observation from vessels. Another issue is that current busters have limited oil storage capacity in the pocket, and therefore booming operations must stop, and switch to skimming when the system becomes full. Therefore, the overall encounter rate/oil recovery rate over an operational period may not vary significantly when compared to traditional techniques.

Effective containment and recovery can reduce the potential risks and impact of a marine pollution event associated with:

- marine fauna
- sensitive shoreline environments
- shoreline response
- waste generation.

However, the overall effectiveness of containment and recovery can be limited by a combination of operational constraints which may include but not limited to:

- slick: thickness and percentage cover on surface (affecting the encounter rate)
- slick: state of weathering (how recoverable the oil is with a skimmer)
- weather: suitable weather/sea state conditions and current strengths



Generally, oil needs to be $>100 \text{ g/m}^2$ ($>0.1 \text{ mm}$, which equates to Bonn Code 4/5) to feasibly corral oil with a boom and achieve any significant level, or operationally efficient level, of oil recovery with skimmers during an offshore C&R operation (O'Brien 2002 and IPIECA-IOGP 2015a)

Continuing containment and recovery operations for slicks noted to be in Code 1, Code 2, and Code 3 (silver/grey sheen, rainbow sheen and metallic sheen respectively) would require consideration of potential recovery rates versus the likely benefits to the environment, as well as operational risk and cost.

The rate at which the spilled oil can be captured within the boom is known as the encounter rate (IPIECA-IOGP 2015a), and is a product of the:

- swathe width of the boom configuration
- speed at which the boom is being towed
- thickness and continuity of the oil slick that is being encountered, which may vary considerably, due to slick spreading & fragmentation.

It is possible to estimate encounter rates and recovery volumes based on the following; oil thickness x boom opening (which is generally 1 third length) x efficiency rate (typically around 10% but could be higher depending on oil type).

Containment and recovery potential calculations provide an indication of the possible impact per strike team on oil spill budget. Calculations can be done on the following basis to indicate a maximum recoverable volume in m^3/hr :

- width of boom collecting oil on water (full span width for advanced boom systems such as a Current Buster, or 30% of boom length for conventional Ro-Boom or similar system)
- thickness of oil on water (typically within BONN Agreement Discontinuous True Colour range of between $50\mu\text{m}$ and $200\mu\text{m}$)
- rate of travel over water, which is typically a maximum of 0.75 knots for conventional boom, or up to 4 – 5 knots for advanced booming systems (because excess speed over water will result in oil escaping beneath the boom)
- time of operation per day (daylight hours minus deployment time, skimming time (advancing boom systems) or other HSE requirements/constraints)

Two worked examples for oil spill budget for at sea containment and recovery are provided below. Note, these examples are based on the strike team encountering contiguous oil of $50\mu\text{m}$ (minimum containment potential) and $200\mu\text{m}$ (maximum containment potential), across the entire mouth of the boom, for the entire duration of an operational period.

- Current buster strike team
 - Equipment Current Buster 4 (National Plan stockpile standard)
 - Encounter width full span (22 m)
 - BONN agreement Discontinuous True Colour Range, $50\mu\text{m}$ and 2 knots speed over water (minimum)
 - BONN agreement Discontinuous True Colour Range, $200\mu\text{m}$ and 4 knots speed over water (maximum)
 - 8 hr operational period per day
 - **Minimum containment potential = $33 \text{ m}^3/\text{day}$**
 - **Maximum containment potential = $261 \text{ m}^3/\text{day}$**
- Traditional Ro-Boom strike team
 - Equipment 2 x 200 m lengths offshore Ro-Boom



- U or J formation with encounter span 30% of total length = 120 m
- BONN agreement Discontinuous True Colour Range, 50µm (minimum) and 200µm (maximum) oil on water
- Speed over water 0.75 knots
- 8 hr operational period per day
- **Minimum containment potential = 67 m³/day**
- **Maximum containment potential = 267 m³/day**

However, based on the constraints listed above, experience has shown that the efficiency of at-sea containment and recovery operations can vary widely and recovery is usually limited to between 5% and 20% of the initial spilled volume (IPIECA-IOGP 2015a).

6.3.2 Surface Dispersant

Dispersant application is designed to transfer oil from the surface of the ocean to the water column and to enhance the natural process of biodegradation. Being able to target oil closest to the source provides the best outcome in terms of efficacy of the dispersant product on the hydrocarbon. This minimises the ongoing impact of pollution in the environment and reduces the overall potential oil spill budget. Dispersants can treat more oil over time typically than other response options due to the versatility of application using both aircraft and vessels. Careful planning for dispersant operations will ensure that any requirement for dispersant application can continue as needed for the duration of a response.

For successful operations the dispersant must be effective. This can be determined in a number of ways including:

- jar test (From a sample collected at source or spill) conducted on site
- efficacy testing by a laboratory on known products and hydrocarbons
- visual analysis by trained responders of test spray from aircraft or vessel

Noting that for heavier oils dispersion can take longer (up to 30 minutes) to occur depending on the dose/concentration applied and wind/wave activity, which will drive mixing of the dispersant into the oil.

Australian stockpiles of dispersant consist generally of products considered to be effective on a broad range of oils rather than specific to a given type. The application rate may change considerably (high application rates for thicker layers of viscous oil, lower rates for thinner, lighter oils) but efficacy on a typical crude product is usually above 70%.

In addition, calculations can be derived to generate an indicative number of assets or strike teams. Example dispersant oil spill budget considerations are provided below.

Aircraft Application

Aircraft application for an offshore response provides the ability to treat large volumes of oil over a large area, in a relatively rapid timeframe. Aircraft also have the ability to transit quickly to respond and to treat slicks separated over large distances.

Aerial operations are restricted to daylight hours and typically require good visibility, minimum cloud ceiling of 1000ft, and wind speeds below 35 knots to ensure aircraft and pilot safety. Pilots are responsible for aircraft operations and safety at all times.

Defining a single aircraft and support requirements as a strike team, indicative impact on oil budget per strike team can be derived using the following parameters (based on an air-tractor / crop-duster type aircraft):



- total or daily volume of release
- calculated dispersant volume to treat at initial 1:20 dispersant to oil ratio
- dispersant efficacy on oil is 70%
- one aircraft can deliver 3 m³ per sortie
- one aircraft can typically conduct a maximum of 4 sorties per day, reduced to 3 sorties per day, if conducting operations a significant distance offshore)

The impact of one Fixed Wing Aircraft strike team is approximately 42 m³ of oil treated per sortie or 126 m³ per day with 4 sorties.

Vessel Application

Vessel-based dispersant spray application provides the ability to accurately target oil on the water. However, air support, or the use of drones, allows operators to locate slicks that are difficult to observe from sea level. Smaller amounts of dispersant, or diluted dispersant can be applied based on onsite assessment of efficacy, improving application efficiency.

There are a number of different systems for vessel-based application and the general considerations for efficient use include:

- mounting of spray arms as far forward as possible to avoid the bow wave moving oil out of the spray path
- nozzles that produce a flat spray of droplets (not mist or fog) that strike the water in a line perpendicular to the direction of vessel movement
- operation of vessel in prevailing wind/weather conditions to avoid overspray onto decks or personnel
- initial (rule of thumb) dispersant to oil ratio of 1:20 which can then be adjusted to actual field concentrations based on observed efficacy
- treatment should initially target the outer edges of the thicker portions of any slick rather than through the middle or on thin sheen at surrounding edges.

Defining a single vessel and support requirements as a strike team, indicative capability impact on oil spill budget can be derived using the following parameters:

- total or daily volume of release
- calculated dispersant volume to treat at initial 1:20 dispersant to oil ratio
- dispersant efficacy on oil is 70%
- calculated vessels required based on 1 m³/hr dispersant delivery per 8 hour day per vessel (based on single AFEDO system – note - other spray systems may vary in delivery rates /capability)
- number of spray systems per vessel

The impact of one vessel-based strike team is approximately 14 m³ of oil treated per 1 m³ of dispersant, or 112 m³ of oil per day, using 8 m³ of dispersant per day.

6.3.3 Subsurface Dispersant Injection

Sub-sea dispersant injection (SSDI), conducted essentially at the source, has a significant impact on the oil spill budget and provides a number of advantages over surface dispersant application including:

- application can be continuous regardless of time of day or weather and sea state
- once set up, injection requires less manpower and assets
- efficacy on fresh oil at source is higher, and with increased dispersant mixing due to the turbulent flow in the oil/gas stream, SSDI requires less dispersant (1:100 dispersant to oil



ratio typically used for SSDI) providing the ability to treat large volumes of oil with lower volumes of dispersant compared to surface dispersant application.

- sub-surface injection has been shown to significantly reduce volatile organic carbons (VOCs) at surface (e.g., Macondo/Gulf of Mexico incident), increasing safety of responders on waters adjacent to the source of the release.

An indicative capability impact on oil budget can be derived using the following parameters:

- total or daily volume of oil released
- calculated dispersant volume to treat the oil at an initial 1:100 dispersant to oil ratio (AMOSC 2016; IPIECA-IOGP 2016a), or
- maximum dispersant flowrate at point of injection

6.3.4 In Situ Burning

ISB requires wave heights typically below 1 m and wind speeds below 10 knots (IPIECA-IOGP 2016b)

To implement an effective in-situ burn response, a minimum surface hydrocarbon thickness of 2- 5 mm (2000 - 5000 g/m²) is required to be present. Booms would be required to corral the spill, in an attempt to generate additional oil thickness. Therefore, ISB could potentially be attempted in the same locations, on the same slicks as at sea containment and recovery.

The efficiency rates can then be calculated based on the same factors as used for at sea containment and recovery, noting that additional time is then required to conduct the burn itself.

6.3.5 Protection of Sensitive Resources

There is no 'minimum thickness' for effective P&D booming (unlike at sea containment and recovery where 100 g/m² typical thickness is required for reasonable oil recovery volume). Booming at lower floating oil concentrations can still result in a positive environmental outcome, by preventing accumulation over time.

Oil spill budget factors that can be:

- location specific tidal ranges and current speeds will need to be taken into consideration, to determine potential nearshore/shoreline booming configurations and their potential effectiveness.
- based on potentially effective booming configurations, it is possible to calculate the required lengths of boom and associated ancillaries for specific receptors/locations.
- an estimate would then need to be made in regard to the interception rate and recovery rates for nearshore/shoreline oil.

6.3.6 Shoreline Response

Shoreline response is one of the final areas to impact the oil spill budget. Clear derivation of the impact is complex considering:

- volumetric changes to the oil over time due to weathering
- bulking factors based on marine or shoreline debris
- bulking factors introduced through cleaning methods or requirements
- waste management and hazardous waste minimisation

A 'rule of thumb' estimate (IPIECA-IOGP 2015c) of the impact of shoreline clean-up efforts on oil spill budget is that one person can remove 1–2 m³ per day.



6.3.7 Oiled Wildlife Response

Some elements of potential oiled wildlife capability can be evaluated, based on a range of parameters, including:

- location, density and abundance (and seasonality) of wildlife population(s) potentially at risk from a WCSS
- oil types (including weathering properties) and how the fresh vs weathered oil(s) may affect the various wildlife species
- credible response options/tactics for the various species/populations (E.g., comparison of hazing vs pre-emptive capture and translocation vs collection/rescue, intake, first aid/stabilisation, initial clean and rapid release, or full cleaning, long-term rehabilitation and release).
- the species protection/priority status, and evaluation of the impact of the loss of individual animals on the overall species/population viability; which informs the justification for full cleaning and rehabilitation, vs other treatment/welfare options.

OWR planning should ensure that capabilities are available for the likely/credible OWR options/tactics, based on the evaluation of the key species at risk.

During oiled wildlife cleaning, it is expected that between 600 – 1000 L of fresh water may be required to wash and rinse one wildlife casualty. Additional water is required for rehabilitation pools, general cleaning etc. Therefore, the supply of fresh water, and oily water storage is a key consideration.

An overall space requirement of approximately 2,400 m³, a water flow capacity reaching 60,000L/day and an electrical load of 200 Amps (for heating, air conditioning etc) are a conservative estimate for a centre dealing with 100 to 500 wildlife casualties at a cleaning/rehabilitation facility at one time (DBCA 2014).

6.4 Environmental Overview of the BROPEP Region

A detailed description of the existing environment, including full EPBC Protected Matters Search outputs and literature review of the values and sensitivities potentially impacted by oil spills are contained within each activity specific EP, related to this BROPEP.

In addition, environmental values and sensitivities maps are provided in Appendix A of the BROPEP (HSE_GEN_016765).

However, to provide context for spill response planning purposes, a very high-level summary of the environmental values and sensitivities of the region is provided below.

- Deep offshore waters
 - Typically nutrient poor, supporting pelagic fish, sharks, cetaceans etc, and marine avifauna
 - Some demersal fisheries
 - Some offshore oil and gas developments
- Offshore submerged banks and shoals
 - typically coral/coralline algae dominated substrates, supporting diverse shallow water reef ecosystems, including aggregation/feeding areas for marine megafauna
- Offshore emergent reefs/islands



- typically coral/coralline algae dominated substrates, supporting diverse shallow water reef ecosystems, including aggregation/feeding areas for marine megafauna
- coarse sandy beaches, some with limited vegetation
- most offshore islands typically supporting protected marine fauna (turtle/bird) roosting/breeding/nesting.
- Kimberley/NT coastline – outer islands
 - highly tidal, typically moderate wave energy rocky shorelines or coarse sandy beaches, with highly diverse fringing coral reef ecosystems
 - some beaches supporting protected marine fauna (turtle/bird) roosting/breeding/nesting, and occasional presence of estuarine crocodiles.
- Kimberley/NT coastline – inshore islands/mainland coast
 - highly tidal, typically moderate to low energy shorelines, dominated by extensive mangrove habitats, with some rocky outcrops and medium to fine-grain sediment beaches.
 - mangrove and beach habitats support diverse ecosystems, including significant populations of estuarine crocodiles.

6.5 Tiered Preparedness

Tiered preparedness is described by the IPIECA-IOGP (2016c) Tiered Preparedness Guideline as:

- Tier 1 capabilities describe the locally held resources used to mitigate spills that are typically operational in nature occurring on or near an operator's own facility.
- Tier 2 capabilities are typically extra resources from regional or national providers, used to increase response capacity or to introduce more specialist technical expertise.
- Tier 3 capabilities are globally available resources that further supplement Tiers 1 and 2. The resources held at the three tiers work to complement and enhance the overall capability by enabling seamless escalation according to the requirements of the incident.

An important concept is the cumulative nature of a tiered response. The elements of a Tier 1 response are supplemented by higher tier capability and not superseded or replaced by it.

The National Plan (AMSA 2020a) identifies three levels of incidents as follows:

- Level 1: Incidents are generally able to be resolved through the application of local or initial resources only (E.g., first-strike capacity)
- Level 2: Incidents are more complex in size, duration, resource management and risk and may require deployment of jurisdiction resources beyond the initial response
- Level 3: Incidents are generally characterised by a degree of complexity that requires the Incident Controller to delegate all incident management functions to focus on strategic leadership and response coordination and may be supported by national and international resources.

Combining these two descriptions, for the purposes of regional response planning, within an Australian context,

- Tier one resources are typically being held 'locally'
- Tier two are those held regionally (E.g., West Coast vs East Coast resources) or a portion of the nationally capability
- Tier three being full deployment of the national resources, and global capability where required.



Table 6-2 presents an example analysis of the equipment/assets which could be deployed for each field response activity under each tier of response in an Australian context.

This table was initially prepared by the Australian Marine Oil Spill Centre (AMOSC) in 2020, as part of an Australian Petroleum Production and Exploration Association (APPEA) IMT training and capability assessment project and is therefore presented below as an indicative/conceptual model only (i.e. this a conceptual model, not endorsed under the NatPlan or any State/Territory Control Agency oil spill contingency plan (OSCP)).

This conceptual model has been developed/presented below, for the purposes of assisting in the consideration of field capability units/strike teams, when conducting the field capability assessment process.

Table 6-3 presents the BROPEP specific definitions of tiered capability.



Shell Australia

Table 6-2: Example Tiered Preparedness Capability Overview

Response Strategy	Response objectives strategy	Capability Description	Tier One Example Criteria	Tier Two Example Criteria	Tier Three Example Criteria
Surveillance, monitoring and visualisation (SMV)	To collect spill event/response data from a wide variety of sources, to enable informed and timely IMT decision making during a response.	<p>Oil Spill Trajectory Modelling (OSTM)</p> <ul style="list-style-type: none"> OSTM will provide predictions of the trajectory and fate of the oil spill OSTM can be used to predict effectiveness of dispersant OSTM outputs can be further interrogated to inform health and safety decisions (such as atmospheric risks etc). <p>The capability requirements for OSTM are provided below.</p> <ul style="list-style-type: none"> Validated OSTM computer model/program Trained personnel, on call, to rapidly activate the OSTM. 	1 x OSTM run ordered and received.	2 or more OSTMs ordered and received over a few days to 1 week.	Multiple daily OSTMs ordered and received over long duration response.
		<p>Aerial surveillance aircraft and trained spotters</p> <ul style="list-style-type: none"> aerial surveillance will assist with validating the OSTM predictions, through visual confirmation of the location and type of slick. personnel trained in aerial observation <p>The capability requirements for Aerial Surveillance are provided below.</p> <ul style="list-style-type: none"> Suitable aircraft (fixed or rotary wing) Trained air observer personnel 	1 x vessel maintaining surveillance (spill is small enough that vessel surveillance is sufficient to replace planned aerial surveillance)	Opportunistic – primary visual surveillance provided by aerial surveillance.	Opportunistic – primary visual surveillance provided by aerial surveillance.
		<p>Vessel surveillance</p> <ul style="list-style-type: none"> vessel surveillance will assist with validating the OSTM predictions, through visual confirmation of the location and type of slick. <p>The capability requirements for Aerial Surveillance are provided below.</p> <ul style="list-style-type: none"> Suitable vessel Trained spill observer personnel 	1 x vessel maintaining surveillance (spill is small enough that vessel surveillance is sufficient to replace planned aerial surveillance)	Opportunistic – primary visual surveillance provided by aerial surveillance.	Opportunistic – primary visual surveillance provided by aerial surveillance.
		<p>Electronic surface tracker buoys (ESTBs)</p> <ul style="list-style-type: none"> ESTBs will assist with validating the OSTM predictions ESTBs will assist with aerial surveillance flight planning <p>The capability requirements for ESTBs are provided below.</p> <ul style="list-style-type: none"> ESTBs satellite tracking/data reporting platform suitable deployment platforms (vessels, aircraft etc). 	1-3 x Satellite Tracker Buoys deployed near release location during initial release (first 3-6 hours) only.	Additional ESTBs deployed near leading edge of slick or separately identified slicks that develop over time (Sets of 3 buoys depending on slick leading-edge size) at end of daylight operations. 3 - 6 ESTBs deployed.	<p>Routine deployment of clusters of ESTBs deployed near leading edge of slick at end of daylight operations, over multiple days during a long-duration spill event.</p> <p>>6 ESTBs deployed.</p> <p>The need for ongoing deployment of additional ESTBs, or re-deployment of those used previously, would be subject to review based on overall benefit over time.</p>



		<p>Satellite imagery</p> <ul style="list-style-type: none"> satellite imagery will assist with validating the OSTM predictions <p>The capability requirements for satellite imagery are:</p> <ul style="list-style-type: none"> satellites with suitable spectrum for spill observations satellite data reporting platform personnel trained in the interpretation of satellite imagery. 	N/A	Single satellite imagery acquisition.	Multiple satellite imagery acquisitions over long duration response, with dedicated imagery interpretation capability also activated.
		<p>Operational Monitoring Programs (part of the OSMP)</p> <ul style="list-style-type: none"> provides water quality data and other data to support IMT response decision making <p>The capability requirements for OSMP are:</p> <ul style="list-style-type: none"> trained scientific personnel for sampling, data interpretation and reporting scientific field sampling equipment logistics platforms (typically small to medium vessels) laboratories for analysis of samples 	<p>Not required if hydrocarbon type known and a sample can be obtained.</p> <p>If spill type is unknown, one or two water quality samples, from in-field vessels if available.</p>	Partial OSMP activation (e.g., water quality sampling only).	Full suite of Operational Monitoring activation (exact program details will be scenario specific, depending on activation triggers).
At sea containment and recovery	To reduce the volume of oil on the sea surface, resulting in a reduction in the likelihood and/or consequence of impacts associated with floating oil on the sea surface and on potentially impacted shorelines.	<p>The capability requirements for C&R based on key elements of IPIECA-IOGP (2015a) are:</p> <ul style="list-style-type: none"> Offshore Contain and Recovery (C&R) basic strike team 200-400m offshore boom and skimmer single large vessel with a rolled stern for boom deployment, and with boom-vane (single vessel operation), or an additional small support vessel for two vessel operation for U-sweep or J-sweep operation offshore waste storage/transport resources for transport of recovered oil to shore <p>Offshore C&R – Advanced Strike Team</p> <ul style="list-style-type: none"> 600m - 1000m offshore boom and skimmer advanced booming equipment such as current-buster or speed-sweep U-sweep or J-sweep configuration, or funnel booming arrangements 3-5 vessel configuration aerial surveillance (aircraft or drones) to provide information to vessel to enhance encounter rate <p>C&R trained personnel</p> <ul style="list-style-type: none"> basic and Advanced booming requires experienced/trained C&R personnel, such as AMOSC core-group operations team, who can lead/supervise a contain and recover team vessel deck crews can receive on the job training from appropriately trained C&R team leads Typically a minimum of 5 deck personnel required for a single basic strike-team. Additional teams required for advanced booming configurations. 	1-2 x C&R strike teams (single or two vessel configurations), using locally based C&R equipment and resources.	<p>3 – 5 x C&R strike teams (single or two vessel configurations)</p> <p>1 – 2 x advanced booming configuration</p> <p>Additional C&R equipment and resources sourced from AMOSC/AMSA stockpiles located in the same region.</p>	<p>6 or more basic C&R strike teams (single or two vessel configurations)</p> <p>3 or more advanced C&R strike teams</p> <p>Additional C&R equipment and resources sourced from AMOSC/AMSA stockpiles from around Australia.</p> <p>International C&R equipment mobilised through National Plan and Global Response Network (through AMOSC/AMSA) (e.g., Oil Spill Response Limited (OSRL) equipment).</p>



<p>Surface dispersant vessels –</p>	<p>To reduce the volume of oil on the sea surface, by dispersing it into the water column, resulting in a reduction in the likelihood and/or consequence of impacts associated with floating oil on the sea surface and on potentially impacted shorelines.</p>	<p>The capability requirements for vessel dispersant are provided below, based on key elements of IPECA-IOGP (2015b).</p> <p>Offshore vessel dispersant strike team</p> <ul style="list-style-type: none"> • Typical minimum vessel specs for offshore vessel dispersant would include: <ul style="list-style-type: none"> ○ single vessel (minimum 15-20m length – depending on operating environment and expected sea conditions) ○ deck space for IBCs or single 10 m3 ISO-tank ○ dispersant spray systems, such as fixed booms or AFEDO units <p>Dispersant application trained personnel</p> <ul style="list-style-type: none"> • personnel trained in vessel -based dispersant application • minimum 2 x trained operator + 2 deck crew 	<p>Single vessel dispersant spraying strike team using locally based dispersant equipment & local dispersant stockpile.</p>	<p>2 – 4 vessel dispersant spraying strike teams on station.</p> <p>Some dispersant equipment/stocks shifted to site from AMOSC/AMSA stockpiles located in the same region.</p>	<p>5 or more vessel dispersant spraying strike teams on station.</p> <p>Large scale dispersant equipment/stocks shifted to site from AMOSC / AMSA stockpiles around Australia.</p> <p>Equipment/dispersant stocks sourced and imported from overseas 3rd party suppliers.</p> <p>Possible activation of Global Dispersant Stockpile – Singapore, Americas, Middle East & Europe.</p> <p>Just in time dispersant manufacture considered /actioned (Nalco/ Chemetell/ Dasic/ Total Fluids)</p>
<p>Surface Dispersant - Fixed wing aerial dispersant (FWAD)</p>	<p>To reduce the volume of oil on the sea surface, by dispersing it into the water column, resulting in a reduction in the likelihood and/or consequence of impacts associated with floating oil on the sea surface and on potentially impacted shorelines.</p>	<p>The capability requirements for aerial dispersant using air-tractors (AT) are based on the AMOSC Fixed Wing Aerial Dispersant Operations Plan (FWADOps Plan) (AMOSC 2020) which contains the overarching national fixed wing arrangements, as well as AMOSC regional Aerial Operations plans specific to each state/region.</p> <p>A FWAD air-tractor offshore strike team would consist of:</p> <ul style="list-style-type: none"> • Air tractor(s) – single pilot • Air Attack Supervisor Platform (helicopter preferred over fixed wing aircraft), trained Air Attack Supervisor, and Aircraft Loading Officer. • Search and Rescue platform (vessel or aircraft) <p>The FWAD airbase support requirements outlined in the FWADOps Plan consists of all the elements required to effectively manage airbase operations in support of Aerial Dispersant Application including:</p> <ul style="list-style-type: none"> • Suitable runway/airstrip with: <ul style="list-style-type: none"> ○ operations/coordination room ○ office facilities – internet, fax, telephone ○ catering facilities / Amenities – toilets, kitchen, eating room ○ access arrangements – 24/7 ○ security arrangements – equipment, operations room, airfield ○ availability of bulk water ○ vehicle access – truck, 4wd, car, bus ○ storage for equipment • Additional details confirmed through the Airport Operations Manager or Aerodrome Reporting Officer including: <ul style="list-style-type: none"> ○ refuelling facilities and arrangements – bulk, drums, truck ○ identification of fuel requirements of aircraft – JET A1/AVGAS 	<p>1 x Air Tractor (AT) aircraft on station; 1-3 sortie from FWAD.</p> <p>Delivery of up to 10 m³/day.</p>	<p>2 – 6 AT aircraft on station; multiple sorties (4 – 24 sorties/day).</p> <p>Delivery of up to 77 m³/day.</p>	<p>>6 AT aircraft, >24 sorties/day.</p> <p>Potential for activation of Global Response Network internationally available aircraft – 727, 737 & L-382 aircraft (OSRL and other providers).</p> <p>Delivery of >77 m³/day.</p> <p>Equipment/dispersant stocks sourced and imported from overseas 3rd party suppliers.</p> <p>Potential for activation of Global Dispersant Stockpile – Singapore, Americas, Middle East & Europe.</p> <p>Potential for activation of agreed ‘just in time’ dispersant manufacture considered / actioned (Nalco / Chemetell / Dasic / Total Fluids)</p>



		<ul style="list-style-type: none"> ○ identification of availability and transfer arrangements for refuelling ○ emergency service arrangements – fire, ambulance, rescue, hospital ○ transport arrangements for airbase personnel – distance from town <p>Dispersant stockpiles would be mobilised to meet aircraft at the appropriate location. Timeframes are:</p> <ul style="list-style-type: none"> • 3rd party trucking provided within 4hrs of activation • estimated vehicle loadout = 90 mins per vehicle 			
Offshore subsea dispersants	To reduce the volume of oil floating up to the sea surface, by dispersing it at the seabed, resulting in a reduction in the likelihood and/or consequence of impacts associated with floating oil on the sea surface and on potentially impacted shorelines.	<p>The capability requirements for subsea chemical dispersant injection are provided below. In conjunction with AMOSC the Australian offshore oil and gas industry has established the Sub-Sea First Response Toolkit (SFRT) which is capable of clearing the wellhead as well as allowing sub-sea dispersant injection. The equipment is housed and maintained in Fremantle by Oceaneering and requires the following to assist in mobilisation and deployment:</p> <ul style="list-style-type: none"> • large support vessel with work-class remote operated vehicle (ROV) • small support vessel for operational monitoring – water quality, including towed fluorometer, including trained water quality scientists. <p>Included in the SFRT or available once deployment has been arranged are:</p> <ul style="list-style-type: none"> • dispersant injection wands and associated dispersant injection equipment including pumping manifolds and downlines • access to the AMOSC Fremantle based 500 m³ SSDI dispersant stockpile 	nil	<p>AMOSC SSDI equipment including 500 m³ dispersant stockpile and injection equipment mobilised (as part of the AMOSC Subsea First Response Toolkit).</p> <p>Equipment/dispersant stocks sourced and imported from overseas 3rd party suppliers.</p> <p>Potential for activation of Global Dispersant Stockpile – Singapore, Americas, Middle East & Europe.</p> <p>Potential for activation of agreed ‘just in time’ dispersant manufacture considered/actioned (Nalco/Chemetell/Dasic/Total Fluids)</p>	
Controlled in-situ burning	To reduce the volume of oil on the sea surface, resulting in a reduction in the likelihood and/or consequence of impacts associated with floating oil on the sea surface and on potentially impacted shorelines.	<p>The capability requirements for in-situ burning, based on key elements of IPECA (2016b) are:</p> <ul style="list-style-type: none"> • appropriate support vessels for deployment and management of fire rated containment boom • smaller vessels to facilitate ignition, recovery of burn residue, standby fire safety, and transport of personnel and equipment • fire-retardant booms (from international stockpiles) • incendiary devices • trained personnel from Global Response Network (e.g., MSRC, OSRL) 	nil	nil	Overseas provision of fire boom and trained responders from overseas providers. (OSRL, MSRC and others.)
Protection of sensitive resources (P&D)	To prevent/reduce the volume of oil on entering a sensitive habitat, resulting in a reduction in the likelihood and/or consequence of impacts	<p>The capability requirements for a single protection of sensitive resources/protect & deflect (P&D) strike team include:</p> <ul style="list-style-type: none"> • 100m – 200m shore-seal boom (4 to 8 x 25m, +50kg lengths) • 200m – 400m nearshore boom and associated ancillaries (shoreline and nearshore anchor kits, sandbags etc) (8 to 16 x 25m, +50kg lengths) 	1 – 4 shoreline-based sensitivities protected (shoreline/nearshore booming)	5 – 16 shoreline-based sensitivities protected 3 – 8 P&D strike teams (establish booming and monitor) Regional equipment stockpiles mobilised.	>16 sensitivities protected >8 shoreline protection strike teams National stockpiles of equipment mobilised.



	<p>associated with floating oil on the values and sensitivities of the habitat.</p>	<ul style="list-style-type: none"> • 1 - 2 x small, typically shallow draft support vessel • 1 – 4 x Light vehicle(s)/Utility Task Vehicle (side by side UTV) • 1 x skimmers / oil recovery devices suited for nearshore/shoreline environment • 4 – 8 x nearshore anchor kits • (optional) 1000 – 4000 sandbags • onshore solid and liquid waste management resources • trained responders (2 minimum) • general labour personnel (8 minimum) <p>Once P&D boom is deployed and in place it will require monitoring and potential adjustment over changes in tide and weather/wind/sea state. This can be achieved with a reduced number of personnel, the remainder of which can be redeployed to alternative activities.</p>	<p>1 – 2 P&D strike teams (establish booming and monitor)</p>	<p>1-2 x remote P&D operations. Isolated island or remote operations required – access only via vessel (>2 hours travel from port or marine FOB). Responders required to camp / stay overnight on a support vessel.</p>	<p>>2 remote P&D operations. Isolated island or remote operations required – access only via vessel (>2 hours travel from port or marine FOB). Responders required to camp / stay overnight on a support vessel.</p>
<p>Shoreline and inland assessment (SCAT including oiled wildlife reconnaissance).</p>	<p>To systematically collect data about the location, nature and degree of shoreline oiling, (including at risk/impacted wildlife), to inform shoreline treatment and oiled wildlife response planning.</p>	<p>The capability requirements for an individual SCAT team are provided below, based on key elements of IPIECA (2015c). A single SCAT team will typically consist of:</p> <ul style="list-style-type: none"> • 1 or 2 x trained SCAT specialist • 1 x trained oiled wildlife expert/advisor • 1 x indigenous heritage advisor/ranger and/or 1 x local government ranger • 4x4 vehicle or utility task vehicle (side by side UTV) • SCAT data recording platform/tools • potential for 1 x drone and drone-operator for locations with restricted access <p>Trained SCAT and wildlife personnel are available from industry/AMOSC as well as individual states via National Response Team (NRT) arrangements. Indigenous SMEs and local knowledge specialists are available through the states.</p>	<p>1 SCAT team <10 kilometres shoreline to survey</p>	<p>2 – 10 SCAT teams >10 – 100km shoreline to survey, OR, Complex shorelines (Environmental Sensitivity Index (ESI) 1 or 2, ESI 6 – 10) AMOSC Core-Group (CG), Government Control Agency staff NRT members from other jurisdictions Expanded multi-agency response including multiple state gov agencies. 1-2 x remote SCAT operations. Isolated island or remote operations required – access only via vessel (>2 hours travel from port or Marine FOB). Responders required to camp / stay overnight on a support vessel.</p>	<p>>10 SCAT teams >100km of shoreline to survey OR, Complex shorelines (ESI 1 or 2, ESI 6 – 10), and/or, Full deployment of industry / AMOSC and NRT resources Potential for mobilisation of Global Response Network personnel to SCAT teams from OSRL and other third parties. >2 remote SCAT operations. Isolated island or remote operations required – access only via vessel (>2 hours travel from port or Marine FOB). Responders required to camp / stay overnight on a support vessel.</p>

*Note: 'Remoteness' and 'isolation' are triggers for an escalation in tier. This is based on (1) the time frames for operators to execute this tactic and (2) to reflect the complexity of these operations with resources drawn from outside the immediate region.



<p>Shoreline clean-up</p>	<p>To reduce the volume of oil on shoreline, to reduce the likelihood/consequence of impacts on the values and sensitivities of the shoreline and promote/increase the speed of the natural recovery of the shoreline to its pre-oiled state.</p>	<p>The capability requirements for the Shoreline Clean-up element of the Shoreline Response Program below are based on key elements of IPIECA Shoreline Response Programme Guidance (IPIECA-IOGP 2020) and are for one individual shoreline response clean-up team.</p> <ul style="list-style-type: none"> • 1 x Trained Responder (As shoreline clean-up Team Lead) • 7 - 10 x labour hire personnel (on the job training) • manual clean-up tools (rakes, shovels, hand trowels, etc) • oily waste storage containers (Heavy duty plastic bags) • potentially 1 x small machinery (e.g., rubber tracked bobcat) or tray back all-terrain vehicle to transport recovered oily waste to centralised temporary hazardous waste storage • ablutions and welfare facilities for personnel • decontamination resources (additional personnel and equipment) 	<p>Day 0 – day three</p> <p>Immediate deployment and mobilisation with the aim of having team/s on the ground within 24 to 48 hrs.</p> <p>1-2 x shoreline clean-up teams</p> <p>10 – 20 m³ oily waste recovered per day</p> <p>Resources from local area.</p>	<p>Day three – day seven</p> <p>3 – 30 shoreline clean up teams</p> <p>30 – 300 m³ oily waste recovered per day</p> <p>Potential inclusion of advanced clean-up techniques including high volume / low pressure flushing, surf washing, mechanical equipment.</p> <p>Resources and equipment from within the region from industry, AMOSC/CG, labour contracting entities and other mutual aid, NRT.</p>	<p>Day seven onwards</p> <p>>30 shoreline clean up teams</p> <p>>300 m³ oily waste recovered per day</p> <p>Potential inclusion of advanced clean-up techniques including high volume / low pressure flushing, surf washing, mechanical equipment.</p> <p>Potential for resources from non-spill sector (Defence, volunteer groups) with just-in-time training and provisioning</p> <p>National Plan resources and equipment from industry, AMOSC/CG, labour contracting entities and other mutual aid and NRT.</p> <p>Potential for mobilisation of Global Response Network equipment and resources.</p>
		<p>Escalation of SRP will require utilisation of FOB for the purpose of coordination and support.</p>	<p>Level 1</p> <ul style="list-style-type: none"> • single marquee • 1 x FOB team leader or Sector Command • 1 x medic (also providing admin support). 	<p>Level 2</p> <ul style="list-style-type: none"> • larger FOB base set-up • FOB Manager • 1-2 x shoreline division commanders • 1-2 admin assistants • 4 – 8 Sector Commanders • 1 x health & safety rep • 1 x medic • 1 x logistics/catering coordinator 	<p>Level 3</p> <ul style="list-style-type: none"> • very large FOB set-up • FOB Manager • 3+ x shoreline division commander • 3+ x deputy commanders • 3+ x admin assistants • 8+ x sector commanders • 3+ HSE reps • 2+ medics



				<ul style="list-style-type: none"> 1 x waste management coordinator 	<ul style="list-style-type: none"> 2+ logistics/catering 1-2 waste management coordinators 1-2 Information Technology (IT)/communications specialists
Inland Response	N/A	N/A	N/A	N/A	N/A
Oiled wildlife response (OWR)	To minimize the impacts of an oil spill on wildlife by both prevention of oiling where possible and mitigating the effects on individuals when oiling has taken place (IPIECA-IOGP 2014).	<p>The capability requirements for an individual OWR collection & transport team are provided below, based on key elements of IPIECA-IOGP (2017b) and WA DBCA (2014).</p> <ul style="list-style-type: none"> 2-4 x trained OWR personnel 1 x OWR collection kit (for capture and transport of oiled wildlife) 1 x vehicle <p>The capability requirements for an individual wildlife cleaning/rehabilitation team are provided below, based on key elements of IPIECA-IOGP (2017b) and WA DBCA (2014).</p> <ul style="list-style-type: none"> Wildlife treatment/rehabilitation team would typically consist of: <ul style="list-style-type: none"> 1 x OWR container 5 x trained OWR personnel 10 x labour hire personnel 2 x trades persons (electrician, plumber etc., to set-up of OWR container) liquid and bio-hazard oily waste storage <p>The capability requirement for wildlife hazing typically includes:</p> <ul style="list-style-type: none"> vessel air-horns, vessel water cannons etc. acoustic deterrents/bird scaring devices, deployed onshore or from a vessel visual deterrents physical barriers/structures. 	As per State Plan - level one and two state response Localised resources (Operator + government + AMOSC)	<p>State plan levels three and four Localised +State + National Mutual aid</p> <p>1-2 x OWR collection/transport team operating at a single remote/isolated shoreline. Isolated island or remote operations required – access only via vessel (>2 hours travel from port or Marine FOB) or air. Responders required to camp / stay overnight on a support vessel.</p>	<p>Level five and six (and multiples of) + international + complexity of animal oiling</p> <p>>2 x OWR collection/transport teams operating at multiple remote/isolated shorelines. Isolated island or remote operations required – access only via vessel (>2 hours travel from port or Marine FOB) or air. Responders required to camp / stay overnight on a support vessel.</p>
Tertiary/onshore waste management	To limit the environmental impacts including secondary contamination associated with the transport and disposal of the collected oily waste products (liquids, solids, biohazard, etc.).	<p>The capability requirement for a remote logistics platform are provided below. This capability requirement is based on the Browse Island Oil Spill Incident Management Guide, which extensively examined and risk assessed oil spill response activities in remote northern Australian context and was developed in consultation with the WA Control Agency. In addition, the plan utilised the remote oiled wildlife guidance provided in the WA DBCA OWR Plan (WA DBCA 2014).</p> <p>Remote response platforms may be used to support many response strategies, including P&D, SCAT, Shoreline Clean-up & OWR.</p> <p>An offshore/floating remote response platform to support would likely require:</p>	N/A	<p>1-2 x floating remote response platforms at a single location or; 1 x land-based remote response platform. <20 platform support staff (vessel crews/camp staff) <10 spill response command/admin/support staff <40 field response personnel at single location.</p>	<p>Multiple remote response platforms (floating or land-based) at multiple remote locations. >20 platform support staff (vessel crews/camp staff) >10 spill response command/admin/support staff >40 field response personnel at single location.</p>



		<ul style="list-style-type: none"> • accommodation support vessel (ASV) • sleeping, catering etc for spill response command team, spill response field personnel and vessel crew • offshore FOB, communications, planning platform • remote first aid/emergency response capability • small vessels/tenders <p>Transport crew and equipment between ASV and shorelines, and recover small volumes of oily waste, oiled wildlife</p> <p>Potential for landing barge and light machinery (e.g., tracked bobcat) for transport of heavier equipment and recovery of larger volumes of recovered oily waste from the shoreline</p> <p>Potential for light utility helicopter (landing on ASV helicopter pad) for very logistically challenging locations, including transport of personnel, equipment, and slinging of heavy equipment/waste, as required.</p> <p>Spill response equipment and appropriately trained personnel, as per the relevant response strategy</p> <p>If a floating remote response platform was to be established to support oiled wildlife cleaning at sea, the platform would require (WA DBCA and AMOSC 2015):</p> <ul style="list-style-type: none"> • 200 m² deck space (including space to mount 20ft oiled wildlife cleaning sea-container) • 120,000L water • oily water storage and/or treatment system • fridges/freezers (biological waste/necropsy sample storage) <p>A shore-based remote response platform would likely require:</p> <ul style="list-style-type: none"> • land-based mobile camp • sleeping, catering etc for spill response command team, spill response field personnel and camp crew • onshore FOB, communications, planning platform • remote first aid/emergency response capability • suitable transport (4x4 vehicles, etc) • potential for light utility helicopter (landing on ASV helicopter pad) for very logistically challenging locations, including transport of personnel, equipment, and slinging of heavy equipment/waste, as required. • spill response equipment and appropriately trained personnel, as per the relevant response strategy <p>Remote response personnel would typically include:</p> <ul style="list-style-type: none"> • ~5-10 spill response command personnel (on-scene commander, admin/logistics support, HSE rep, medic). • ~20-40 spill response field personnel (potentially undertaking a range of response strategies including SCAT, OWR and shoreline clean-up) 		<p>Note – smaller vessels and team sizes required for remote SCAT operations.</p>	
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		<ul style="list-style-type: none">• ~10-20 platform support staff (vessel master/camp boss, catering/stewards, vessel/vehicle drivers, helicopter pilots). <p>Note – smaller vessels and team sizes would be expected for remote SCAT operations.</p>			
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IPEICA-IOGP (2016c), encourages contingency planning to be undertaken in a manner which not only examines the tiers of capabilities through single distinct levels (e.g., as represented in Table 6-2), but also to evaluate and illustrate where the resources could/should be sourced from to fulfil risk mitigation aims. The identification of individual/discrete capabilities that may be required for oil spill response enables a much more specific and tailored representation of response capability matched to each operation/risk.

Thus the response capability required is unique to all operations and locations, with each situation being shaped by both setting and operational factors which not only affect the risk profile but also influence how resources will be provided. Each response strategy/capability can be considered independently, and the planning process can consider at least the following four determining factors:

- inherent operational-specific risks (e.g., the oil type, inventory and related release scenarios)
- location-specific risk (e.g., the proximity of oil-sensitive environmental receptors)
- relative proximity and access to supporting resources and their logistical requirements, and
- applicable legislative requirements or stipulated regulatory conditions.

Each of these factors may influence the provision of response resources/capabilities across the range of response strategies, which can then be presented in the form of a unique pictogram (or tiered preparedness wheel) for any operation.

Once completed, the model/tiered preparedness wheel provides a simple visual representation of the response capabilities that are available and how they can be combined to provide the capacity required to mitigate the risk identified for each operation or location. A non-specific example of this model is provided below.

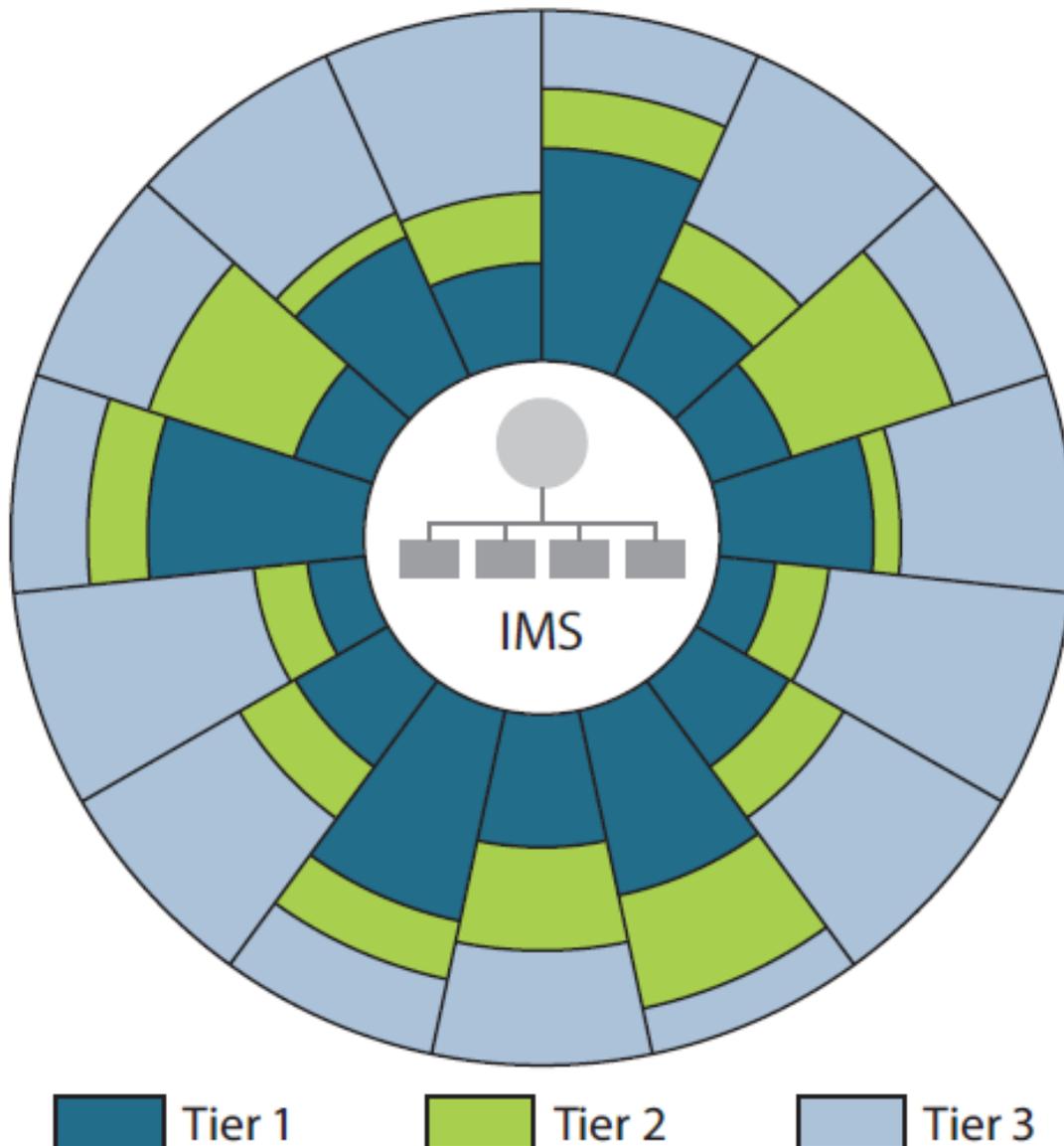


Figure 6-4: Example tiered preparedness wheel (IPIECA-IOGP 2016c)

The IPIECA-IOGP (2016c) tiered preparedness evaluation process described above is considered appropriate, not only for individual petroleum titleholder operations, but also for regional response planning. Within a region/hydrocarbon exploration/production basin, there are inherent similarities in the four determining factors described by IPEICA-IOGP (2016c). For example, consistency in oil types and release scenarios, similar location specific risks and environmental sensitivities, similar logistical challenges and all are operating within the Australian NatPlan and OPGGS (E) regulatory environment.

Using the tiered preparedness wheel concept, a BROPEP specific tiered capability overview is provided in Table 6-3. This table defines the tier, (1, 2 or 3), the target operational timeframe within which the capability should be able to be mobilised, to achieve the response strategy objective, and the geographic location in which the capability should be located, to enable the mobilisation of the response capability within the target timeframe.



Table 6-3: BROPEP Tiered Capability Overview

Tier	General Description	Target operational timeframes	BROPEP capabilities and locations
Tier 1	Basin/area specific resources, typically able to be activated quickly, mobilised (en-route to site) and/or on location and operationally within 24 - 48 hours.	<48 hours	<p>Prelude/ Ichthys offshore facilities and vessels</p> <ul style="list-style-type: none"> • ESTBs • dispersant stockpiles and spray equipment • logistics assets (vessels/aircraft) <p>Broome</p> <ul style="list-style-type: none"> • AMOSC Tier 1 stockpile • logistics assets (vessels/aircraft) <p>Darwin</p> <ul style="list-style-type: none"> • AMSA Tier 2 equipment stockpile • logistics assets (vessels/aircraft)
Tier 2	Regional/coast specific resources, requires air or land movements to FOB, deployed and infield operationally within 48-72 hours (operationally active during days three to four).	48 – 72 hours	<p>AMOSC & AMSA NW Shelf, Exmouth and Fremantle based equipment stockpiles.</p> <p>NW Shelf/Fremantle logistics assets (vessels/aircraft).</p> <p>AMOSC Core-Group within WA/NT.</p> <p>WA/NT Control Agency personnel</p>
Tier 3	National or international resources, operational in the field from day four onwards.	>72 hours	<p>Australian east-coast and international based equipment stockpiles, logistics assets and personnel.</p>

6.6 Field Capability Assessment

The field capability assessment process, which is aligned with the principles of IPIECA-IOGP (2013 and 2016c) and also meets the requirements of the OPGGS (E) Regulations 2009 is summarised as follows:



1. Define the response strategy
2. Present the Strategic SIMA outcome. If YES, continue with evaluation. If NO, no further evaluation required for the response strategy.
3. Evaluate the relevant BOD outcome for the response strategy (E.g., the oil thickness over geographical area and minimum time to contact etc), above relevant response strategy planning thresholds
4. Evaluate relevant oil spill budget considerations for the response strategy
5. Identify the maximum possible field capability in terms of equipment, personnel and logistics assets (vessels, aircraft etc) to treat the WCSS oil spill budget requirement, within the geographical and time constraints derived from the BOD.
6. Evaluate operational considerations, to determine the selected field capability. Operational considerations include factors such as overlap of objectives with other response strategies (E.g., on water response strategies), safety, weather and logistical constraints, cone of response options, environmental values/sensitives at risk, risk of secondary impact etc.
7. Present “As low as reasonably practicable” (ALARP) justification of the selected field capability
8. Present the Selected Field Capability Statement, including specified field capability/arrangements and minimum implementation timeframes.
9. Define the overall capability as Tier 1, 2 or 3, depending on the location of the required resources/capability and mobilisation requirement/arrangements.

To assist in the definition of the tier for a response strategy, within the Selected Field Capability Statement column, the capability can be split into components of Tier 1, 2 or 3, as required.

Table 6-4 and Table 6-5 provide the field capability assessments for two WCSS selected for detailed analysis. Where a more thorough assessment of steps 3 to 8 is required (i.e. space constraints within the tables), a detailed assessment is provided in relevant Appendices, cross-referenced in the tables.

The data from the field capability assessments has then been used to develop the tiered preparedness wheels for the two selected WCSSs. These are presented as Figure 6 5 and Figure 6 6.

For completeness, occasionally other WCSS/BOD outliers are discussed within the field capability assessment tables, for contextual purposes. This ensures all possible variations of a WCSS event are discussed and the required capability and arrangements are addressed.

In addition, stakeholder consultation was conducted with the relevant State/Territory Control Agencies, in regard to the development of the maximum field capability statements for response strategies to be implemented within State/Territory waters/shorelines. Specifically, SCAT, shoreline clean-up, OWR and protection of sensitive resource strategies were evaluated against the BOD scenarios. The BOD (including all figures/tables) were presented to the WA Control Agency (WA Department of Transport (DOT)) and Wildlife Response Agency (WA Department of Biodiversity, Conservation and Attractions (DBCA)), 1 month in advance of the workshop. At the workshop, the proposed maximum capabilities were discussed and agreed, and are presented in Table 6 4 and Table 6 5.

Figure 6 5 presents an indicative Tiered Preparedness Wheel for a condensate well blowout in the BROPEP region. This is a qualitative representation of the field response capability described in Table 6 4.

Note, this wheel is based on the IPIECA-IOGP (2016c) tiered preparedness wheel, which includes elements which are outside of the scope of this document. Specifically; inland response, stakeholder



engagement and communication, economic assessment and compensation have been left blank on this wheel.

Source control is shown in the figure (as SSDI is in scope of this document), however the overall source control capability and arrangements are described/evaluated within the Browse Regional OPEP (HSE_GEN_016765) and Shell internal East Browse Source Control Emergency Response Plan (SCERP) [TEC_GEN_017694].

Figure 6 6 presents an indicative Tiered Preparedness Wheel for a vessel collision resulting in a Group IV hydrocarbon spill in the BROPEP region. This is a qualitative representation of the field response capability described in Table 6 5.



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6.6.1 Well blowout Brewster Condensate Spill

Table 6-4: Field capability assessment – Brewster condensate blowout

Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
SMV - Aerial surveillance	Yes	Maximum lineal distance (km) floating oil >1g/m ² : 833km (Holonema-B model output) 1145km (Bassett Deep model output) Localised slick during first 24-48 hours.	N/A	Day 1 - Single air observation platform with trained aerial observer. (very limited slick extent) Day 2 onwards – Two or more air observation platforms, with trained aerial observers.	<p>The objective of aerial surveillance is to provide ongoing situational awareness of the slick location, size, appearance and behaviour, to enable informed and timely IMT decision making during a response.</p> <p>Aerial surveillance can only be undertaken during daylight hours and is guided using the OSTM modelling results and tracker buoy locations.</p> <p>Aircraft</p> <p>As part of ongoing operations in the region, Titleholder maintains a minimum of four crew change helicopters available in Broome at all times.</p> <p>A crew change helicopter could be cancelled from current tasking and diverted to the spill location immediately if safe to do so, provided it was not required for higher priority safety/evacuation related tasks.</p> <p>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.</p> <p>The cost to maintain dedicated fixed wing aircraft at Broome, Truscott or Darwin would be approx. \$100,000 per month, per aircraft. The cost to maintain a single, or multiple dedicated fixed wing aircraft is not considered reasonable, as Titleholder current arrangements enable aerial surveillance of any permit/license area within 5 hours (daylight only).</p> <p>Trained Aerial Observers</p> <p>The accuracy of aerial surveillance data reported to the IMT via Titleholder helicopters could be improved through the use of trained aerial observers.</p> <p>There would be additional training costs associated with training helicopter and fixed wing pilots as formal aerial oil spill observers. The oil spill observation aid is considered a</p>	<p>The quality of information provided to the IMT by maintaining dedicated fixed-wing aerial surveillance aircraft or trained aerial observers on stand-by is not expected to be improved to a level that would result in substantial environmental benefits or increased situational awareness for the IMT, compared to the use of Titleholder helicopters and crews during the initial days of a spill.</p> <p>Other techniques, such as OSTM will be implemented in parallel with aerial and/or initial/onsite vessel observations. This combination of data is considered sufficient to inform the IMTs situational awareness during the early stages of a spill response.</p> <p>The maximum field capability statement can be achieved within 72 hours, using the</p>	<p>Shell will maintain 2 crew-change helicopters on contract to support petroleum activities in the region.</p> <p>Titleholder will maintain arrangements which provide access to AMOSC and OSRL trained aerial observer personnel.</p> <p>Aerial surveillance will be mobilised using the following capabilities, within the specified timeframes</p> <p>Tier 1; (During initial 24 hours – within 5 hours of IMT activation, crew-change helicopter mobilisation to commence surveillance activities at the spill location, with second pilots using the Oil Spill Observation Guide (daylight operations only))</p> <p>Tier 2 (24 – 72 hours – 1 x fixed wing aircraft. Multiple overflights per day. second pilot/observer using the Oil Spill Observation Guide; or AMOSC Core-Group trained aerial observers from 48 hours onwards.)</p> <p>Tier 3 (48 hours onwards – AMOSC CG trained aerial</p>	3



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
					<p>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.</p> <p>The quality of data that would be received by the IMT, from personnel such as a helicopter co-pilot using the Titleholder oil spill observation aid, and data from other operational and monitoring evaluation techniques, should still provide adequate information for the IMT to conduct its role, especially during the first 24-48 hours of a spill, where the slick is expected to remain close to the release location.</p> <p>It should be noted that the crew change helicopter pilots are familiar with observing the natural colours and shades of the ocean in the BROPEP region, and therefore less likely to incorrectly identify natural phenomenon such as cloud shadow or algal bloom for oil slicks.</p> <p>Trained aerial observers, for use during a protracted spill response are available via AMOSC. These personnel can be mobilised to Broome, Darwin, Truscott, etc., within 48 hours. Additional trained aerial observers are available via OSRL for a large/long duration response.</p> <p>As the BROPEP covers activities in Commonwealth waters, and typically nearest emergent receptors are several/tens of kilometres from the petroleum activities (>20 km where drilling and heavy fuel oil risks are present), immediate aerial surveillance is not critical to the IMT's first strike or Day 1 Incident Action Plan (IAP) development requirements.</p> <p>During the early hours of a spill, vessel/facility surveillance is also available.</p>	proposed arrangements.	observers available in Broome/Darwin) Tier 3 (72 hours onwards – 2+ x fixed wing aircraft. Multiple overflights per day, using trained aerial observers.)	
SMV - Vessel surveillance	Yes	Maximum lineal distance (km) floating oil >1g/m ² : 833km (Holonema-B model output) 1145km (Bassett Deep model output) Localised slick during first 24-48 hours.	N/A	Full-time vessel on stand-by to conduct vessel surveillance of any possible slick.	<p>The objective of vessel/platform-based surveillance is to provide ongoing situational awareness of the slick location, size, appearance and behaviour, to enable informed and timely IMT decision making during a response.</p> <p>Titleholder petroleum activities are all supported by vessels including Infield Support Vessels (ISV), Platform Supply Vessels (PSV) and other vessels types as required. Seismic, geophysical/geotechnical surveys and construction/installation activities are all vessel-based activities. Hence, with the exception of operating a pipeline, most activities almost always have some vessels present or nearby.</p>	The quality of information provided to the IMT by maintaining dedicated or stand-by vessel surveillance capability is not expected to be improved to a level that would result in substantial environmental benefits or increased	Titleholder will maintain routine vessel operations, as required to support its petroleum activities. In the event the IMT determines that surveillance is required, the IMT may task a vessel under existing contract or through MOU to conduct opportunistic vessel-based surveillance activities	1



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Budget Outcome	Spill	Maximum Capability Statement	Field	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
							<p>If a spill occurs at or from a facility, the facility personnel are also able to undertake spill observation/reporting.</p> <p>Close-range vessel surveillance during the initial stages of a loss of well containment or GEP rupture is not considered safe due to the potential for a significant explosion risk (flammable atmosphere) and a limited initial surface slick from a subsurface condensate spill. Therefore, the IMT will be unlikely to direct any vessel to undertake a surveillance activity near the source of any subsea release of condensate.</p> <p>It should be noted that in the event of a vessel/facility collision, the damaged vessel ERT may not be able to conduct dedicated vessel surveillance activities, however, will be able to provide initial pollution report and ongoing situation report information, for the slicks within their visible range. 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 damaged vessels involved in the collision, or search and rescue operations. These could also possibly provide some information to the IMT on slick location, appearance and behaviour.</p> <p>A typical ISV/PSV 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 typical vessel speed (~14-18 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.</p> <p>Additional vessels could be on dedicated stand-by for vessel surveillance at significant cost, however a greater level and quality of information will be obtained, at a cheaper cost, with a quicker mobilisation time, by mobilising aerial observation platforms instead of vessel platforms.</p>	<p>situational awareness for the IMT, compared to the use of Titleholder contracted vessels and helicopters during the first day or two of a spill.</p> <p>Aerial surveillance and OSTM will provide the greatest level of situational awareness to the IMT.</p> <p>The cost to mobilise an additional vessel for surveillance purposes is not considered ALARP, given similar or cheaper cost will provide an aerial surveillance platform.</p> <p>It is therefore considered ALARP to provide oil spill observation tools and training to facility and vessel crews already under contract.</p>	– or will contract an aerial surveillance capability.	
SMV - Oil Spill Trajectory Modelling	Yes	Maximum lineal distance (km) floating oil >1g/m ² : 833km (Holonema-B model output) 1145km (Bassett Deep model output)	N/A		Single OSTM provider on call at all times, able to rapidly complete and provide modelling		<p>The objective of OSTM is to provide forecasts of the trajectory and fate from oil plumes resulting from surface or subsurface releases, to enable informed and timely IMT decision making during a response.</p> <p>OSTM requires access to information/situational awareness data provided by the Emergency Response Team on site. The IMT should reasonably be able to activate and transmit</p>	<p>Sufficient provision has been made for availability of a suitable OSTM contractor.</p> <p>This level of capability is considered suitable</p>	<p>Titleholder will maintain a contract with a suitably experienced OSTM contractor through OSRO AMOSC, available on-call 24/7, for activation by AMOSC through the IMT.</p>	3



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
		Localised slick during first 24-48 hours.		simulations to the IMT. Capability to complete ongoing model validation and model revisions over a long duration event.	relevant situational awareness data to 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 assess risks, select additional response strategies and develop IAPs, which would be implemented in the days after the initial response. Therefore, attempting to reduce the activation timeframe of OSTM would not provide any benefit in relation to 'first strike' activities, and not affect other response strategy selection or capability mobilisation. Therefore, there is no benefit in reducing the activation timeframes. OSTM is an iterative process using real-time observations to refine modelling predictions. No alternatives have been identified that could improve the quality/outputs of this oil spill response control. For the WCSS, only a single OSTM provider is anticipated to be required; however multiple runs over weeks to months may be required for the well blow-out scenario. VOC modelling and dispersant effectiveness modelling (for SSDI only) would also be required, to support the source control and surface response activities.	to achieve the maximum field capability statement.	(OSTM contractor available on 24/7 call-out arrangement). (OSTM contractor activated within 2 hours of IMT formation).	
SMV – Electronic satellite tracker buoys (ESTBs)	Yes	Maximum lineal distance (km) floating oil >1g/m ² : 833km (Holonema-B model output) 1145km (Bassett Deep model output) Localised slick during first 24-48 hours.	N/A	3 x tracker buoys able to be deployed during initial 24 hours of spill. Additional supply of tracker buoys in batches of 3 available for deployment on subsequent days.	The objective of the deployment of ESTBs 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. These processes enable informed and timely IMT decision making during a response. In an ideal situation, three ESTBs should be deployed as a cluster, at the leading edge of the slick. Clusters should be deployed preferable at the end of daylight hours on Day 1, and subsequent days, as required. Shell maintain at least 5 ESTBs, which are positioned at different locations, depending on the activities underway. To support production activities, one ESTB will always be located on the CPF, FPSO and OSV. To support drilling activities, one ESTB will be located on each of the three drilling support vessels (AHTs/PSVs).	Sufficient provision has been made for deployment of multiple ESTBs during day one of a spill from production and drilling activities. Additional ESTBs are available via mutual aid arrangements. This level of capability is considered suitable to achieve the maximum field capability statement.	Shell will maintain a total of 5 ESTBs on Prelude FLNG, to support activities within the region covered by the BROPEP. Shell will maintain mutual aid arrangements with Inpex, AMOSC and OSRL which provide access to additional ESTBs (during 2022, Inpex had 10 ESTBs). Tier 1 (ESTBs maintained at Shell offshore activity locations – deployed by a vessel supporting the petroleum activity)	3



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
					<p>This configuration of ESTBs should ensure that clusters of buoys can be deployed for spills from production/drilling locations.</p> <p>The remaining four ESTBs will be located either at Broome and Darwin logistics bases, or onboard other vessels such as seismic survey, geophysics survey, IMR or installation vessels, during those relevant campaigns. One ESTB on a seismic / geophysical / geotechnical survey vessel is considered appropriate, given they only utilise marine diesel fuel, in lower volumes.</p> <p>At certain times, one or two ESTBs will be out of circulation, for maintenance/biannual servicing.</p> <p>More ESTBs are available via mutual aid, including Shell/Prelude, AMOSC and OSRL, if required.</p>		Tier 2 (Deployment of mutual aid ESTBs)	
SMV- Satellite imagery	Yes	<p>Maximum lineal distance (km) floating oil >1g/m²:</p> <p>833km (Holonema-B model output)</p> <p>1145km (Bassett Deep model output)</p> <p>Localised slick during first 24-48 hours.</p>	N/A	<p>Minimum of one suitable satellite imagery provider/image analyst activated, with imagery available in the IMT within a few hours of the spill occurring.</p>	<p>Information gained from satellite imagery would be used in combination with other controls such as visual surveillance and OSTM, to enable informed and timely IMT decision making during a response.</p> <p>Access to satellite imagery is limited due to the continuous movement and orbit of satellites around the globe. Typically, imagery can only be obtained a few days after the initial request is made to the satellite imagery from service providers.</p> <p>The delays are not considered a risk, as they do not reduce the IMT's situational awareness. During the first few days of a spill, the slick will remain in a small geographic area, and other techniques including vessel and aerial surveillance should provide sufficiently accurate information, to inform IMT decision making.</p> <p>If the spill was 'Level 2', with a slick which will be easily monitored via air surveillance, and no significant or complex shoreline contacts are expected, satellite imagery may not be required.</p> <p>However, satellite imagery would be required for any Level 3 event, where monitoring of a significantly large or dispersed slick is required, or complex/multiple shoreline contacts in remote areas are anticipated, and therefore satellite imagery would help support OSTM validation, impact predictions.</p>	<p>The actual timing of receipt of imagery is dependent on satellite orbits/paths.</p> <p>Maintaining arrangements for access to at least one satellite imagery provider is the best that can be achieved.</p> <p>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 situational awareness, if satellite imagery isn't immediately available.</p> <p>Therefore, the selected capability is considered ALARP.</p>	<p>Titleholder will maintain mutual aid arrangements with AMOSC and OSRL to ensure suitable oil spill observation satellite imagery is available to be accessed by the IMT.</p> <p>Tier 3 (Satellite imagery requested within 6 hours of IMT formation for a Level 3 spill)</p>	3



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Budget Outcome	Spill	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
Surveillance, Monitoring and Visualisation – Operational Monitoring	Yes	Maximum lineal distance (km) floating oil >1g/m ² : 833 km (Holonema-B model output) 1145 km (Bassett Deep model output) Localised slick during first 24-48 hours.	N/A		Surface and subsurface water quality sampling, including fluorometry.	The objective of the surface and subsurface water quality operational monitoring program is to provide ongoing situational awareness of the slick location, size, appearance, behaviour, and its potential impacts/risks, to enable informed and timely IMT decision making during a response. The capability requirements for OSMP are provided below. <ul style="list-style-type: none"> trained scientific personnel for sampling, data interpretation and reporting scientific field sampling equipment logistics platforms (typically small to medium vessels) laboratories for analysis of water quality samples. 	Titleholder will maintain a contract with a suitable OSMP contractor, to mobilise undertake a full OSMP program. This level of capability is considered suitable to achieve the maximum field capability statement.	Titleholder will maintain a contract in place with an OSMP service provider which includes: <ul style="list-style-type: none"> Project Management Plans (E.g., HSE, Medivac, Communications, Security etc) OSMP method statements OSMP readiness/capability reporting process Refer to the Browse Regional Operational and Scientific Monitoring Bridging Implementation Plan (HSE_PRE_016370), for the specific OSMP activation and termination criteria and mobilisation timeframes.	3
At Sea Containment and Recovery	No	N/A	N/A		N/A	N/A	N/A	N/A	N/A
Surface Dispersant – Vessel	No	N/A	N/A		N/A	N/A	N/A	N/A	N/A
Surface Dispersant – Aerial	No	N/A	N/A		N/A	N/A	N/A	N/A	N/A
Offshore Subsea Dispersant	Yes	3200 m ³ condensate released per day at seabed.	Typical SSDI requires approximately 100:1 oil to gas ratio. Therefore, approximately		For a condensate well blow-out, SSDI would not typically be applied to entrain the oil, as condensate has a	Offshore subsea dispersant (or subsea dispersant injection/SSDI) involves the use of an ROV, to inject dispersant directly into the hydrocarbon stream flowing from the damaged well. The outcome of SSDI is a significant increase of entrainment of oil in the water column. By increasing the proportion of hydrocarbons becoming entrained, there will be a reduction in hydrocarbons arriving	Sufficient provision has been made for availability of a SSDI spread and dispersant stockpile and large	Titleholder will maintain contracts with AMOSC, to ensure access to the SFRT, including the 500 m ³ dispersant stockpile and dispersant injection tools.	3



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Budget Outcome	Spill	Maximum Capability Statement	Field	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
			32 dispersant required per day.	m ³ per day.	naturally high entrainment rate. SSDI can significantly reduce VOC risks, to enable safe direct intervention activities (debris clearance, capping stack etc.). Therefore, SSDI would not be required to be mobilised until day 10 onwards (following well site surveys to confirm direct intervention activities are needed). To treat the ongoing flow and reduce surface VOC risks from a condensate well-blowout, SSDI equipment including a support vessel with work-class ROV, and SSDI injection equipment and a dispersant supply chain is required.	high	on the ocean surface, and an associated reduction in hydrocarbons evaporating into the atmosphere. As discussed in Table 5 2 the primary consideration for use of SSDI for Brewster/Plover wells is to reduce the VOCs in the atmosphere during direct well intervention activities; not to reduce surface expression of condensate. Modelling results (RPS 2019c) indicates that under a worst-case Brewster blowout scenario, VOC concentrations from oil/condensate evaporating into the atmosphere are likely to exceed safe exposure thresholds within 1 km of the release location. The workforce onboard vessels conducting source control activities (e.g., BOP intervention, debris clearance and capping stack installation) could therefore be exposed to VOCs, and if gas monitoring indicated exposure had exceeded the VOC thresholds, the vessel would be required to cease the activity move out of the area. In effect, VOC exposure may impact the feasibility of debris clearance, capping stack installation and ultimately limit available source control options to drilling a relief well. There is no requirement for additional/duplicate SSDI spreads. A single SSDI spread will be able to successfully inject dispersant into the well stream at the optimal ratio of approximately 100:1, which has been demonstrated to reduce VOC concentrations below safe levels (RPS 2019c). Injecting additional dispersant into the well-stream will not result in any greater/beneficial reduction in VOC concentrations in the atmosphere. Based on a worst-case oil release rate 3200 m ³ /day, at 100:1 treatment ratio, the dispersant requirement is 32 m ³ /day. For a worst case (complex) activity, 30 days of SSDI could be required. Therefore, a worst-case total of ~1000 m ³ dispersant could be required. SSDI would generally not be required to commence mobilisation onto a vessel in Broome until approximately day 10 of a response (aligning with BOP intervention/debris clearance mobilisation activities). The SSDI spread maintained by AMOSC as part of the subsea first response toolkit (SFRT). The SFRT is located in Fremantle, WA and includes 500 m ³ of Slick-Gone-NS dispersant and can be mobilised to Broome within 10 days. Therefore, 50% of the total worst case dispersant requirement for a worst	vessels with work-class ROVs. This level of capability is considered suitable to achieve the maximum field capability statement	Titleholder will maintain its OSRL membership, to ensure access to the global dispersant stockpile.	



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					<p>credible SSDI response can be mobilised outside of critical path timeframes. Additional Australian and global dispersant stockpiles can be mobilised, should it be estimated that the AMOSC 500 m³ will be used up.</p> <p>Additional dispersant would not be required until a minimum of ~day 25 of the response, and therefore any additional dispersant stocks could be easily mobilised by vessel or aircraft to Broome within the required timeframe.</p> <p>Titleholder maintains access to the global dispersant stockpile through Titleholder membership with OSRL.</p> <p>Therefore, Titleholder has access to sufficient dispersant for a worst case (30 day) SSDI activity.</p>			
Controlled in-situ burning	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SCAT (including OWR reconnaissance)	Yes	<p>Maximum of 158 km of shoreline oiled >10 g/m²</p> <p>Shorelines oiled spread over wide range of offshore islands and islands of the Bonaparte and Buccaneer Archipelagos.</p> <p>Minimum 1 - 3 days for first shoreline contact >10 g/m² (for FPSO spill scenario).</p> <p>Minimum time to contact 3 days for well blowout scenario.</p> <p>Typically, up to 3-4 weeks before second shoreline sector is contacted.</p> <p>Significant increase in shoreline contacts between days 30-60.</p>	N/A	<p>As agreed through stakeholder consultation with WA Control Agency.</p> <p>First remote SCAT team to mobilise from port (e.g., Broome/Darwin) within 2 days.</p> <p>Two additional remote SCAT teams required within 7 days.</p> <p>Peak capability of 6 remote SCAT teams; 3 roving SCAT teams and 3 SCAT teams embedded within remote shoreline response units.</p> <p>This capability will ensure roving/highly</p>	<p>The objective of SCAT is to systematically collect data about the location, nature and degree of shoreline oiling and at risk/impacted wildlife, to inform shoreline treatment and oiled wildlife response planning.</p> <p>Control Agency Overview</p> <p>Shoreline response activities including SCAT are typically under the control of the relevant State/Territory Control Agency.</p> <p>Control Agencies may choose to conduct the SCAT activity, including provision of SCAT specialists, wildlife specialists, local government rangers and/or Aboriginal heritage advisors/rangers. The Control Agency may also request of Titleholder some specialist support personnel including SCAT and OWR experts and logistical support for remote and/or larger SCAT operations.</p> <p>The only two shoreline locations within the region which do not have a State/Territory Control Agency are Ashmore Reef and Cartier Island, both of which are Commonwealth Lands. In the event of a spill from a petroleum activity reaching these locations, Titleholder would be the Control Agency. Under this scenario, the SCAT team would only consist of SCAT specialists and wildlife response specialists provided by industry mutual aid, and possibly a Parks Australia ranger or other government appointed person with local knowledge.</p>	<p>Sufficient provision has been made to support the deployment of multiple remote SCAT teams.</p> <p>Whilst SCAT teams will typically be appointed and under the control of the relevant State/Territory Control Agency, additional SCAT personnel can be made available via mutual aid arrangements, within the required timeframes.</p> <p>This level of capability is considered suitable to achieve the maximum field capability statement.</p>	<p>Titleholder will maintain mutual aid arrangements with AMOSC and OSRL which provide access to SCAT specialist (including drone operator and drone capability), and oiled wildlife response specialist personnel.</p> <p>Tier 2 (1 x remote SCAT team, (2 x SCAT and 1 x OWR personnel) and SCAT equipment including drone, available to mobilise from Broome/Darwin within 48 hours)</p> <p>(Additional 2 x remote SCAT teams, (4 x SCAT and 2 x OWR personnel) available to mobilise from Broome/Darwin within 7 days)</p> <p>Tier 3 – Peak capability</p>	3



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				<p>mobilise SCAT teams, to rapidly evaluate a wide range of shorelines, with additional SCAT capability to work directly with shoreline response teams at identified protection priority locations.</p>	<p>There are no relevant Aboriginal Heritage Advisors required at Ashmore Reef / Cartier Island.</p> <p>Note: Cartier Island and the surrounding marine area within a 10 km radius was a gazetted Defence Practice Area up to 20 July 2011. Although no longer used, there is a substantial risk that Unexploded Ordnances remain in the area. Landing or anchoring anywhere within the Cartier Island Commonwealth Marine Reserve is strictly prohibited. Therefore, SCAT of these islands should be conducted via drone for Cartier Island. Due to the sensitivity of these shoreline receptors and safety issues outlined above, the merits of SCAT and shoreline clean-up at Cartier Island will need to be discussed in consultation with Director of National Parks.</p> <p>SCAT Personnel</p> <p>In accordance with WA DoT consultation, each remote SCAT team should consist of 2 x SCAT personnel, 1 x OWR personnel, and 1 x local government or parks advisor /aboriginal heritage advisor (person with local knowledge of the area).</p> <p>The relevant State/Territory Control Agency, or Commonwealth Government, will provide personnel such as Park rangers, and Aboriginal Heritage Advisors.</p> <p>Titleholder is able to source relevant SCAT and wildlife specialists via its mutual aid arrangements with AMOSC.</p> <p>AMOSC staff and core-group SCAT trained personnel, and OWR personnel are available to mobilise to a vessel alongside in Broome/Darwin within 48 hours.</p> <p>Additional SCAT trained personnel are available via OSRL for a large/long duration response.</p> <p>SCAT Equipment</p> <p>SCAT equipment typically consists of a paper-based or electronic (e.g., tablet/phone application) SCAT recording platform.</p> <p>The Control Agency may specify their preferred SCAT recording tool. Alternatively, AMOSC have suitable SCAT recording tools/templates. Therefore, there is no requirement for Titleholder to maintain any specific SCAT recording tools/templates.</p>		<p>(Additional 3 x remote SCAT teams (3 additional teams embedded within remote shoreline response units (6 x SCAT and 3 x OWR) available to mobilise from Broome/Darwin – one team each at day 6, 14 and 30)</p> <p>Total capability (total of 24 x SCAT & 12 x OWR personnel - 12 x SCAT & 6 OWR each team working 14-day rotations)</p> <p>Refer Remote Logistics rows regarding vessels and light utility helicopter capability and arrangements.</p>	



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					<p>SCAT Logistics</p> <p>Small vessels would be used for 'roving' SCAT teams.</p> <p>Other SCAT teams would be embedded within larger remote shoreline response units, operating from both large and small vessels.</p> <p>Refer to the row 'Remote Response – Vessels' for details regarding small vessel capability and arrangements.</p> <p>AMOSC maintain a drone and drone operators (also trained in SCAT), which can be used to assist with SCAT operations in remote or difficult to access locations.</p>			
Protection of sensitive resources (PSR)	No	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Shoreline clean-up	Yes	<p>Maximum of 433 m³ total volume oil ashore from worst stochastic run</p> <p>Maximum of 158 km of shoreline oiled >100 g/m² including 4 x offshore islands, and islands in the Buccaneer and Bonaparte Archipelago (refer Figure 4 7).</p> <p>Oil volumes ranging from <2 m³ to <50 m³.</p> <p>Minimum 1 - 2 days for first shoreline contact >100 g/m² (for FPSO spill scenario).</p> <p>Minimum time to contact 3 days for well blowout scenario.</p> <p>Typically, up to 3-4 weeks before second shoreline sector is contacted.</p>	<p>Assume no emulsion factor associated with condensate spills.</p> <p>Assume 10x bulking factor, for oily waste on shoreline.</p> <p>Worst-case of 433 m³ neat oil ashore at Browse Island = 4300 m³ oily waste to be recovered.</p> <p>Assume each shoreline clean-up person can recover 1 m³ oily waste per day = 4300 person days for worst-case (by volume)</p>	<p>As agreed through stakeholder consultation with WA Control Agency.</p> <p>First remote shoreline response unit (including SCAT, shoreline response and OWR) to mobilise from port (e.g., Broome/Darwin) within 6 days.</p> <p>A second remote shoreline response unit required within 14 days.</p> <p>A third remote shoreline response unit required within 30 days.</p> <p>Peak capability 3 remote shoreline response units.</p>	<p>The objective of shoreline clean-up is to reduce the volume of oil on shoreline, to reduce the likelihood/consequence of impacts on the values and sensitivities of the shoreline and promote/increase the speed of the natural recovery of the shoreline to its pre-oiled state.</p> <p>Control Agency Overview</p> <p>Shoreline response activities including shoreline clean-up are typically under the control of the relevant State/Territory Control Agency.</p> <p>Control Agencies may choose to deploy their own shoreline clean-up leads and teams, or the Control Agency may also request of Titleholder some specialist support personnel including shoreline clean-up team leads, additional labour hire, shoreline clean-up equipment and logistical support for remote and/or larger clean-up operations.</p> <p>The only two shoreline locations within the region which do not have a State/Territory Control Agency are Ashmore Reef and Cartier Island, both of which are Commonwealth Lands. In the event of a spill from a petroleum activity reaching these locations, Titleholder would be the Control Agency. Under this scenario, the SCAT team would only consist of SCAT specialists and wildlife response specialists provided by industry mutual aid, and possibly a Parks Australia ranger or other government appointed person with local knowledge.</p>	<p>Whilst shoreline clean-up teams will typically be under the control of the relevant State/Territory Control Agency, additional shoreline clean-up specialist personnel, labour hire and standard and specialist shoreline clean-up equipment can be made available via mutual aid arrangements, within the required timeframes.</p> <p>This level of capability is considered suitable to achieve the maximum field capability statement.</p>	<p>Titleholder will maintain mutual aid arrangements via AMOSC and OSRL which provide access to shoreline clean-up team lead personnel.</p> <p>Titleholder will maintain labour hire contracts, for access to general labour hire personnel.</p> <p>Titleholder will maintain mutual aid access via AMOSC to shoreline clean-up equipment including the AMOSC stockpiles, for mobilisation to a support vessel alongside in Broome/Darwin Port.</p> <p>Tier 2 (Mobilise single remote shoreline response unit including SCAT, shoreline clean-up team and OWR team and associated equipment and logistics</p>	3



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		Significant increase in shoreline contacts between days 30-60.	shoreline clean-up operation. Worst-case shoreline response (by length) could be across several remote locations – however not at all locations simultaneously.	This capability will ensure rapid mobilisation of the first remote shoreline response unit to the first potentially contacted shoreline receptor. Additional shoreline contacts are not expected for a few weeks, therefore the mobilisation of second and third remote shoreline response units is aligned with worst-credible multiple shoreline contact scenarios and timings.	There are no relevant Aboriginal Heritage Advisors required at Ashmore Reef/Cartier Island. Refer note in SCAT row regarding Cartier Island unexploded ordinance risk. Remote shoreline response will not be triggered until sufficient SMV and or SCAT information is provided to the relevant Control Agency, to make a determination that remote shoreline clean-up is both safe and appropriate to undertake, especially in consideration of the oil type – weathered condensate. It is expected that the minimum time for mobilisation (departure from a port) for any remote shoreline clean-up operation would be 6 days. 6 days is based on extensive consultation with the WA Control Agency in 2021. In addition, WA DoT conducted detailed evaluation, including multi-day exercise on remote response at Browse Island in 2019. Tasks undertaken during this 6-day preparation period include risk assessments and HSE planning, identification and mobilisation of a large number of specialist personnel and equipment (including significant number of government agency personnel), identification and mobilisation of a number of large and small vessels, and possibly light utility helicopter. Whilst extensive preparatory works for this type of activity have already been undertaken (e.g., detailed planning for remote response undertaken as part of the Browse Island Oil Spill Incident Management Guide, the actual event specific planning and HSE/risk assessments for a remote shoreline response must be undertaken thoroughly, given the significant risks associated with this type of an activity. Shoreline Clean-Up Personnel There is an appropriate limit to the number of personnel that should be put ashore during shoreline response in a remote and typically environmentally sensitive locations, to avoid additional impacts, e.g., trampling of turtle nests and disturbance to bird feeding, roosting and nesting behaviours. In general, to reduce wildlife disturbance on small, offshore remote locations, a longer duration response with a smaller number of personnel may be desired. The numbers of responders able to access a shoreline are also somewhat limited by accommodation/logistics support. For offshore islands with the ability for helicopters to safely land,		support from Broome/Darwin wharf within 6 days) Tier 3 (Mobilise second remote shoreline response unit within 14 days, and third unit within 30 days) Refer Remote Logistics rows regarding vessels and light utility helicopter capability and arrangements.	



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					<p>it has been calculated that up to 24 personnel could work onshore on a single day, based on one utility helicopter conducting the daily transits between the shore and a single floating accommodation platform. Higher numbers could be transferred daily, using small boats, or a combination of boats plus helicopter, for shoreline access.</p> <p>The exact numbers of personnel and skills of those personnel selected to respond on a shoreline will be made by the relevant Control Agency, based on the degree of oiling, seasonality and sensitivity of receptors are risk at the time. However, as a basis for planning, as defined by the WA Control Agency, an ideal single remote shoreline response unit would include a total of 43 response personnel, plus vessel/support crew. Details as follows:</p> <ul style="list-style-type: none"> • Sector Command Team (10 personnel – 2 x leader/deputy, 3 x admin, 2 x HSE, 2 x paramedic, 1 x multi-media/communications). • SCAT team (4 personnel – 2 x SCAT, 1 x OWR, 1 x local ranger) • shoreline clean-up team (21 personnel - 4 leadership, 17 labour hire) • OWR wildlife collection/rescue and preventative actions team (5 personnel) • OWR intake (TRIAGE, first aid or other response) (3 personnel including 1 vet) • vessel crew, tender drivers, helicopter operations staff etc. <p>Based on a shoreline clean-up team of 21 personnel per remote shoreline response unit, and assuming 1 m³ oily waste recovered per person per day, a single unit would be required to operate for ~200 days to complete the clean-up, or 3 remote shoreline response units operational for ~70 days, to recover 4300 m³ of oily waste.</p> <p>It is expected the relevant State/Territory Control Agency will provide some government appointed personnel to oversee/lead the remote shoreline response operation. WA Control Agency expect to provide approximately 20 of the response personnel. Titleholder would be required to provide the additional field response personnel.</p> <p>However, should the Control Agency request/require additional remote shoreline response personnel, or</p>			



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					<p>Titleholder is the Control Agency (e.g., Ashmore/Cartier) Titleholder plus mutual aid capability and labour hire, will provide the full shoreline response personnel capability.</p> <p>Initial contingents of AMOSC staff and core-group personnel with shoreline clean-up expertise are available to mobilise to Broome or Darwin within 48 hours, however initial full team assembly is not expected until day 6.</p> <p>Additional shoreline clean-up trained personnel are available via OSRL for a large/long duration response.</p> <p>Titleholder is able to source additional labour hire personnel via contracted labour hire providers.</p> <p>Therefore, Titleholder consider that sufficient arrangements are in place to mobilise shoreline clean-up teams within required timeframes.</p> <p>Additional trained shoreline clean-up personnel could be positioned on stand-by in Broome or Darwin. However, as full remote shoreline response unit mobilisation is planned for day 6, this is not considered to be ALARP.</p> <p>Shoreline Clean-Up Equipment</p> <p>Shoreline types of the regional (as classified by IPIECA-IOGP 2015c) include:</p> <ul style="list-style-type: none"> • rocky shorelines of the Bonaparte and Buccaneer Archipelago including outer islands of King Sound (shoreline types 1A, 1B, 1C, 2A and 2B) • fine sands, silts, clays, muds of the sheltered and highly tidal mangrove/salt marsh and salt flat systems of the Kimberley and NT mainland shorelines (shoreline types 8A-E, 9 A-C, and 10A, 10C & 10D). • coarse sandy/gravel beaches, typical of the offshore islands and outer islands of the Kimberley coastline (shoreline types 3B, 4, 5, 6A, 6B and 7). <p>In regard shoreline clean-up of the cliffs/rocky coves of the Buccaneer and Bonaparte Archipelagos, IPIECA-IOGP (2015c) advises that in many cases the base of cliff faces can be accessed only with great difficulty and can present an extremely hazardous working environment. Typically, cliffs and inaccessible rocky coves are highly exposed and are best left to clean naturally unless there are overriding reasons to do otherwise. Unless the oil has been thrown up to extreme heights by exceptional weather conditions and is therefore</p>			



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					<p>unlikely to be reached by the sea under normally prevailing conditions, residual staining would be expected to diminish markedly over two or three seasonal cycles. Given the extreme tidal regime of the Kimberley coastline, and recommendations from IPEICA-IOGP (2015c), planning for cleaning of remote rocky cliffs/shorelines of the Kimberley is not considered appropriate.</p> <p>In regard to mangroves/salt marshes, IPEICA-IOGP (2015c) states that based on experience, in general light refined products are more damaging than crude oils and crude oils are more damaging than heavy fuel oils. Also, there is potential for significant damage to mangrove and salt-marsh plants/root systems from attempting most clean-up techniques. Therefore, given the BOD/modelling identified very little condensate loading at WA/NT mainland locations (where significant mangrove and saltmarsh system exist), planning for shoreline clean-up of these areas is not required for this WCSS.</p> <p>Typical response strategies for sandy beaches will be small remote response teams, conducting manual clean-up (e.g., rakes, shovels and lined bulka-bags), with limited likelihood for use of any mechanical/machinery assisted cleaning, except for small, tracked vehicles which may be used for collection and transport of small volumes collected oily waste to collection points/landing barges. The high tidal regime will result in enhanced natural surf washing/flushing, a recognised technique within IPEICA-IOGP (2015c).</p> <p>If significant volumes of buried oil (which could be re-mobilised) were identified, advanced cleaning techniques may be required. IPEICA-IOGP (2015c) states that the options for removal of buried oil include lifting the clean overburden and moving it aside to expose the band of buried oil, which is then removed and transported off the beach for disposal. Another option is to transport the band of buried oil to the water's edge for surf washing. If relatively close to the surface, the oil might be mobilised through harrowing or ploughing, or by using flushing lances to release the oil and flush it to the water's edge where it can be recovered with skimmers or sorbents. These techniques would need to be assessed/recommended by the Control Agency, as part of a long-term shoreline treatment program. This type of shoreline</p>			



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					<p>clean-up/treatment equipment is available from the AMOSC Level 3 stockpiles.</p> <p>WA/NT Control Agency may choose to mobilise their own shoreline clean-up equipment. WA Control Agency spill response trailers are located in Karratha, Fremantle and Albany.</p> <p>The AMOSC Broome stockpile and AMSA Darwin stockpiles also includes additional shoreline clean-up equipment.</p> <p>Additional AMOSC shoreline clean-up equipment stockpiles are located at Exmouth, Fremantle and Geelong.</p> <p>Shoreline Clean-Up Logistics</p> <p>It is expected the relevant Control Agency would require Titleholder to provide the logistical support/platforms for any remote shoreline clean-up operations. The response platforms for remote shoreline clean-up activities typically include small and large support vessels, and potentially light utility helicopters. Refer to the row 'Remote Response' for details regarding capability and arrangements.</p>			
<p>OWR</p> <p>Hazing / deterrence</p> <p>Pre-emptive capture and relocation</p> <p>Collection / rescue & intake</p> <p>Cleaning & rehabilitation</p>	Yes	<p>1-2 days (FPSO) or 3 days (well blowout) for time to contact at shoreline >100 g/m² at turtle breeding Biologically Important Area (BIA) shoreline.</p> <p>Worst case volume 433 m³ oil ashore in areas of >100 g/m² at turtle breeding BIA shoreline.</p> <p>Multiple marine avifauna and turtle BIA shorelines (several offshore islands, plus several islands of Buccaneer & Bonaparte Archipelago) contacted at >100 g/m².</p> <p>Typically, up to 3-4 weeks before second</p>	<p>Key receptors potentially affected are EBCP listed species, with marine turtles and avifauna identified as the species most susceptible to oiling.</p> <p>Review of the WCSSs with WA DoT and DBCA did not trigger a requirement to plan for large scale OWR washing and rehabilitation.</p>	<p>As agreed through stakeholder consultation with WA Control Agency and OWR Agency:</p> <p>First remote shoreline response unit (including SCAT, shoreline response and OWR) to mobilise from port (e.g., Broome/Darwin) within 6 days.</p> <p>A second remote shoreline response unit required within 14 days.</p> <p>A third remote shoreline response</p>	<p>The objective of oiled wildlife response is to minimise the impacts of an oil spill on wildlife by both prevention of oiling where possible and mitigating the effects on individuals when oiling has taken place (IPIECA-IOGP 2014).</p> <p>Control Agency Overview</p> <p>Shoreline response activities including OWR are typically under the control of the relevant State/Territory Control Agency.</p> <p>Control Agencies may choose to deploy their own OWR team leads and support personnel, or the Control Agency may request Titleholder provide some specialist support personnel including OWR team leads, additional OWR trained personnel and labour hire, OWR equipment and logistical support for remote and/or larger OWR operations.</p> <p>The only two shoreline locations within the region which do not have a State/Territory Control Agency are Ashmore Reef and Cartier Island, both of which are Commonwealth Lands. In the event of a spill from a petroleum activity reaching these locations, Titleholder would be the Control Agency. Under this scenario, the SCAT team would only consist of SCAT specialists and wildlife response specialists provided by</p>	<p>Whilst OWR teams will typically be under the control of the relevant State/Territory Control Agency, additional OWR specialist personnel, labour hire and OWR equipment can be made available via mutual aid arrangements, within the required timeframes.</p> <p>This level of capability is considered suitable to achieve the maximum field capability statement.</p>	<p>Titleholder will maintain mutual aid arrangements with AMOSC and OSRL which provide access to OWR team personnel.</p> <p>Titleholder will maintain labour hire contracts, for access to general labour hire personnel.</p> <p>Titleholder will maintain mutual aid access to OWR equipment including OWR kits and containers, for mobilisation to a support vessel alongside in Broome/Darwin Port.</p> <p>Tier 2</p> <p>(Mobilise single remote shoreline response unit including SCAT, shoreline clean-up team and OWR</p>	2



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		shoreline sector is contacted. Significant increase in shoreline contacts between days 30-60.		unit required within 30 days. Peak capability 3 remote shoreline response units. This capability will ensure rapid mobilisation of the first remote shoreline response unit to the first potentially contacted shoreline receptor. Additional shoreline contacts are not expected for a few weeks, therefore the mobilisation of second and third remote shoreline response units is aligned with worst-credible multiple shoreline contact scenarios and timings.	industry mutual aid, and possibly a Parks Australia ranger or other government appointed person with local knowledge. There are no relevant Aboriginal Heritage Advisors required at Ashmore Reef/Cartier Island. Refer note in SCAT row regarding Cartier Island unexploded ordinance risk. Remote oiled wildlife response will not be triggered until sufficient SMV and/or SCAT (including OWR) information is provided to the relevant Control Agency, to make a determination that remote OWR is both safe and appropriate to undertake. It is expected that the minimum time for mobilisation (departure from a port) for any remote shoreline clean-up and OWR operation would be 6 days. OWR personnel There is an appropriate limit to the number of personnel that should be put ashore during shoreline response in a remote and typically environmentally sensitive locations, 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 a smaller number of personnel may be desired. The numbers of responders able to access a shoreline are also somewhat limited by accommodation/logistics support. For offshore islands with the ability for helicopters to safely land, it has been calculated that up to 24 personnel could work onshore on a single day, based on one utility helicopter conducting the daily transits between the shore and floating accommodation location. Higher numbers could be transferred daily, using small boats for shoreline access. The exact numbers of personnel and skills of those personnel selected to response on a shoreline will be made by the relevant Control Agency., based on the degree of oiling, seasonality, density and sensitivity of receptors are risk at the time. However, as a basis for planning, as defined by the WA Control Agency, an ideal single remote shoreline response unit would include a total of 44 response personnel, plus vessel/support crew. Details as follows:		team and associated equipment and logistics support from Broome/Darwin wharf within 6 days) Tier 3 (Mobilise second remote shoreline response unit within 14 days, and third unit within 30 days) Refer Remote Logistics rows regarding vessels and light utility helicopter capability and arrangements.	



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					<ul style="list-style-type: none"> sector command team (10 personnel – 2 x leader/deputy, 3 x admin, 2 x HSE, 2 x paramedic, 1 x multi-media/communications). SCAT team (4 personnel – 2 x SCAT, 1 x OWR, 1 x local ranger) shoreline clean-up team (21 personnel - 4 leadership, 17 labour hire) OWR wildlife collection/rescue and preventative actions team (5 personnel) OWR intake (TRIAGE, first aid or other response) (3 personnel inc. 1 vet) vessel crew, tender drivers, helicopter operations staff etc. <p>It is expected the relevant State/Territory Control Agency will provide some government appointed personnel to oversee/lead the remote shoreline response operation, including key OWR personnel such as vets and other OWR team leads.</p> <p>Personnel from government agencies with local knowledge of the species potentially impacted are most likely to be living/working in Darwin, Kununurra and Broome, and therefore the mobilisation of these personnel should not limit the overall OWR mobilisation timeframes.</p> <p>WA Control Agency expect to provide approximately 5 of the OWR personnel. Titleholder would be required to provide the additional OWR personnel.</p> <p>However, should the Control Agency request/require additional remote shoreline response personnel, or Titleholder is the Control Agency (e.g., Ashmore/Cartier) Titleholder plus mutual aid capability and labour hire, will provide the full OWR personnel capability.</p> <p>Titleholder maintains OWR personnel capability and arrangements via the AMOSC OWR Team, and associated AMOSC OWR mutual aid capabilities. These include:</p> <p>AMOSC OWR team</p> <ul style="list-style-type: none"> trained wildlife personnel available through the Oiled Wildlife Rehabilitators Network (approximately 100 personnel) Philip Island Nature Park (approximately 100 personnel). 			



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					<ul style="list-style-type: none"> Titleholder could provide additional personnel via Titleholder contracts/agreements with Environmental Service Providers, or other labour hire companies. <p>Initial contingents of AMOSC staff and OWR team and mutual personnel with OWR training are available to mobilise to Broome/Darwin within 48 hours, however initial full team assembly is not expected until day 6.</p> <p>Additional OWR trained personnel are available via OSRL for a large/long duration response.</p> <p>Therefore, Titleholder consider that sufficient arrangements are in place to mobilise OWR personnel within required timeframes.</p> <p>Additional trained OWR trained personnel could be positioned on stand-by in Broome or Darwin. However, as full remote shoreline response unit mobilisation is planned for day 6, this is not considered to be ALARP.</p> <p>OWR Equipment- Wildlife hazing</p> <p>Hazing/deterrence are terms used for activities that are undertaken to prevent wildlife from entering contaminated sites, and/or to make wildlife move away from areas that are likely to be affected by the spill (IPIECA-IOGP 2014). Techniques include:</p> <ul style="list-style-type: none"> human disturbance (the simple presence of people in the wildlife habitat) vehicular disturbance (e.g., terrestrial vehicles, boats and aircraft) visual disturbance (e.g., lights, reflectors, flags, effigies, etc.) auditory disturbance (e.g., noise generators) physical structures (e.g., fences) to prevent wildlife accessing contaminated sites. <p>Animals often quickly become habituated to the deterrent stimulus, at which point efficacy will decrease markedly and the deterrent should be changed accordingly.</p> <p>Hazing/deterrence is better undertaken by trained and experienced personnel as there are many factors to be considered, both before and during hazing. These include the geographical area (e.g., is there a suitable, un-oiled environment for the animals to relocate to) and species variation. Effective hazing requires the creativity of experts</p>			



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					<p>with a knowledge of species behaviour and their natural history so that the most appropriate methods can be applied. A significant consideration is the need to avoid methods that make animals move towards the oil instead of away from it (IPECA-IOGP 2014).</p> <p>In the case of a condensate and diesel spills, where surface oil slicks are thin and not considered particularly adhesive, the likelihood and severity of impacts on wildlife are less, in contrast to IFO/HFO. Additionally, hazing isn't considered an effective measure against volatile spills which rapidly evaporate, such as condensate.</p> <p>Therefore, given the open ocean environment likely to be impacted by a floating slick from a well blow-out, at sea wildlife hazing would not be likely to result in a significant environmental benefit.</p> <p>Wildlife hazing/deterrence would be more suitable when used near or on sensitive shoreline habitats, and generally against more persistent oil slicks.</p> <p>Wildlife hazing equipment such as bird scarers could be purchased and maintained offshore, on dedicated vessels for rapid deployment to a shoreline. However, floating slicks from the WCSSs in this BROPEP are likely to take days to reach sensitive shorelines, during which time, vessels can be mobilised with OWR experts and wildlife hazing equipment from a port. Therefore, maintaining wildlife hazing equipment onshore is considered appropriate. AMOSC maintain a range of wildlife hazing equipment as part of their stockpiles.</p> <p>Wildlife collection pre-contact capture and translocation</p> <p>Both alive and deceased oiled wildlife will need to be collected during an oil spill response operation. Alive oiled wildlife is collected for translocation, and/or subsequent assessment, treatment, rehabilitation or other wildlife welfare options.</p> <p>AMOSC OWR kits have been developed and are located around Australia including in Broome, Exmouth, Fremantle and Geelong. Titleholder could purchase additional OWR kits however sufficient capability is considered already available. In addition, the types of equipment are readily</p>			



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					<p>available to be purchased from typical retail outlets/hardware stores.</p> <p>Physical structures, such as drift-fences (e.g., wooden stakes and rolls of shade-cloth), could be set-up on remote beaches to capture emergent turtle hatchlings before they enter an oiled intertidal zone, and relocate/release the hatchlings to an area well away from the slick (informed by modelling to determine the best locations for release). This type of equipment (and other visual disturbance type equipment) is readily available from gardening or hardware stores within the region. Therefore, is not considered necessary to maintain stockpiles of these types of equipment.</p> <p>Oiled wildlife cleaning/rehabilitation equipment</p> <p>Oiled wildlife containers (20 ft sea containers, specifically built for oiled wildlife cleaning) are located around Australia including Darwin, Karratha and Fremantle. Oiled wildlife containers are accessible via AMOSC. Given the current availability of containers, it is not considered ALARP for Titleholder to purchase/maintain additional containers.</p> <p>The oiled wildlife containers could be mounted onto the deck of a large support vessel, to facilitate the intake/TRIAGE and possibly cleaning of small numbers of oiled wildlife. However, following cleaning, wildlife would be required to be transported to a dedicated/purpose build oiled wildlife rehabilitation centre. If a full rehabilitation centre was required for a large number of animals, it would need to be established at an onshore location. The physical area required for wildlife intake, first-aid, necropsy, cleaning, rehabilitation etc. is far larger than can be accommodated utilising vessels offshore. The challenge associated with remote operations is the time to transport oiled wildlife from the collection location to a rehabilitation centre. In the context of the BROPEP region, this could be >24 hours for transport alone. The welfare of animals, and overall objectives of the oiled wildlife response operation will need to be taken into consideration, before establishing a full rehabilitation centre.</p> <p>Stakeholder consultation with WA DBCA has confirmed that based on the WCSS modelling and wildlife species most likely to be impacted by shoreline oil in the BROPEP region, a full oiled wildlife remote cleaning operation and/or transport and mainland rehabilitation program would be unlikely to be</p>			



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Budget Outcome	Spill	Maximum Capability Statement	Field	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
							<p>required. The relevant State/Territory Control Agency would make the decision based on OWR information available at the time.</p> <p>Therefore, mobilisation of oiled wildlife containers is not anticipated to be required as part of floating remote shoreline response units. However, if oiled wildlife containers were required, they are available for use via AMOSC mutual aid arrangements.</p> <p>Oiled wildlife waste management</p> <p>Oiled wildlife cleaning will generate liquid oily waste. Approximately 0.5 m³ of liquid waste is estimated per medium size bird. Therefore, if 100 medium size birds were cleaned, up to 50 m³ of liquid oily waste would be generated.</p> <p>At an offshore location, liquid waste can be stored in the inboard tanks, or on deck mounted liquid waste storage tanks. At an onshore location, liquid waste storage would need to be established.</p> <p>Ultimately, all oily waste would be required to be disposed of at a licensed onshore oily waste disposal facility.</p> <p>Refer Waste Management row for further information.</p> <p>It should be noted, a review of the WCSSs with WA DoT and DBCA did not trigger a requirement to plan for large scale OWR washing and rehabilitation, and therefore detailed planning for the management of significant volumes of liquid oily waste is not required.</p> <p>OWR Logistics</p> <p>It is expected the relevant Control Agency. would require Titleholder to provide the logistical support/platforms for any remote OWR operations. The response platforms for remote OWR activities typically include smaller and larger support vessels and possibly light utility helicopters. Please refer to the rows 'Remote Response' for details of remote response capabilities and arrangements.</p>			
Controlled in-situ burning	No	N/A	N/A		N/A		N/A	N/A	N/A	N/A



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Waste management	Yes	Maximum volume (433 m ³) oil ashore	No emulsion factor for condensate spills. Bulking factor 10:1 for shoreline clean-up = 4300 m ³ oily waste (including PPE, etc.). No significant liquid waste is expected to be generated from a condensate spill response.	Suitable logistics supply vessel to transport solid/liquid oily waste from remote locations to port. Licensed land-based transport and oily waste disposal capability for 4300 m ³ solid waste. No significant liquid waste is expected to be generated from a condensate spill response.	Titleholder maintains contracts with licensed waste contractors, to treat and/or dispose of oil contaminated wastes as part of routine operations. Titleholder existing waste contracts allows for immediate mobilisation of any required waste receptacles (drums, Intermediate Bulk Containers (IBCs), covered skip-bins, tote-tanks etc.) to offshore facilities, when requested by Titleholder. There are no limitations/no additional capability required, for obtaining waste storage and transport receptacles, as these are used as part of routine offshore operations. Based on the estimated worst-case volume of oil accumulated on shorelines (430 m ³), no emulsification factor and a bulking factor for waste created of 10:1, approximately 4300 m ³ of waste could be generated. Shoreline clean-up waste would likely be captured in lined bulka-bags and 1 m ³ IBCs or transportable half-height containers. Therefore approximately 4300 m ³ capacity would be required, over the full duration (weeks/months) of any shoreline clean-up. AMOSC maintains specialised oil spill waste management equipment, including lancer barges, fast-tanks etc. equipment, predominantly stored in the Fremantle and Geelong stockpiles, with small amounts in Broome and Exmouth stockpiles. The licenced waste contractors have capacity to treat/dispose of the calculated volume of solid oily contaminated waste, at existing waste management facilities in the NT and WA. Whilst no significant liquid oily wastes are expected to be generated from a condensate spill response, onshore liquid oily waste disposal capabilities are available in NT and WA. These capabilities are routinely utilised as part of Titleholder offshore production and maintenance activities.	Sufficient provision has been made for availability of a suitable licensed waste management contractor. This level of capability is considered suitable to achieve the maximum field capability statement.	Titleholder will maintain contracts with licensed waste contractors for the disposal of solid and liquid oil contaminated wastes. Titleholder will maintain mutual aid agreements for access to AMOSC specialist solid and liquid waste storage/transport equipment.	2
Remote response - support vessels	N/A	The BOD has identified that multiple remote response operations may be required at multiple remote shorelines.	N/A	The maximum field capability statement presented in this row is based on the combined selected field	Titleholder maintains access to a range of vessels through long-term hire contracts (e.g., OSVs/PSV/AHTs etc. currently operating in the BROPEP region) and access to a wide variety of other vessels through various call-off contracts/framework agreements. These contracts/arrangements include larger	Shell maintains on contract 3 IVSs and 2 PSVs. In addition, Shell has a call off contract with Inpex for their vessels.	(IVSs, OSVs/PSVs fitted with dispersant spray capability) (Large and small vessels, able to support C&R operations; one C&R strike-team within Ichthys	



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		Refer SCAT, shoreline clean-up and OWR rows for further details.		<p>capability statements from both WCSSs presented in Table 6-4 and 6-5.</p> <p>OSV and PSVs capable of dispersant spray supporting Ichthys Field activities.</p> <p>One large support vessel and one small support vessel to support 1 x C&R strike teams in Ichthys Field within 48 hours. Additional C&R strike-team (one large and one small support vessel) departing Darwin or NW shelf within 48 hours.</p> <p>A single small vessel to support remote SCAT within 2 days.</p> <p>Two additional small vessels for SCAT within 7 days.</p> <p>Single remote floating platform to support SCAT/shoreline clean-up/OWR (large vessel plus supporting tenders etc.) required to</p>	<p>vessels such as PSVs, AHTs, construction vessels etc. and also medium to small support vessels (<30m length).</p> <p>Larger vessels could be used for activities such as containment and recover, vessel dispersant, wildlife hazing and as accommodation support vessels to support remote shoreline response activities.</p> <p>Small support vessels are widely available and can be used for supporting shallow water/nearshore response activities (E.g., SCAT, P&D and wildlife hazing, etc.), and appropriately designed smaller vessels including landing barges can be used for transporting equipment and personnel to shore and backloading oiled waste and wildlife as part of remote shoreline response operations.</p> <p>Each vessel can be loaded with different spill response equipment as relevant to the response activity and location. Support vessels are available in Broome and Darwin, and elsewhere around WA/Australia as required.</p> <p>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.</p> <p>To support offshore production and drilling activities in the BROPEP region, there is a regular flow of large support vessels between offshore facilities and Broome and Darwin ports. Therefore, a large support vessel could be alongside Broome/Darwin port, loaded with spill response equipment and back underway steaming towards a spill location, generally within ~24 hours.</p> <p>However, there are some limitations. Large vessels can't always be guaranteed to be in close proximity to Broome or Darwin, and on rare occasions, it may take 18-24 hours for a large vessel to steam from an offshore location to port, to commence mobilisation of spill response equipment, and then steam back to a spill location. Therefore, total duration to mobilise equipment (E.g., C&R offshore booms and skimmers) from port to a spill location could be up to 48 hours.</p> <p>Other limitations include limited berth spaces available on wharfs in Broome and Darwin for these larger vessels. Therefore, immediate access to wharf space cannot be guaranteed. In addition, the Darwin marine supply base only</p>	<p>The cost of maintaining a large support vessel, and fleet of smaller ancillary vessels, on stand-by is not considered ALARP, given the very large additional cost, and very low likelihood of a spill reaching a shoreline at >100 g/m² within the first few days of a spill event.</p> <p>Suitable arrangements will be maintained to ensure small and large vessels and other logistical support is available to support an initial C&R and vessel dispersant activity, and multiple remote SCAT, shoreline clean-up and OWR teams, within the specified mobilisation timeframes.</p> <p>This level of capability is considered suitable to achieve the maximum field capability statement.</p>	<p>Field/Browse Basin within 48 hours)</p> <p>(Small vessel mobilised within 48 hours to support remote SCAT. Two additional small vessels within 7 days).</p> <p>(Single large vessel, and support tenders for remote shoreline response unit able to complete vessel mobilisation and depart from Broome/Darwin wharf within 6 days. Second unit in 14 days. Third unit in 30 days.)</p>	



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				<p>mobilise within 6 days.</p> <p>Second remote shoreline response unit (large vessel and small support vessels) within 14 days. Third within 30 days.</p>	<p>has two very short windows per day to transit the access channel due to tidal restrictions, placing further restrictions on mobilisation from Darwin.</p> <p>Surge capability is available, with additional large support vessels also typically available on the NW Shelf (E.g., Exmouth/Dampier). Vessels from the NW Shelf would require approximately 48 hours to transit to Broome and then commence mobilisation activities.</p> <p>The mobilisation from port of a remote shoreline response unit is not expected to be required until day 6, due to the more complex HSE planning, large and complex team size and additional equipment all required for the mobilisation. Therefore, sufficient time is available to identify and mobilise additional large support vessels.</p> <p>It should be noted that the relocation of equipment stockpiles from their storage facilities in Broome and 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, and in conjunction with other activities (E.g., bunkering).</p> <p>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 and personnel. It is not possible (space and weight limitations) to store and maintain all potentially required types of equipment offshore at all times. 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.</p> <p>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. This cost is not considered ALARP, given the low likelihood of the spill event, and low likelihood (especially in the dry season) of a significant shoreline contact occurring in a short period of time.</p> <p>It should be noted that strong winds and elevated sea-states will limit the effectiveness of most vessel-based response</p>			



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					<p>activities and reduce shoreline accessibility. There is no additional vessel-based capability that can overcome this limitation. Light utility helicopter capability can assist to overcome this issue, discussed below.</p> <p>It should be noted that if poor weather conditions were found to be limiting vessel-based responses and access to islands/shorelines, these same weather conditions would also very likely be significantly increasing the entrainment rates of any floating condensate, reducing volumes of oil ashore and increasing natural weathering of any oil on shorelines.</p>			
Remote Response - land based remote accommodation camp	N/A	The BOD has identified that multiple remote response operations may be required. Refer SCAT, shoreline clean-up and OWR rows for further details	N/A	3 remote response platforms required, however all floating/offshore. Therefore, no land-based remote accommodation camps required.	<p>The vast majority of the area covered by the BROPEP has no road access at all, which prevents the ability to establish a remote response land-based camp/FOB.</p> <p>The only area within the region with potential for suitable land-based road access is the Dampier Peninsula, between Broome and Cape Leveque/One-Arm Point. However, the BOD results for the WCSS's did not identify any shoreline contact >100 g/m² on the Dampier Peninsula. Therefore, there is no requirement for the establishment of capability/arrangements to support a large shoreline clean-up or OWR, supported by a remote response land-based camp/FOB on the Dampier Peninsula.</p>	A remote response land-based camp/FOB is not considered as an appropriate/ALARP element of the BROPEP.	N/A	N/A
Remote response helicopters	N/A	The BOD has identified that remote response operations may be required. Refer shoreline clean-up and OWR rows for further details	N/A	<p>Shoreline clean-up and OWR will likely need to be supported by floating remote response platforms required.</p> <p>A helicopter may also be required for situations where shoreline access was significantly challenging and there is an urgent need to rapidly conduct the</p>	<p>The objective for use of a helicopter during remote shoreline response is to provide a mechanism for transporting personnel, equipment and oily waste/wildlife, between the remote shoreline and remote support base (accommodation support vessel or remote shoreline FOB).</p> <p>Shoreline responses including shoreline clean-up and OWR would typically only be mobilised pending results of an initial SCAT survey, followed by a level of detailed remote response logistical, operational and HSE and Emergency Response planning. Early SCAT assessment results may quickly indicate that some level of shoreline clean-up and OWR may be required, however it is expected that a minimum of 7 days of planning and equipment/personnel mobilisation would be required, prior to a remote response vessel mobilisation from port. Therefore, a helicopter would not be required in any less than 7 days.</p> <p>The use of additional utility helicopters would enable more responders to access the affected location. However, this will</p>	<p>Due to high cost (\$1.5M-\$2M AUD/year), it is not considered ALARP to maintain a helicopter on stand-by at all times in Broome/Darwin for spill response.</p> <p>A helicopter is not required for 6 days, and only required under certain circumstances, should vessel-based logistics to land personnel ashore be unfeasible due to</p>	Shell will make arrangements directly or through OSRO's for helicopters as required during an emergency spill event when deemed required by the spill event.	3



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
				<p>shoreline clean-up/OWR activity. Only a single receptor would be contacted in the first week – therefore only a single light utility helicopter would be required initially.</p> <p>Should a helicopter be required for the initial shoreline clean-up/OWR activity, that activity would not mobilise from port until a minimum of day 6.</p> <p>Therefore, a single helicopter available by day 7, to join the vessel on its mobilisation to/at the remote shoreline response location is considered as the maximum field capability requirement.</p>	<p>require additional helicopter landing pads/locations to accommodate the helicopter overnight. To mobilise and maintain a second helicopter offshore, a very large support vessel equipped with a helicopter pad would be required.</p> <p>The costs associated with this large support vessel and second helicopter would be in excess of \$100,000 per day.</p> <p>Under a worst credible scenario, only a single remote shoreline operation requiring the use of a helicopter is anticipated.</p> <p>The minimum requirements for a helicopter to support oil spill response activities at remote shoreline locations are:</p> <ul style="list-style-type: none"> • 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. <p>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.</p> <p>Therefore, crew transfer helicopters, including the search and rescue (SAR) helicopter, are not available for shoreline oil spill response support activities.</p> <p>In addition, whilst the Sikorsky S-92 helicopters used for crew changes meet some of the criteria (E.g., personnel capacity, twin engines and long-range fuel tanks required to access remote areas), 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 S-92, the downwash generated is in excess of 125 km/h and landing on unprepared sites can cause “brown-out” 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.</p> <p>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</p>	<p>weather/metocean constraints.</p> <p>Therefore, maintaining existing agreements with helicopter companies to provide a helicopters is considered ALARP in relation to the maximum field capability statement.</p>		



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
					<p>be able to land at remote shoreline locations with extreme caution.</p> <p>Under the International Association of Oil and Gas Producers - Aircraft Management Guidelines Document 390, Titleholder risk assessments, the Titleholder Refueling Handbook and CASA Civil Aviation Advisory Publication 234-1 (2) Paragraph 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 Ashmore or Cartier Islands, the closest usable airport would be Mungalalu-Truscott Airbase. The remoteness of other potential shoreline response locations along the WA coastline presents similar challenges.</p> <p>Based on the distance of Cartier Island to Mungalalu-Truscott 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).</p> <p>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.</p> <p>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 Titleholder's aviation standards for safety, fuel range or have the ability to transport enough people/equipment to implement an effective response.</p> <p>The only way to guarantee the availability of a helicopter would be to position one, on standby in Broome or Darwin on a permanent basis. The high cost (calculated as 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.</p> <p>This is because the remote shoreline response operations are not expected to mobilise until day 6, and the helicopter is only needed if shoreline landing via vessel is not practicable or safe.</p>			



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
					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.			
Remote Response Crew Change Helicopters	N/A	N/A	N/A	Single crew change helicopter available to support ongoing crew rotations from remote response operations.	<p>The objective for use of a crew change helicopter during remote shoreline response is to provide an alternative mechanism for transporting personnel between a remote vessel-based response platform and a mainland airbase.</p> <p>Under most remote response operations, it is envisaged that the remote response vessel fleet will be able to facilitate crew changes in and out of ports. However certain circumstances (E.g., larger scale, long duration remote responses) may warrant the additional support of crew change helicopters, to conduct personnel movements between the remote response location and mainland airbases.</p> <p>In addition, a crew-change helicopter could be utilised as an air-attack aircraft (observing FWAD air-tractor operations), (refer Table 6-5 FWAD row for further information).</p> <p>Titleholder maintain contract with a helicopter provider, to provide two (2) crew-change helicopters for routine operations. These helicopters would be utilised to facilitate crew-change for oil spill response activities at remote locations.</p> <p>If additional crew-change helicopters are required above the standard fleet already maintained in Broome, additional aircraft can be arranged through the helicopter provider.</p>	<p>The Titleholder crew-change helicopter fleet which supports petroleum activities will be suitable for managing crew-change of spill responders at remote locations.</p> <p>This level of capability is considered suitable to achieve the maximum field capability statement.</p>	<p>Titleholder will maintain a fleet of crew change helicopters to support petroleum activities. These helicopters can be used to support remote oil spill response crew change, or FWAD activities if required.</p> <p>(Titleholder crew-change helicopters always available – daylight hours)</p>	

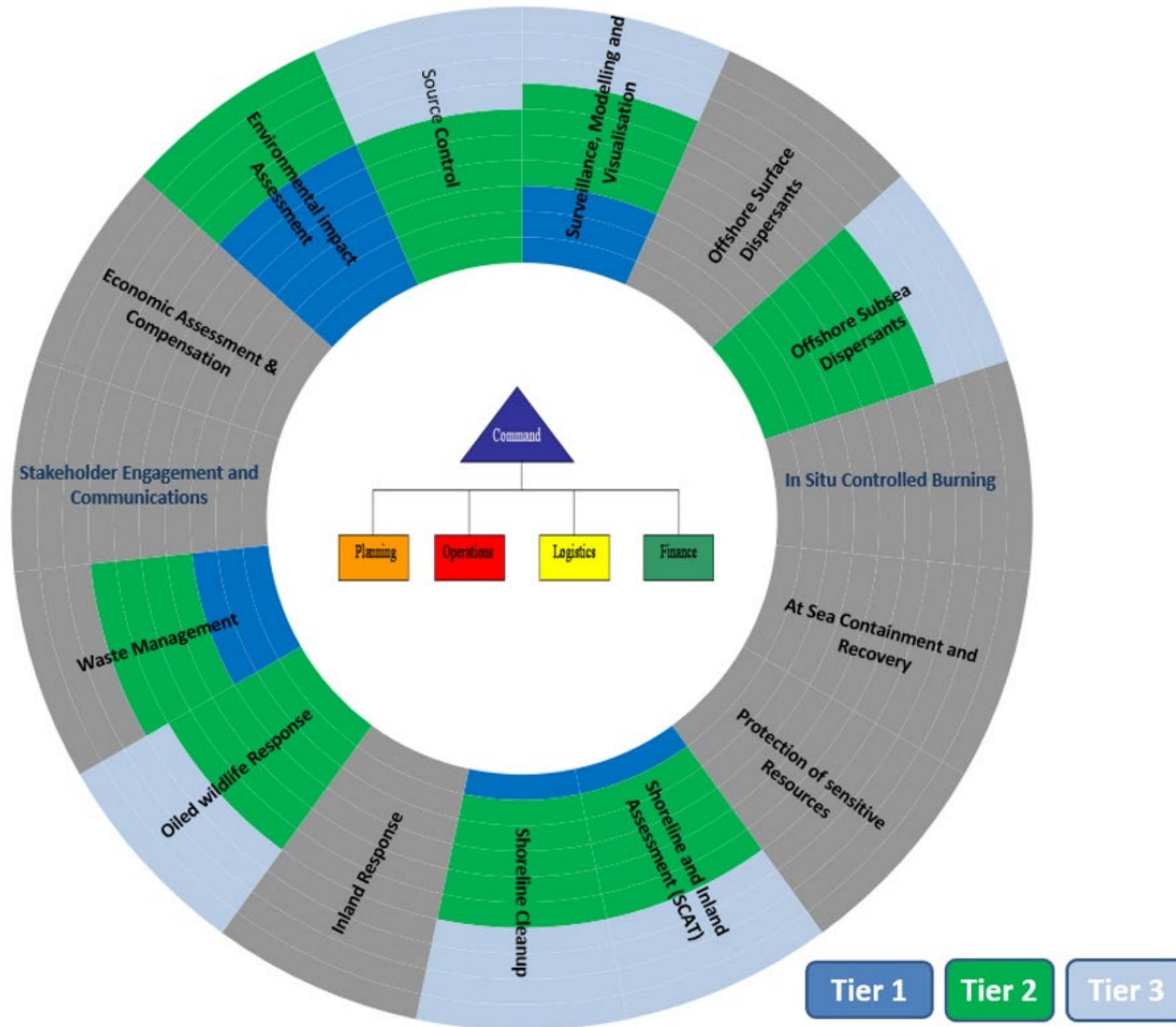


Figure 6-5: Tiered Preparedness Wheel – Condensate Well Blow-out



6.6.2 : Vessel collision Group IV spill

Table 6-5: Field Capability Assessment – Vessel Collision 776 m3 HFO Spill

Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)	
SMV - Aerial surveillance	Yes	Maximum lineal distance (km) floating oil >1g/m ² : 1150km Localised slick during first 24-48 hours.	Refer Table 6 4– row “SMV - Aerial surveillance”						
SMV - Vessel surveillance	Yes	Maximum lineal distance (km) floating oil >1g/m ² : 1150km Localised slick during first 24-48 hours.	Refer Table 6 4– row “SMV – Vessel surveillance”						
SMV - Oil Spill Trajectory Modelling	Yes	Maximum lineal distance (km) floating oil >1g/m ² : 1150km Localised slick during first 24-48 hours.	Refer Table 6 4– row “SMV – Oil spill trajectory modelling”						
SMV – Satellite tracker buoys	Yes	Maximum lineal distance (km) floating oil >1g/m ² : 1150km Localised slick during first 24-48 hours.	Refer Table 6 4– row “SMV - SMV – Satellite tracker buoys”						
SMV – Satellite imagery	Yes	Maximum lineal distance (km) floating oil >1g/m ² :	Refer Table 6 4– row “SMV - SMV – Satellite imagery”						
At Sea Containment and Recovery	Yes	Refer to Appendix A						Titleholders will maintain contracts/framework agreements with large vessel providers. Titleholders will maintain mutual aid arrangements with AMOSC, which provides access to C&R equipment for two strike-	2



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
							<p>teams as part of the AMOSC Broome/Exmouth stockpiles. In addition, AMOSC can provide advancing booming systems from the Fremantle, and Geelong stockpiles.</p> <p>Titleholders will maintain access to AMOSC Core-Group personnel trained in offshore C&R.</p> <p>(Single C&R strike team available in Ichthys Field within 48 hours)</p>	
Surface Dispersant Vessel –	Yes	Refer to Appendix B					<p>Titleholders will maintain a vessel dispersant capability respond to Group IV spills in the Prelude/Crux Field, including the following:</p> <ul style="list-style-type: none"> Prelude FLNG’s support vessels – including vessel dispersant spray systems, dispersant stockpiles and trained personnel <p>Shell will maintain a mutual aid arrangements with INPEX and AMOSC, which provide access to:</p> <ul style="list-style-type: none"> FPSO Venturer – 16 m³ dispersant and AFEDO system and dispersant spray trained personnel Ichthys 3 x OSV/PSVs – equipped with 	2



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
							<p>dispersant spray systems and trained personnel</p> <ul style="list-style-type: none"> • AMOSC Broome & Exmouth stockpiles – including vessel dispersant spray systems and dispersant stockpiles, and Core-Group trained personnel. 	
Surface Dispersant - Aerial	Yes	Refer to Appendix C					<p>Titleholders will maintain mutual aid arrangements with AMOSC, which provide access to the AMOSC contracted FWAD capability.</p> <p>(Two AT-802 air tractors and supporting FWAD capability including dispersant stocks and FWAD airbase personnel available at nominated airfield within 24 hours)</p>	
Offshore Subsea Dispersant	No	N/A						
Controlled in-situ burning	No	N/A						
SCAT	Yes	<p>Maximum of 295 km of shoreline oiled >10 g/m²</p> <p>Shorelines oiled spread over wide range of offshore islands and islands of the Bonaparte and Buccaneer Archipelagos.</p>	N/A	Refer to Table 6 4 row "SCAT"				



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
		<p>Minimum 1 day for first shoreline contact >10 g/m².</p> <p>Typically, up to 3-4 weeks before second shoreline sector is contacted.</p> <p>Significant increase in shoreline contacts between days 30-60.</p>						
Protection of sensitive resources (PSR)	Yes	N/A	N/A	<p>Protection booming maintained offshore, or on remote shorelines ready for rapid deployment.</p>	<p>As discussed in Table 5 2, there are a significant number of challenges associated with nearshore/shoreline protection booming at both offshore locations, and along the WA/NT mainland coastlines/archipelagos, including very large tidal ranges/currents, estuarine crocodiles at all mainland locations etc. The overall length of the intertidal zone, in areas with tidal ranges of 5m – 12m is so vast that attempting to utilise shore-seal/shore-guardian boom over such a large area would not be feasible. In addition, the extreme currents of the region would likely result in very limited effectiveness of booms.</p> <p>Decision to deploy shoreline/protection booming would need to be based on an assessment of a specific spill scenario, weather conditions and accessibility/practicalities of the operation at a specific location of interest.</p> <p>Therefore, maintaining shoreline protection equipment at a centralised stockpile, which can be rapidly mobilised to a vessel to deploy to a remote location is the most practical option.</p> <p>Should shoreline/protection booming be deemed appropriate, it is likely (and was verified by WA DoT/WA Control Agency during stakeholder consultation) that nearshore booming would be conducted as part of a broader remote shoreline response operation, at a very specific shoreline location. Therefore planning/mobilisation and logistics would be conducted as part of the broader remote shoreline response operation.</p> <p>AMOSC maintain shoreline/protection booming equipment at the Broome and Exmouth stockpile, as well as a large stockpile in Geelong.</p>	<p>It is not considered ALARP to maintain any shoreline / protection booming equipment offshore or at any specific sensitive receptor location, due to the very low likelihood of activation of this strategy.</p> <p>It is considered ALARP to maintain some shoreline/protection booming equipment as part of the Broome stockpile.</p>	<p>Maintain mutual aid arrangements to provide access to AMOSC shoreline protection booming systems within the AMOSC stockpiles including Broome.</p> <p>Maintain mutual aid arrangements to provide access to AMOSC and OSRL personnel trained in shoreline protection.</p>	1



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
					AMOSC maintain personnel trained in shoreline/protection booming. Additional shoreline/protection booming trained personnel are available via OSRL for a large/long duration response.			
Shoreline clean-up	Yes	<p>Maximum of 276 m³ total volume oil ashore from worst stochastic run.</p> <p>Maximum of 75 km of shoreline oiled >100 g/m² including 4 x offshore islands, and islands in the Buccaneer and Bonaparte Archipelago (refer Figure 4.3).</p> <p>Oil volumes ranging from <2 m³ to <50 m³.</p> <p>Minimum 1 days for first shoreline contact.</p> <p>Typically, up to 3-4 weeks before second shoreline sector is contacted.</p> <p>Significant increase in shoreline contacts between days 30-60.</p>	<p>Assume 2 x emulsification factor for IFO/HFO spill.</p> <p>Assume 10x bulking factor, for oily waste on shoreline.</p> <p>Worst-case of 276 m³ neat oil ashore = 5520 m³ oily waste to be recovered.</p> <p>Assume each shoreline clean-up person can recover 1 m³ oily waste per day = 5520 person days for worst-case (by volume) shoreline clean-up operation.</p> <p>Worst-case shoreline response (by length) could be across several remote locations – however not at</p>	<p>Refer to Table 6.4 – row “Shoreline clean-up”</p> <p>Note, the only difference between the Group I and Group IV shoreline clean-up oil spill budget is a slight increase in worst-case volume oil ashore, from 4300 m³ oily waste for the condensate scenario, to 5520 m³ oily waste from the IFO/HFO scenario.</p> <p>The proposed number of remote shoreline response units would remain at a peak of 3, for both the Condensate and IFO/HFO scenario. However, the remote shoreline response units would be required to operate for an extra 20 days, to recover the additional volume of oily waste from the IFO/HFO scenario.</p>				



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
			all locations simultaneously.					
Oiled wildlife response – wildlife collection	Yes	<p>1 day for time to contact at shoreline >100 g/m² at turtle breeding BIA shoreline.</p> <p>Worst case volume 276 m³ oil ashore in areas of >100 g/m² at turtle breeding BIA shoreline.</p> <p>Multiple marine avifauna and turtle BIA shorelines (several offshore islands, plus several islands of Buccaneer & Bonaparte Archipelago) contacted at >100 g/m².</p> <p>Typically, up to 3-4 weeks before second shoreline sector is contacted.</p> <p>Significant increase in shoreline contacts between days 30-60.</p>	<p>Key receptors potentially affected are EBCP listed species, with most at risk species being turtles and birds.</p> <p>Review of the WCSSs with WA DoT and DBCA did not trigger a requirement to plan for large scale OWR washing and rehabilitation.</p>	Refer to Table 6 4– row “Oiled Wildlife Response”				
Waste management	Yes	Maximum volume (276 m ³) oil ashore	<p>2 x emulsion factor for IFO/HFO spills.</p> <p>Bulking factor 10:1 for shoreline clean-up = 5520 m³ oily waste including Personal Protective Equipment (PPE) etc.</p>	<p>Suitable logistics supply vessel to transport solid/liquid oily waste from remote locations to port.</p> <p>Licensed land-based transport and oily waste disposal capability for 5220 m³ solid waste, and 100 m³ liquid oily waste</p>	<p>Titleholders maintain contracts with licenced waste contractors, to treat and/or dispose of oil contaminated wastes as part of routine operations.</p> <p>Shell’s existing waste contracts allows for immediate mobilisation of any required waste receptacles (drums, IBCs, covered skip-bins, tote-tanks etc.) to offshore facilities, when requested by Shell. There are no limitations/no additional capability required, for obtaining waste storage and transport receptacles, as these are used as part of routine offshore operations.</p> <p>Based on the estimated worst-case volume of oil accumulated on shorelines (276 m³) and the assumed emulsion and bulking factors for wastes, 5520 m³ of solid oily waste could be generated.</p> <p>Shoreline clean-up waste would likely be captured in bulka-bags and 1 m³ IBCs or transportable half-height containers.</p>	<p>Sufficient provision has been made for availability of a suitable licensed waste management contractor.</p> <p>This level of capability is considered suitable to achieve the maximum field capability statement.</p>	<p>Titleholder will maintain contracts with licensed waste contractors for the disposal of solid and liquid oil contaminated wastes.</p> <p>Titleholder will maintain mutual aid agreements for access to AMOSC specialist solid and liquid waste storage/transport equipment.</p>	2



Response strategy	Strategic SIMA outcome	BOD Outcome	Oil Spill Budget Outcome	Maximum Field Capability Statement	Operational Considerations and ALARP assessment of the Field Capability	ALARP Justification of Selected Field Capability Statement	Selected Field Capability Statement (minimum implementation time)	Tier (1/2/3)
			Assuming a highly efficient C&R operation was conducted, assume 10% oil recovered, assume ~30 m ³ liquid oily waste. Assume a conservative additional 20 m ³ liquid oily waste from sensitive receptor protection activities.		Therefore approximately 5520 m ³ capacity would be required, over the full duration (weeks/months) of any shoreline clean-up. AMOSC maintains specialised oil spill waste management equipment, including lancer barges, fast-tanks etc. equipment, predominantly stored in the Fremantle and Geelong stockpiles, with small amounts in Broome and Exmouth stockpiles. The licenced waste contractors have capacity to treat/dispose of the calculated volume of solid oily contaminated waste and liquid waste, at existing waste management facilities in the NT and WA. These facilities are routinely utilised for oily waste disposal as part of Shell's offshore production/maintenance activities.			
Remote response - support vessels	Refer to Table 6 4 – row "Remote response - support vessels"							
Remote response - land based remote accommodation camp	Refer to Table 6 4– row "Remote response - land based remote accommodation" camp							
Remote response - light utility helicopters	Refer to Table 6 4– row "Remote response - light utility helicopters"							
Remote response – crew change helicopters	Refer to Table 6 4– row "Remote response – crew change helicopters"							

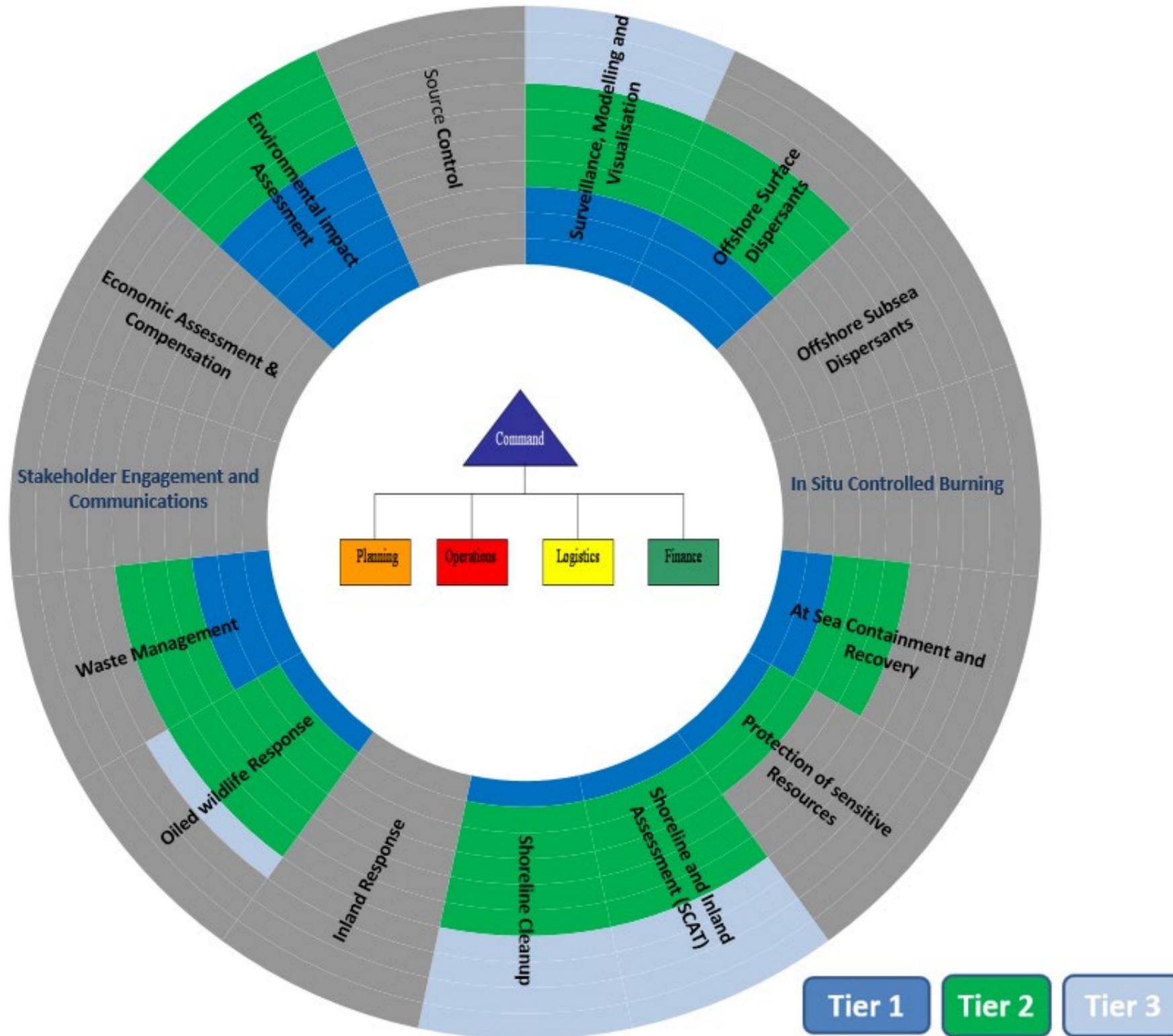


Figure 6-6: Tiered preparedness wheel – Vessel collision HFO / Group IV spills



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7 Field Capability, Arrangements and Environmental Risk Assessment of Response

This section provides:

- a suite of EPOs and EPSs related to maintaining and testing preparedness of the capabilities and arrangements for the oil spill response strategies
- an evaluation of the potential environmental impacts and risk associated with the implementation of the oil spill response strategies.

The EPOs and EPSs related to the IMT capability/arrangements are contained in the BROPEP IMT Capability Assessment Report (Attachment 2).

The EPOs and EPSs related to the implementation of the capability/arrangements during spill response are contained in the BROPEP (HSE_GEN_016765).

7.1 Oil Spill Response Field Capability Preparedness

Table 7-1 provides the EPOs, EPSs and measurement criteria related to maintaining oil spill response strategy/capability preparedness.



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Table 7-1: Environmental performance outcomes, standards and measurement criteria for oil spill response field capability preparedness

Environmental Performance Outcome	Performance Standards	Measurement Criteria
Titleholder will be prepared and ready to respond to oil spill events.	Shell will maintain vessel sharing agreements with INPEX/Ichthys and APPEA MOU, which facilitates best endeavours sharing of vessels including access to dispersant capability and oil spill tracker buoys between Ichthys and Prelude offshore production assets.	Documented Shell/INPEX agreements/arrangements
	Titleholders will validate a subset oil spill response capability and arrangements through a desktop capability/arrangements validation exercise once per calendar year. Mutual aid personnel and equipment capabilities will be validated through review of AMOSC/OSRL service level statements and AMOSC/OSRL assurance activities.	Exercise reports demonstrate objectives have been tested, improvement opportunities identified, and links provided to relevant action tracking registers.
	Titleholder's will maintain contracts with three ISVs, supporting Prelude FLNG, equipped with dispersant spray equipment and 15 m ³ of dispersant.	Records demonstrate two Shell support vessels and three ISV's are equipped with dispersant spray systems. Records demonstrate the three ISVs have a combined 15m ³ of dispersant onboard.
	ISV 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).	Records demonstrate: <ul style="list-style-type: none"> dispersant deployment exercises have been conducted annually by vessel crews.



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**Browse Regional Oil Pollution Emergency Plan – Basis of Design and Field Capability
Assessment Report**

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7.2 Risk Assessment of Response Strategy Implementation

As identified in the Strategic SIMA, not all response strategies are appropriate for every WCSS. Different hydrocarbon types, spill locations and spill volumes require different combinations of strategies, to implement an effective response.

Based on the field capability evaluations presented in Table 6 4 and Table 6 5, Titleholder's have identified appropriate response strategy capabilities and arrangements to reduce the impacts and risks of hydrocarbon spills from Shell's petroleum activities to ALARP.

However, the deployment of response strategies has the potential to introduce further impacts and risks to the environment. This section evaluates the potential environmental impacts and risks associated with implementing response strategies and evaluates the controls to manage those risks.

An impact and risk evaluation for the implementation of the response strategies is presented in Table 7 2.

The impact and risk evaluation table presented below utilises the same risk evaluation process as described in Section 9 of Shells EPs.

The EPOs and EPSs presented in Table 7 2 have been duplicated within Section 4 of the BROPEP (HSE_GEN_016765), as the IMT must be aware of and implement the below EPOs/EPs during a spill response



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Table 7-2: Impact and risk evaluation – Response strategy implementation

Identify hazards and threats – All response strategies
<p>Vessel and aviation activities.</p> <p>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 changes to water quality resulting in the exposure of EPBC-listed species to untreated/non macerated discharges.</p> <p>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.</p> <p>The physical presence of vessels used in oil spill response has the potential to result in vessel to vessel collisions.</p> <p>The physical presence and use of vessels during spill response has the potential to result in collision (vessel strike) with marine fauna which may result in death or injury to individuals. Increased vessel traffic may result in increased turtle/vessel interactions and disruption to inter-nesting behaviours. The physical presence and use of vessels during spill response near to shorelines used for wildlife roosting and breeding has the potential to result in light emissions affecting wildlife behaviour.</p> <p>The movement/anchoring of nearshore/shoreline protection booms in intertidal waters of remote shorelines/offshore islands has the potential to physically damage intertidal/shallow subtidal reefs.</p> <p>The introduction of inappropriately managed ballast water could result in the introduction of marine pests into shallow benthic habitats including Australian and State/Territory Marine Parks.</p> <p>The movement of equipment and personnel from vessels and helicopters onto remote locations/offshore islands has the potential to introduce terrestrial exotic pests, including rats.</p> <p>The operation of aircraft including helicopters and fixed wing aircraft may result in noise impacts and/or other disturbance to cetaceans.</p> <p>Shoreline response activities</p> <p>The movement of equipment and personnel and lighting onto turtle nesting beaches has the potential to disturb turtle nests and turtle nesting activities.</p>



Incorrect management of hydrocarbon contaminated wastes generated during sensitive receptor protection booming and shoreline clean up has the potential to create additional contamination of the shoreline.

OWR activities

Poorly implemented wildlife hazing can result in unintended secondary impacts and disturbance to natural wildlife activities.

Capture, cleaning and rehabilitation of oiled wildlife has the potential to create additional stress to animals and introduce diseases back into wild populations.

Surface and subsea dispersant activities

Dispersant use can result in reduced water quality and toxicity to intertidal and subtidal marine flora and fauna from dispersant and increased concentrations of entrained/dispersed hydrocarbons in the water column.

Containment and recovery activities

Operational efficiencies may be achieved during containment and recovery activities, by discharging oil/oily water to maximise the concentration of oil in vessel/deck storage tanks. As such, some discharges of oil/oily water back to the marine environment may be required during containment and recovery activities.

Potential consequence: Vessel and aviation activities	Severity
<p>The values and sensitivities with the potential to be impacted are transient, EPBC listed species (marine fauna including foraging BIAs).</p> <p>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, Lacapede Islands 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/NT 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).</p>	Moderate (D)



Various conservation management plans 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 response strategies has the potential to increase the risk of a vessel to vessel collision. The hazards, consequences, likelihood and risks of a vessel collision are discussed in all EPs, and therefore this is not replicated within this BROPEP. The standard controls specified within EPs to prevent vessel collisions are replicated within this table.

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 (2017), 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, whale-shark or turtle, it would not be expected to cause a significant effect at the population level. Therefore, the consequence is considered to be Minor (E).

The use of deck lighting on vessels at night during the implementation of response strategies has the potential to increase the risk of disturbance to marine megafauna (if vessels are operating adjacent to turtle nesting beaches at night). Under most circumstances, night-time vessel based oil spill response activities adjacent to shorelines is not expected to be required. Therefore, vessels close to shore would likely be at anchor. Therefore, significant on water or deck lighting is not expected to be in use on vessels supporting remote shoreline spill response. The impact of vessel light emissions on adjacent sensitive shorelines could result in some behavioural disturbance, such as impact on turtle hatchling orientation. Any impact is likely to be minor, only affecting a small proportion of the population, and temporary in nature (i.e. only for the duration of the spill response). Therefore, the consequence is considered to be 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 impacts to these habitats (Minor E).

Vessel-based contain and recover response activities would generate a significant quantity of hydrocarbon contaminated solid and liquid waste. Contaminated solids would include PPE, oil coated booms, skimmers etc. and the oily contaminated liquids collected during the response activity. Inappropriate management of the oily contaminated waste could result in localised contamination of the marine environment resulting in harm to individuals of protected species (Minor E).

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



<p>of protected species (Moderate D). Similarly, the consequence of inappropriate ballast water management could result in the introduction of marine pests into marine parks, resulting in medium-term impacts on a protected ecosystem (Moderate D).</p> <p>An individual close pass of an aircraft over an individual or group of cetaceans during oil spill response activities would likely result in a minor disturbance, such as very short term behavioural changes, for the affected cetaceans (Insignificant F).</p>	
<p>Potential consequence: Shoreline response activities</p>	<p>Severity</p>
<p>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).</p> <p>Sensitive receptor protection (intertidal booms and skimming) and shoreline clean up responses may generate a significant quantity of hydrocarbon contaminated solid and liquid waste. Contaminated solids would include PPE, spill clean up equipment (shovels, rakes, etc.) and the oil contaminated sediments collected from shorelines (IPIECA 2015) and oil coated booms, skimmers etc. and the oily contaminated liquids and sediments collected during the nearshore booming/skimming activities. Inappropriate management of oil contaminated waste could result in localised secondary contamination of the nearshore marine environment shoreline sediments and harm to individuals of protected species (Minor E).</p>	<p>Minor (E)</p>
<p>Potential consequence: Oiled wildlife response activities</p>	<p>Severity</p>
<p>The values and sensitivities with the potential to be impacted are transient, EPBC listed species (turtles and marine avifauna).</p> <p>A wildlife hazing tactic 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. However, 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-IOGP 2017b). In addition, inappropriate hazing activities could also temporarily interfere with other natural roosting/breeding processes of a local population. Therefore, the consequence of inappropriately implemented wildlife hazing activities is considered Minor (E).</p> <p>Pre-contact and post contact OWR (capture and translocation, or capture, intake, first-aid cleaning, and rehabilitation of wildlife) can increase the survival rates of wildlife which may be, or has become, oiled at sea or onshore. However depending on the species, there is significant potential for increased stress and other issues to some animals during capture, cleaning, relocation and/or</p>	<p>Moderate (D)</p>



<p>rehabilitation (IPIECA-IOPG 2017b). The welfare considerations for each individual animal, whilst also balancing the conservation significance of the wider population/species must be considered, when determining the appropriate wildlife response tactics to implement. The consequence of inappropriate selection of wildlife response tactics could result in additional harm or poor welfare outcomes to individual animals and could also result in the introduction of zoonotic diseases back into, and spreading throughout wild populations, resulting in longer term impacts to populations not impacted by the spill. Therefore, the consequence of inappropriate selection of OWR tactics is considered (Moderate D).</p>	
<p>Potential consequence: Surface dispersant and subsea dispersant activities</p>	<p>Severity</p>
<p>The values and sensitivities with the potential to be impacted are:</p> <ul style="list-style-type: none"> • transient, EPBC listed species (marine fauna) • benthic communities (submerged reefs and shoals, and seagrasses) • BIAs associated with turtle and marine avifauna nesting. <p>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.</p> <p>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 hydrocarbon 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 surface dispersant application during the Montara spill showed increases in entrained hydrocarbons concentrating in the top 25 m of the water column (AMSA 2010).</p> <p>The distance at which receptors could be impacted by dispersed hydrocarbons has been assessed using the 100- parts per billion (ppb) threshold for entrained/dissolved hydrocarbons.</p> <p>INPEX commissioned a series of dispersant effectiveness modelling simulations for a 1000 m³ IFO release from a GEP installation vessel, at various locations along the Ichthys GEP route prior to GEP construction. 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</p>	<p>Minor (E)</p>



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 m³ to 120 m³ 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 ten times higher, than the 100-ppb impact threshold.

In another modelled scenario, 48 m³ 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, which is still double the concentration of the 100-ppb threshold.

In another scenario, 50 m³ 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, one order of magnitude below the 100-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 Titleholders dispersant application decision guide, 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 Controlling Agencies, or Director of National Parks if within an Australian Marine Park, 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. 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 positive outcome for dispersant use. The decision to conduct dispersant application (including consideration of the associated consequences) within 3 nautical miles (nm) of a State/Territory shoreline would only occur under direction/instruction from the relevant WA/NT Control Agency, or Director of National Parks if within an Australian Marine Park.

Subsea Dispersant Injection (SSDI) on condensate wells has traditionally not been considered environmentally acceptable, as under light wind conditions (<5 knots), a high proportion of condensate will evaporate into the atmosphere, removing the hydrocarbons from the marine environment. With increasing wind conditions, more hydrocarbons become entrained. By conducting SSDI, an even higher proportion of the condensate would become entrained in the water column, resulting in a potential increase in impacts associated with entrained hydrocarbons.

SSDI modelling (RPS 2019c) confirmed (using multiple Ichthys Field worst-case blow-out scenarios) that under light wind conditions, up to 80% of the released condensate would evaporate into the atmosphere, and likely exceed VOC safe exposure thresholds in close proximity (<1 km) of the release location. Under the light wind conditions, approximately 20% of the condensate would become entrained in the top ~3 m of the water column, with a very small proportion undergoing biodegradation (<10%).

SSDI modelling (RPS 2019c) also confirmed that when comparing the same scenarios (without SSDI vs with SSDI), under the same light wind conditions, the effect of SSDI would be an increase in condensate entrainment up to ~70%, in the top ~3 m of the water column, with evaporation reduced to ~30%. RPS (2019e) weathering simulations also confirmed that with elevated wind speeds (>10 knots), the natural rate of entrainment of condensate is roughly equivalent to that which occurs when SSDI is in use.

In addition, the SSDI modelling (RPS 2019c) also confirmed that after approximately 1 week of SSDI use, due to the much smaller oil droplet sizes, the rate of biodegradation has increased to ~50% of the rate of entrainment (compared to a biodegradation rate of <10% without SSDI).

SSDI modelling results (RPS 2019c) concluded that SSDI would significantly reduce the risk of VOCs exceeding safe exposure thresholds. Therefore, the use of SSDI to eliminate the VOC risk to source control vessels/workers may increase the likelihood of a successful well kill using a capping stack, instead of a relief well, potentially reducing source control activities by several months.

A credible worst-case scenario could involve the use of SSDI for up to one-month duration, to complete a complex debris removal and capping stack installation activity. If the scenario was less complex, SSDI may only be required for a few days. Therefore, SSDI could result in an increase in entrainment of condensate from ~20% to ~70%, in the top ~3 m of the water column, for the days on which SSDI was used. However, the time saved to control the well through the use of SSDI and a successful capping stack installation would result in an overall net reduction in the volume of condensate entrained in the water column over the response period.



<p>In summary, the overall effect of SSDI is considered to be a temporary increase in entrained hydrocarbons in the top ~3 m of the water column, for the duration which SSDI is used. The increase in entrainment from SSDI is similar to normal levels of entrainment expected to occur under higher wind conditions. The effects of increased entrainment due to SSDI are partially offset due to a reduction in oil droplet size, resulting in a very significant increase in biodegradation rates. Any impacts associated with the use of SSDI to achieve a successful well-kill using a capping stack are offset by the significant reduction in the overall duration of the blow-out (and net reduction in entrained hydrocarbons) compared to a relief well-kill scenario.</p> <p>Due to the mitigating factors described in the paragraph above, the potential impacts and risks associated with SSDI on submerged and intertidal receptors is considered Insignificant (F).</p>	
Containment and recovery activities	Severity
<p>AMSA (2020b) Maritime discharges of oil and oily water during emergency and response situations provides guidance on the legal mechanism to obtain approval for discharge of oil/oily water during containment and recovery activities. Therefore, provided the relevant AMSA (or State/Territory government) approval has been granted, the discharge of oil/oily contaminated water from vessels during containment and recovery activities would be conducted, to achieve higher rates of efficiency in the overall oil recover operation. Therefore, the consequence is considered Insignificant (F).</p>	Insignificant (F)
Identify existing design safeguards / controls	
<p>Vessels fitted with lights, signals, an automatic identification system (AIS) transponders and navigation equipment as required by the Navigation Act 2012.</p> <p>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.</p> <p>Implementation of EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.05 and 8.07).</p> <p>Vessel speed restrictions and separation distances maintained for whale sharks, consistent with the Whale Shark Wildlife Management Program no. 57 (DPaW 2013).</p>	



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, Titleholder 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.
	Eliminate use of vessel lighting (to eliminate light emission impacts on shoreline receptors) during a remote shoreline response.	No	Vessels used during spill response must maintain adequate lighting for safety of navigation, and lighting as required for safety of personnel undertaking activities on a deck at night.
Substitution	None identified.	N/A	N/A
Engineering	None identified.	N/A	N/A
Procedures administration and	Visual inspections to prevent introduction of terrestrial exotic pests to offshore islands.	Yes	Visual inspections of vessels, helicopters, equipment and personnel 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.



	<p>Shoreline response activity HSE plan prepared and implemented which incorporates consideration of impacts to turtle nesting and anchoring of shoreline protection booms.</p>	<p>Yes</p>	<p>To ensure risks to turtle nesting activities are minimised 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.</p> <p>The plan will address specific issues including:</p> <ul style="list-style-type: none"> • personnel and equipment movement on turtle nesting beaches • light spill (if night time activities are required) <p>These sections of the relevant HSE plan will be prepared in consultation with AMOSC, Department of Agriculture, Water and the Environment (DAWE) (for response on Cwlth shorelines), and WA/NT Control Agencies and wildlife agencies for responses on WA/NT shorelines.</p>
	<p>Vessel specific lighting plan, prepared and implemented, which incorporates consideration of impacts to turtle nesting, from vessel light emissions.</p>	<p>Yes</p>	
	<p>Vessel specific lighting plan, prepared and implemented, which incorporates consideration of impacts to turtle nesting, from vessel light emissions.</p>	<p>Yes</p>	<p>To ensure risks to turtle nesting activities are minimised a vessel specific lighting plan will be prepared, for vessels supporting remote shoreline response operations, adjacent to identified turtle nesting beaches, during turtle nesting season.</p> <p>The plan will address specific issues including:</p> <ul style="list-style-type: none"> • minimum lighting required for navigation



			<ul style="list-style-type: none">permitted/restricted activities on deck at night, and the minimum lighting requirements for the safe conduct of those permitted activities. <p>The vessel specific lighting plans will be developed by the Vessel's bridge crew, in consultation with AMOSC, Department of Agriculture, Water and the Environment (DAWE) (for response on Cwlth shorelines), and WA/NT Control Agencies and wildlife agencies for responses on WA/NT shorelines.</p>
	Shoreline response activity HSE plan prepared and implemented which incorporates consideration of impacts to anchoring of shoreline protection booms on intertidal habitats.	Yes	<p>To ensure risks to intertidal habitats are minimised a site specific HSE plan for any sensitive receptor protection activity will be developed to address any risks of anchoring/equipment damage to intertidal habitats including intertidal coral reefs.</p> <p>These sections of the relevant HSE plan will be prepared in consultation with AMOSC, DAWE (for response on Cwlth shorelines), and WA/NT Control Agencies for responses on WA/NT shorelines.</p>
	No discharge of ballast water within Commonwealth and State/Territory Marine Parks	Yes	<p>Whilst all vessels are required under Australian law to manage ballast water according to the Australian Ballast Water Management Requirements, an additional control, to further reduce risks from ballast water will be the prohibition of discharge of ballast water within Commonwealth and State/Territory Marine Parks.</p>
	A waste management plan will be prepared and implemented for any offshore, nearshore or shoreline response operations, in	Yes	<p>A waste management plan to manage all hydrocarbon contaminated solid/liquid waste is necessary to prevent secondary contamination of shorelines and nearshore marine environment.</p>



	consultation with AMOSC and relevant Control Agencies.		
	Vessel and/or aerial dispersant application on Group IV hydrocarbons will only occur in accordance with the IMT dispersant application decision.	Yes	<p>Titleholder has a dispersant application decision guide which outlines specific conditions that must be satisfied before dispersant applications can take place, in order to reduce impacts and risks to ALARP.</p> <p>In order to verify that applications are acceptable to key stakeholders, in accordance with the WA DoT Dispersant Use Guidelines, WA/NT Controlling Agency will be notified before any dispersant application in Commonwealth waters for spills which may enter WA/NT waters. This requirement is captured within the IMT dispersant application decision matrix.</p>
	Dispersants with high efficacy for dispersal of Group IV hydrocarbons will be used for surface dispersant application.	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.
	Dispersants with high efficacy for dispersal of condensates and demonstrated oil to dispersant injection ratios will be used for SSDI.	Yes	The initial SSDI stockpile is the AMOSC SFRT 500 m3 of Slick-gone NS. Slick-gone NS was tested along-side two other dispersants (Corexit 9500 and Finasoil OSR 52), in a study (Brandvik et al. 2014) to evaluating dispersant effectiveness (shift in droplet size distribution) under typical SSDI conditions, including direct injection of the dispersant into fresh/warm oil, under very turbulent conditions. Three dispersants were tested against four oil types (paraffinic crude, waxy crude, asphaltenic crude and a light oil/condensate), with specific gravities ranging from 0.941 kg/l (heavy crudes), to 0.797 kg/l (condensate). The results of simulated SSDI dispersant injection on the condensate concluded that Slick-gone NS



			achieved in the largest reduction in droplet sizes, with a significant shift observed with a 100:1 oil to dispersant injection ratio. Therefore, the use of the AMOSC SFRT Slick-gone NS dispersant stockpile is considered appropriate for use on Ichthys Field condensates.
	Titleholder will monitor VOC levels during a well control incident to inform the need to activate SSDI and adjust dispersant injection flowrates, as required to reduce VOCs on the ocean surface to safe levels, to facilitate debris clearance and capping stack deployment.	Yes	SSDI is only planned for use when VOCs are above safety thresholds, which would prevent the safe vessel operations to conduct debris clearance and capping stack deployment. Any increased condensate entrainment due to SSDI is partially offset due to a reduction in oil droplet size, resulting in a very significant increase in biodegradation rates. Any impacts associated with the use of SSDI to achieve a successful well-kill using a capping stack are offset by the significant reduction in the overall duration of the blow-out (and net reduction in entrained hydrocarbons) compared to a relief well-kill scenario.
	Dispersant injection rates will be informed by water quality monitoring outcomes.	No	As discussed above, the purpose of SSDI use on condensate wells is to reduce VOC risks in the atmosphere, to facilitate safe debris clearance and capping stack deployment. Therefore, dispersant ratios/injection rates will be monitored and adjusted based on atmospheric VOC measurements, not based on water quality monitoring.
	Dispersant impacts to the marine environment will be verified via water quality monitoring.	Yes	Should SSDI be required to be activated, the impact of SSDI on water quality and the broader environment will be monitored, in accordance with the OSMP/water quality monitoring program.
	Conduct discharges of oil/oily contaminated water (decanting) during containment and	Yes	In accordance with AMSA (2020b), the relevant government administrators include the following AMSA positions: the



	<p>recovery activities, to improve the efficiency of oil recovery during the spill response.</p>	<p>AMSA Local Manager; the Manager Marine Environmental Pollution Response; the General Manager, Marine Environment; and the General Manager, Ship Safety Division.</p> <p>Some States/Territories may have processes for approval within their relevant jurisdiction, however if the State/Territory is silent on the issue, or in conflict with the MARPOL Regulation intent (to permit the discharge during spill response), then the Commonwealth legislation applies, as the means to implement the international/MARPOL obligation.</p> <p>Note, the approvals are specified vessels for a particular spill response, and not as a general discharge approval.</p> <p>There is no specific AMSA form for this application, however the applicant (IMT) should provide a full explanation to assist the person assessing the approval, and as a minimum, should provide the following information:</p> <ul style="list-style-type: none"> •who and why - the vessel, the incident and the applicant •what - the planned response operations that require the oily water discharge •how - the state and capability of the ship as a response platform •result - the expected discharge volumes or rates.
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Identify the likelihood

<p>Likelihood</p>	<p>The likelihood of Level 2 or Level 3 spills from Titleholder’s petroleum activities are evaluated in each activity specific EP. The use of response strategies may increase the likelihood of an additional impact occurring if the response strategies are implemented inappropriately. However, based on the controls described, the likelihood of response activities resulting in the consequences described is considered Unlikely (4).</p>
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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		
<p>Legislative requirements</p> <p>The activities and proposed management measures are compliant with industry standards and relevant Australian legislation/guidance, E.g., the NatPlan (AMSA 2020a); AMSA (2020b) regarding oil discharges during spill response activities, the Western Australian State Hazard Plan – Maritime Environmental Emergencies (WA DoT 2021), specifically concerning implementation of oil pollution emergency plans; EPBC Regulations regarding vessel and aircraft operations near cetaceans, and MARPOL 73/78 for vessel discharges and garbage management.</p> <p>Stakeholder consultation</p> <p>Stakeholders have been engaged and issues/feedback have been incorporated into the BROPEP regarding potential impacts and risks associated with implementation of response strategies. Stakeholder engagement is an ongoing process.</p> <p>Conservation management plans / threat abatement plans</p> <p>Several conservation management plans 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.</p> <p>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</p>		



invasion or reinvasion via prevention / risk reduction for rodents gaining access to key vessels at key ports. Titleholder’s controls align with the intent of preventing invasion/establishment of pests.

The recovery plan for marine turtles in Australia (DEE 2017) and the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds (DEE 2020) 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 and National Light Pollution Guidelines have been adopted.

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 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
- 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
Risks of impacts to the environment from vessel discharges during oil spill response activities will be reduced and maintained to ALARP and acceptable levels.	All vessels involved in oil spill response activities will conduct sewage disposal activities in accordance with MARPOL 73/78, Annex IV.	Emergency event response records.



	All vessels involved in oil spill response activities will conduct food scrap disposal activities in accordance with MARPOL 73/78, Annex V.	Emergency event response records.
No disturbance/injury/ mortality of cetaceans, whale sharks or turtles resulting from interactions with vessels undertaking spill response activities.	<p>Interactions between support vessels and cetaceans will be consistent with EPBC Regulations 2000 – Part 8, Division 8.1 (Regulation 8.05) Interacting with cetaceans (modified to include turtles):</p> <ul style="list-style-type: none"> • Spill response vessels will not travel faster than 6 knots within 300 m of a cetacean or turtle (caution zone) and minimise noise. • Spill response vessels will not approach closer than 50 m to a dolphin or turtle and/or 100 m for a whale (with the exception of bow riding). <p>If a cetacean shows signs of being disturbed, support vessels will immediately withdraw from the caution zone at a constant speed of less than 6 knots.</p>	Records of event reports if vessel strike occurs during spill response.
	Interactions between spill response vessels and whale sharks will be consistent with the Whale Shark Wildlife Management Program no. 57 (DPaW 2013); specifically, spill response vessels will not travel faster than 8 knots within 250 m of a whale shark (exclusive contact zone) and not approach closer than 30 m of a whale shark.	Records of breaches of whale shark code of conduct are documented.
	Interactions between spill response aircraft and cetaceans will be consistent with EPBC Regulations 2000 – Part 8, Division 8.1 (Regulation 8.07) - aircraft/cetacean separation requirements (500m	Emergency event response records.



	altitude and radius for helicopters, 300m altitude and radius for fixed wing aircraft).	
No inappropriate disposal of waste to the marine environment from vessels during spill response.	All vessels involved in oil spill response activities will conduct garbage management in accordance with MARPOL 73/78, Annex V.	Emergency event response records.
No introduction of terrestrial exotic pests to island ecosystems or introduction and establishment of introduced marine species of concern to State/Territory or Commonwealth marine parks during response activities.	Premobilisation visual inspections of vessels and equipment before mobilisation to an island location and recorded on quarantine inspection checklists. Inspection date/time/outcome to be recorded on quarantine inspection checklists	Emergency event response records.
	Premobilisation visual inspections of helicopters and equipment before mobilisation to an island location. Inspection date/time/outcome to be recorded on aircraft technical log.	Emergency event response records.
	No de-ballasting within State, Territory or Commonwealth marine parks during oil spill response activities.	Emergency event response records.
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.	Emergency event response records.
No secondary ocean or shoreline contamination due to inappropriate waste management	Waste management plan(s) will be developed in consultation with AMOSC, and as necessary, the relevant State/Territory Control Agency.	Emergency event response records.



<p>during the implementation of spill response strategies.</p>	<p>Waste management plans will include consideration of:</p> <ul style="list-style-type: none"> • methods to eliminate, reduce and re-use materials to reduce the overall volume of waste generated • waste storage, transport and disposal arrangements • decontamination stations and other relevant processes to prevent secondary contamination. 	
<p>Risks of impacts to transient, EPBC-listed species, (marine turtles) and intertidal habitats from a shoreline response are reduced and maintained to ALARP and acceptable levels.</p>	<p>In the event of a shoreline response, an HSE plan will be prepared, in consultation with AMOSC and WA/NT wildlife agencies (via relevant WA/NT Control Agency) or DAWE (for Commonwealth lands) which addresses potential impacts to turtle nesting including:</p> <ul style="list-style-type: none"> • personnel and equipment movement on turtle-nesting beaches • light-spill (if night-time activities are required). 	<p>Emergency event response records.</p>
	<p>In the event of a shoreline response, a vessel specific lighting plan will be prepared, for vessels supporting remote shoreline response operations, adjacent to identified turtle nesting beaches, during turtle nesting season.</p> <p>The plan will address specific issues including:</p> <ul style="list-style-type: none"> • minimum lighting required for navigation 	<p>Emergency event response records.</p>



	<ul style="list-style-type: none">permitted/restricted activities on deck at night, and the minimum lighting requirements for the safe conduct of those permitted activities. <p>The vessel specific lighting plans will be developed by the Vessel's bridge crew, in consultation with AMOSC, Department of Agriculture, Water and the Environment (DAWE) (for response on Cwlth shorelines), and WA/NT Control Agencies and wildlife agencies for responses on WA/NT shorelines.</p>	
Risks of impacts to intertidal habitats from nearshore/shoreline booming operations reduced and maintained to ALARP and acceptable levels.	In the event of a sensitive receptor protection response, an HSE plan will be prepared, in consultation with AMOSC relevant WA/NT Control Agency or DAWE (for Commonwealth lands) which addresses potential impacts to intertidal reefs and defines controls for nearshore/shoreline booming anchor layouts and other controls to limit impacts to intertidal ecosystems.	Emergency event response records.
Risks of impacts to transient, EPBC-listed species, (marine turtles, marine mammals and marine avifauna) from wildlife response activities are reduced and maintained to ALARP and acceptable levels.	<p>OWR shall be undertaken in accordance with the relevant State/Territory OWR Plan and/or Manual, under direction from the relevant State/Territory Control Agency, or in consultation with the DAWE (Commonwealth waters and shoreline OWR).</p> <p>All necessary regulatory permits will be obtained prior to commencing wildlife response activities, and conditions will be implemented.</p>	Emergency event response records.
Risks of impacts to marine water quality and shallow benthic communities from surface	Vessel and/or aerial dispersant applications will be undertaken in accordance with the IMT dispersant application decision matrix.	Emergency event response records.



<p>dispersant application are reduced and maintained to ALARP and acceptable levels.</p>	<p>Only dispersants with high efficacy for dispersal of Group IV hydrocarbons which are listed on the AMSA oil spill control agent (OSCA) register will be used in the event of dispersant application.</p>	<p>Emergency event response records.</p>
<p>Impacts to the shallow water column through use of SSDI will be reduced to ALARP through the implementation of the Environmental Performance Standard.</p>	<p>SSDI (AMOSC SFRT Slick-Gone NS dispersant stockpile) will only be activated when:</p> <ul style="list-style-type: none"> • Air quality monitoring and/or modelling determines there is a credible risk of atmospheric VOC concentrations exceeding safe exposure thresholds for source control activities; and • There is a requirement to conduct source control activities in the zone where atmospheric VOCs may present a hazard to the safety of workers, and <p>Air quality monitoring and/or modelling of gas levels and lower explosive limits determines if source control activities including SSDI could be safely conducted.</p>	<p>Records of:</p> <ul style="list-style-type: none"> • Air quality monitoring and/or modelling demonstrating a credible risk of atmospheric VOC concentrations exceeding safe exposure thresholds for source control activities <p>SSDI injection occurring concurrently with source control activities</p>
	<p>SSDI injection concentration will initially be set at 100:1 (based on best estimate of well flow-rate at the time of the blow-out).</p> <ul style="list-style-type: none"> • Effectiveness of SSDI will be monitored through ongoing measurement of VOC concentrations on the surface, by source control vessels. If VOC exposure thresholds are exceeded, SSDI ratio will be incrementally increased, until VOC 	<p>Records of SSDI injection ratio</p> <ul style="list-style-type: none"> • Records of atmospheric VOC concentration monitoring during source control activities



	concentrations are below safe exposure thresholds.	
	In the event of SSDI activation, water quality monitoring will be activated in accordance with the Operational and Scientific Monitoring Program, to verify impacts from SSDI activities upon the marine environment.	Records of OSMP activation and water quality monitoring results.



8 Implementation

An implementation strategy is described within all Titleholder's EPs. The implementation strategy addresses the following;

- overview of Titleholder's Business Management System, including HSE management systems/processes
- leadership and commitment including Environment Policy
- capability and competency including the organisational team and responsibilities associated with the implementation of the EP
- documentation, information and data management related to the EP
- risk management process used within the EP
- operate and maintain; specific processes/systems required for EP implementation
- management of change, including the specific change management process for the EP
- stakeholder engagement, including processes for ongoing engagement and consultation with stakeholders potentially affected by the EP
- contractors and suppliers, including selection and management processes
- security and emergency management
- incident investigation and lessons learned, which also includes monthly and annual performance reporting.
- monitor, review and audit; defining the processes to ensure ongoing compliance and continual improvement of the EP
- management review, including senior management review of the EP

Within the implementation strategy of each EP, only some elements are relevant to the BROPEP suite of documents. The following are considered necessary to include as stand-alone processes within this document;

- the review process for the BROPEP suite of documents
- the management of change process to be applied for the BROPEP suite of documents
- the annual performance reporting requirements against the BROPEP suite of documents
- the management review process for the BROPEP suite of documents.

The details of these are provided in the following sections.

8.1 Review of the BROPEP

The BROPEP suite of documents are listed in Table 1 1.

The BROPEP suite of documents will be reviewed following any events requiring their activation, in order to identify any lessons learned, or other relevant triggers for review.

Environmental performance outcomes, standards and measurement criteria relating to updating the BROPEP suite of documents are presented in Table 8 1.



Table 8-1: Environmental performance outcome, standards and measurement criteria for updating the BROPEP

Environmental performance outcome	Performance standards	Measurement criteria
Titleholder will be prepared and ready to respond to oil spill events.	The BROPEP suite of documents will be reviewed and updated if necessary, following any IMT exercise or incident in which the BROPEP was used/activated.	Records demonstrate a review and update (if necessary) of the BROPEP.
	The BROPEP suite of documents will be reviewed and updated if necessary, if new oil spill related information is identified through the quarterly risk review process, which could affect the BROPEP.	Records demonstrate quarterly risk reviews consider oil spill risk elements.
	The BROPEP suite of documents will be reviewed and updated if necessary, based on findings from the annual management review and annual performance report.	Records demonstrate a review and update (if necessary) of the BROPEP.

8.2 Management of Change

Changes to Titleholder's documents are 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 Titleholder's business rules, it is mandatory to undertake an environmental risk assessment in every case for changes that could affect the environment, including oil spill risks and response arrangements.

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 an 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 BROPEP suite of documents



- 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 1468.4.

As the BROPEP suite of documents are an integrated element of all NOPSEMA accepted EPs, the MoC process is also applicable to these documents. Due to the nature of the BROPEP process, specific BROPEP MoC evaluation processes have been developed.

Figure 8 1 shows the process to assess and document potential changes associated with the BROPEP BOD and Field Capability, as defined in this document.

Figure 8 2 shows the process to assess and document potential changes associated with the IMT capability and arrangements, as presented in the BROPEP IMT Capability Assessment Report.

Where an MoC is required for changes to BROPEP documentation, the Shell MOC Process (as described within associated EPs) will be used to formally record/document the change.

When a new or revised EP is required to be re-submitted to NOPSEMA, and the new or revised EP also requires/results in changes to any of the BROPEP suite of documents, the updated BROPEP documents will be submitted, with the new/revised EP, to NOPSEMA.

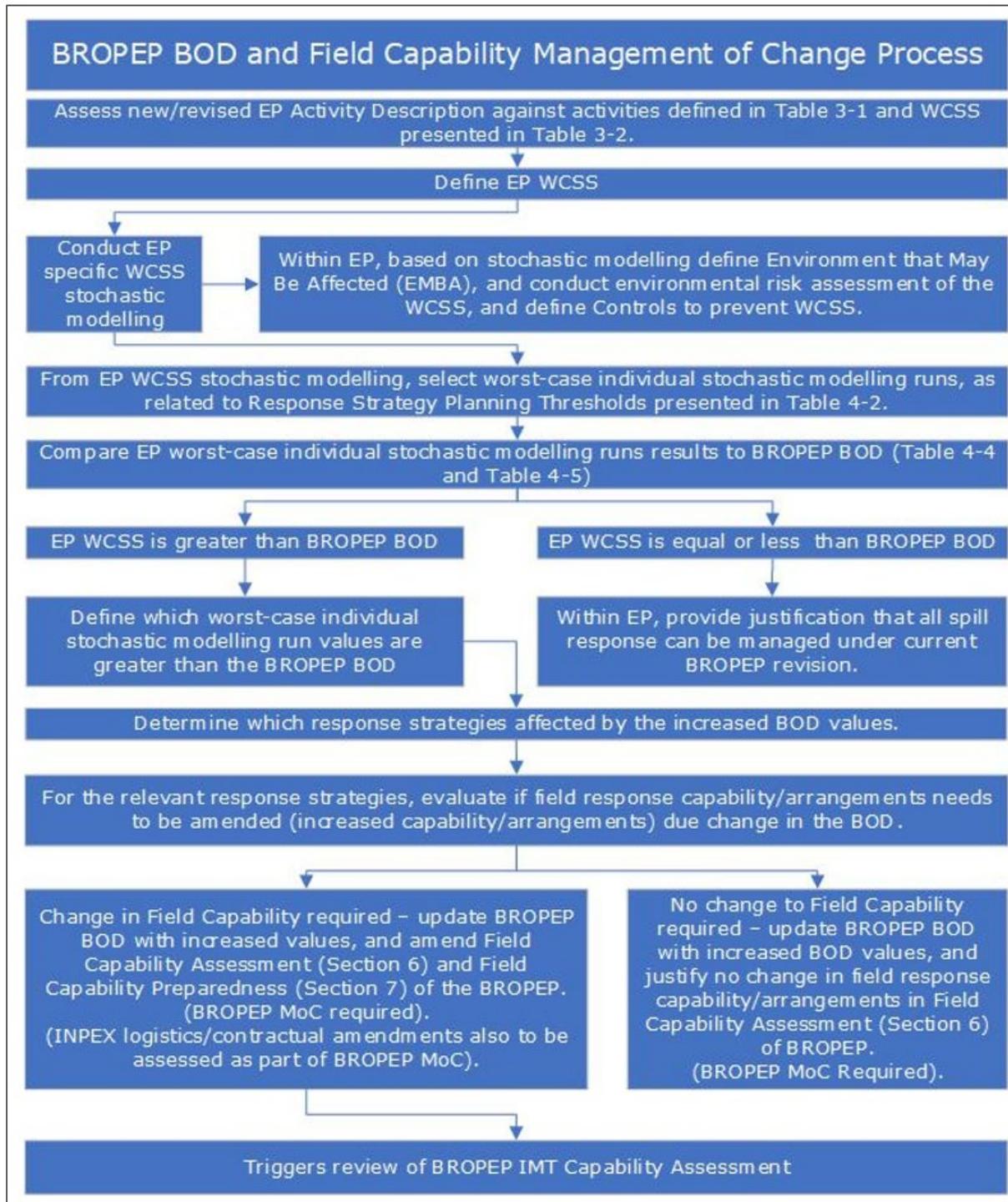


Figure 8-1: BROPEP BOD and Field Capability Management of Change Process

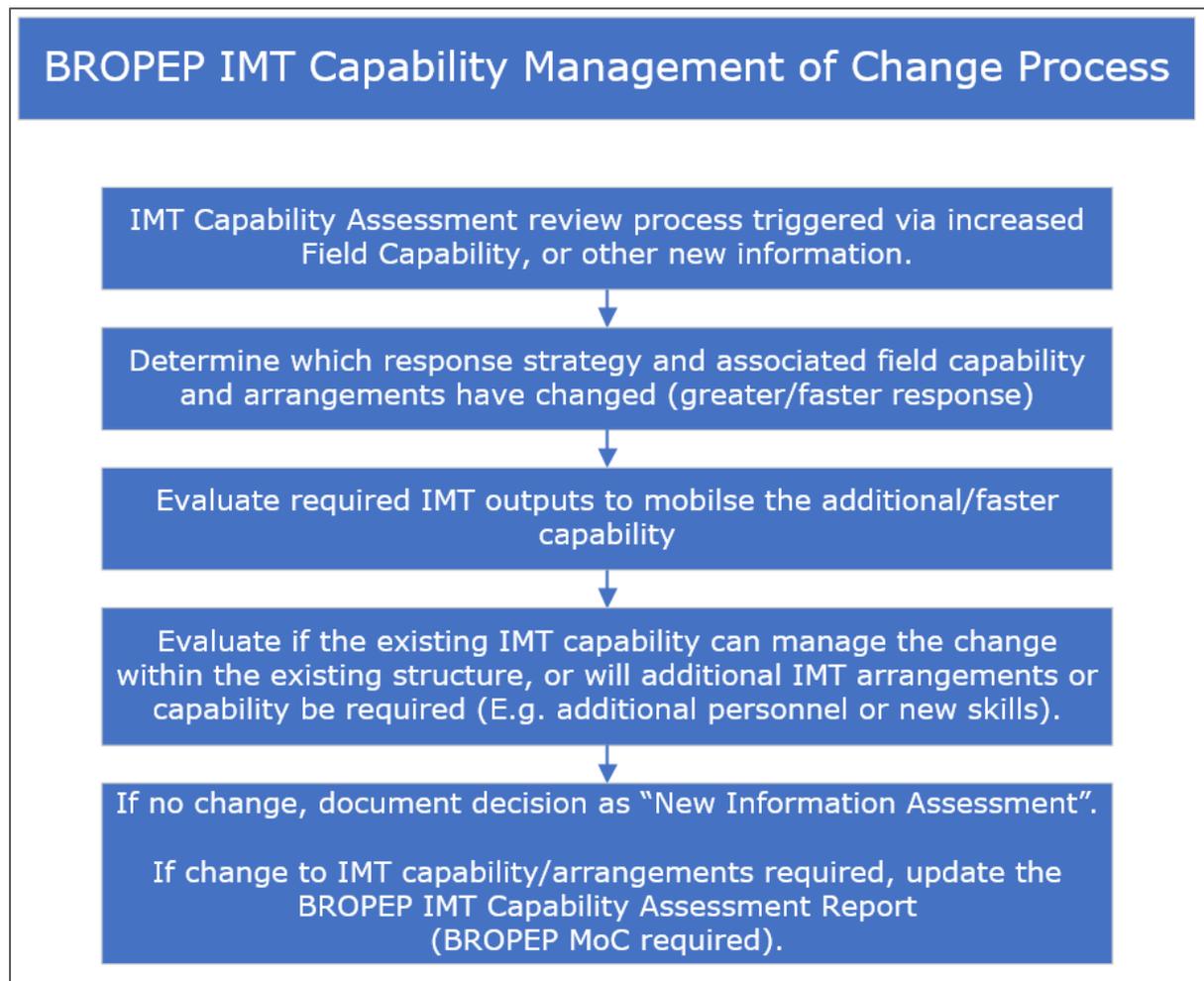


Figure 8-2: BROPEP IMT Capability Management of Change Process

8.3 Annual Performance Reporting

In accordance with Regulation 14(2) of the OPGGS (E) Regulations 2009, Titleholder's will undertake a review of its compliance with the environmental performance outcomes and standards set out in the BROPEP suite of documents and will provide a written report of its findings to NOPSEMA on an annual basis. The BROPEP annual reporting period will be from the 01 January to 31 December of each calendar year. The submission date for the BROPEP environmental performance report will be 01 April each calendar year.

Any findings from the Annual Performance Report will be included on a Titleholder action tracking register.

8.4 Management Review

Management reviews of the BROPEP suite of documents shall assess whether:

- control measures detailed in this BROPEP are effective in maintaining spill preparedness and response capability to an ALARP and acceptable level
- implementation of the MoC process has been applied consistently and appropriately, ensuring oil spill preparedness and response capability and arrangements remain ALARP and at acceptable levels, commensurate with Titleholder's activities and spill risks



- any changes in legislation, NOPSEMA guidance or other matters relating to oil spill preparedness and response have been taken into consideration in relation to the BROPEP suite of documents
- the Operational and Scientific Monitoring Program (within the BROPEP) remains fit for purpose

Where the documented findings of the BROPEP management reviews have implications for the BROPEP documents, the BROPEP will be updated in accordance with Table 8 1.

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APPENDIX A: FIELD CAPABILITY ASSESSMENT – AT SEA CONTAINMENT AND RECOVERY

Appendix A provides a detailed field capability assessment for at sea containment and recovery (C&R), in response to a 776 m³ IFO/HFO WCSS at the Ichthys Field location.

A.1 SIMA outcomes

Strategic SIMA for IFO/HFO determined C&R and surface dispersant application would both have positive effect for majority of values and sensitivities in Commonwealth waters. The nearest shoreline receptors are Browse Island (33 km from FPSO), and Scott Reef (100 km from FPSO).

A.2 Cone of response

Cone of response associated with on-water response strategies for IFO/HFO spill would typically involve a combination of the following:

- surveillance, monitoring and visualisation (SMV)
- at-sea containment and recovery (C&R)
- fixed wing aerial dispersant (FWAD)
- vessel dispersant

The exact arrangement/combination of response strategies would be selected based on the spill scenario, state of weathering of the oil, weather forecast and best available combination of vessels/aircraft and equipment.

A.3 Basis of Design – WCSS Modelling Overview

Based on the stochastic modelling, the probability of shoreline oil accumulation >100 g/m², and the maximum accumulated volume (m³) oil ashore, averaged over all replicate simulations, at Browse Island (closest shoreline receptor to the HFO spill risk location) is as follows:

- wet season (December – February) – 21% probability of contact – average of 11 m³ ashore.
- dry season (March – August) – 5% probability of contact – average of 3 m³ ashore.
- transition season – (September – November) – 19% probability of contact – average of 9 m³ ashore.

The maximum instantaneous area of floating oil >50 g/m² was 7.6 km², indicating there should be no limitation on the number/size of vessel fleet to conduct C&R operations.

Figure 4 11 displays the results of the stochastic run (transition 050) which produced the worst-case instantaneous area (7.6 km²) for floating oil >50 g/m². An analysis of the first 72 hours across all 300 runs was completed, and the range for maximum instantaneous area >50 g/m² was 5.75 km² to 7.6 km².

For the purpose of comparing short duration releases to longer duration release scenarios, four additional 776 m³ HFO spill deterministic runs were also conducted, as many vessel/tanker spills do not occur instantaneously and often remaining ongoing for several days. The following process was used for these additional deterministic modelling runs:

- Two sets/samples of wind data (covering 10 days) were selected. These represented relatively windy conditions (to maximise the calculated trajectory in the downwind direction)



but within range of spill responses (C&R and surface dispersant application); typically wind data in the range of 15-20 knots. The samples of wind data also used the corresponding current data, to keep surface current response realistic.

- The selected wind/current data sets were used as model inputs for a 2-hour release scenario and a 4-day release scenario.
- For the four-day scenario, a variable discharge rate was used over 4 days. The loss rates were represented as exponentially reducing but with the following daily distribution, representing a decreasing release rate over time (i.e. typical long duration tanker spill scenario):
 - Day 1 – 325 m³
 - Day 2 – 225 m³
 - Day 3 – 150 m³
 - Day 4 – 76 m³
- Each simulation spanned 7 days beyond spill cessation (10 days beyond spill commencement).
- This process was repeated for the two wind/current data sets, generating four deterministic model runs.

Once the model runs were completed, the modelling data was analysed and the area swept by oil concentrations > 50 g/m² over the full duration was mapped and the area of slicks > 50 g/m² was calculated at 6 hourly intervals.

The output of the model scenarios is provided in Table 9 1, and presented as Figure 9 1 to Figure 9 4

Table 9-1: 776 m³ HFO Scenario – Analysis of 50g/m² threshold for 4 deterministic runs

Scenario	Replicate	Area of coverage of floating oil at >50 g/m ²		
		Total area (km ²)	Maximum instantaneous area (km ²)	Time step at maximum instantaneous area
4-day release of 776 m ³ of HFO	1	8	0.3	12
	2	22	0.5	17
2-hour release of 776 m ³ of HFO	1	256	5.7	59
	2	183	5.4	39

The short duration releases (refer Figure 9 3 and Figure 9 4) result in the movement of a single, compact and concentrated patch of oil. Figure 9 1 and Figure 9 2 present the 'instantaneous' spill as a series of small patches of floating oil >50g/m². In reality, between the patches of floating oil >50 g/m² (visible on these figures), other areas slightly <50 g/m² would occur. Further, it would result in a long continuous streamer of oil, with some areas greater and some areas less than 50 g/m². A similarly long streamer of oil from the release location would continue to be present over



the duration of the 4-day release, slowly reducing in thickness/concentration as the release rate decreases. Streamer concentration would increase from a 2- or 3-day spill.

Figure 9 1 shows the total swept area/total simulation coverage of floating oil >50 g/m² for the entire 10-day duration of the simulation, as well as the maximum instantaneous area floating oil >50 g/m², which occurred at hour 12 of this simulation.

Figure 9 2 shows the total swept area/total simulation coverage of floating oil >50 g/m² for the entire 10-day duration of the simulation, as well as the maximum instantaneous area floating oil >50 g/m², which occurred at hour 17 of this simulation.

Figure 9 3 shows the total swept area/total simulation coverage of floating oil >50 g/m² for the entire 10-day duration of the simulation, as well as the maximum instantaneous area floating oil >50 g/m², which occurred at hour 59 of this simulation.

Figure 9 4 shows the total swept area/total simulation coverage of floating oil >50 g/m² for the entire 10-day duration of the simulation, as well as the maximum instantaneous area floating oil >50 g/m², which occurred at hour 39 of this simulation.



Shell Australia

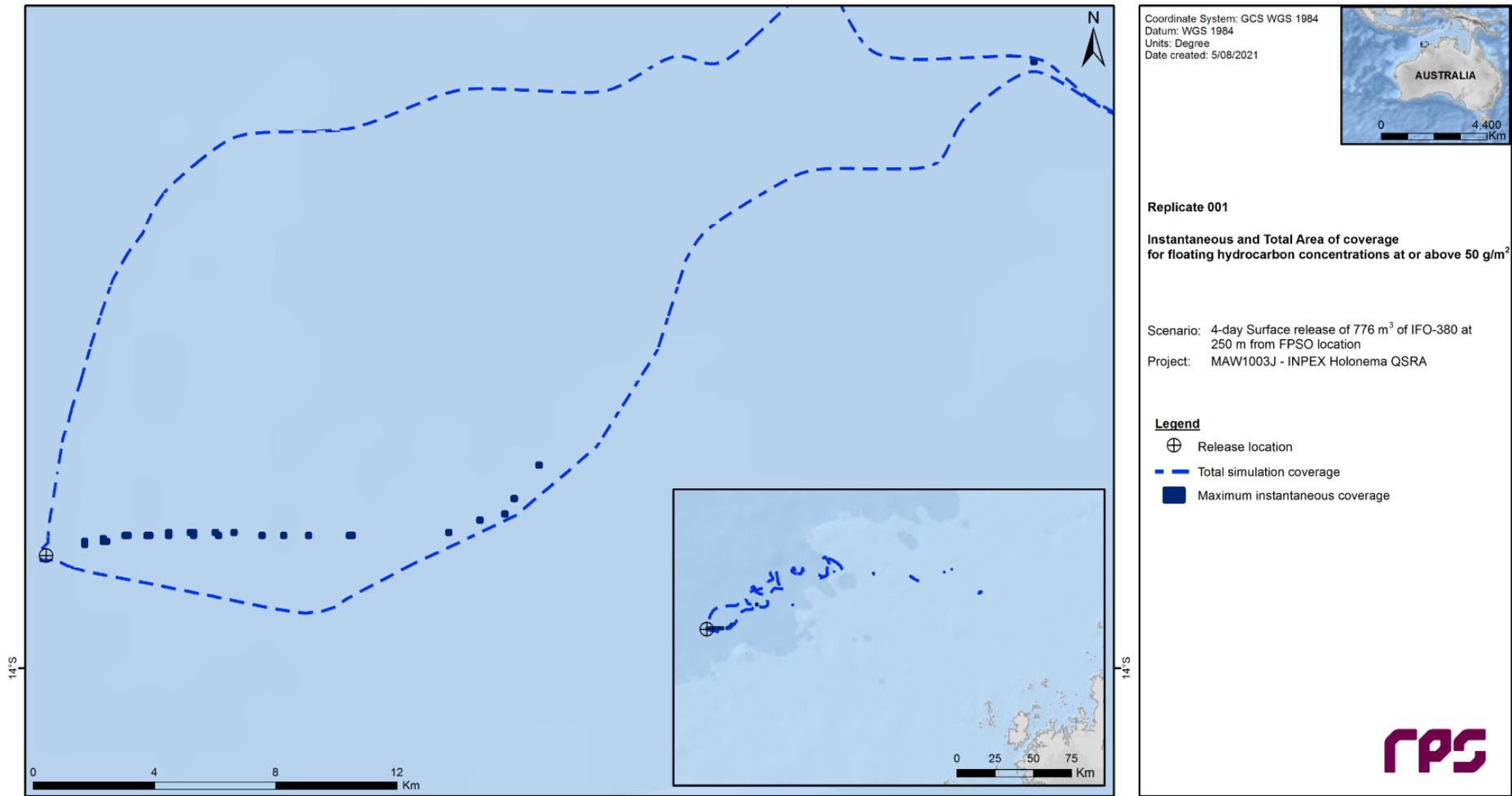
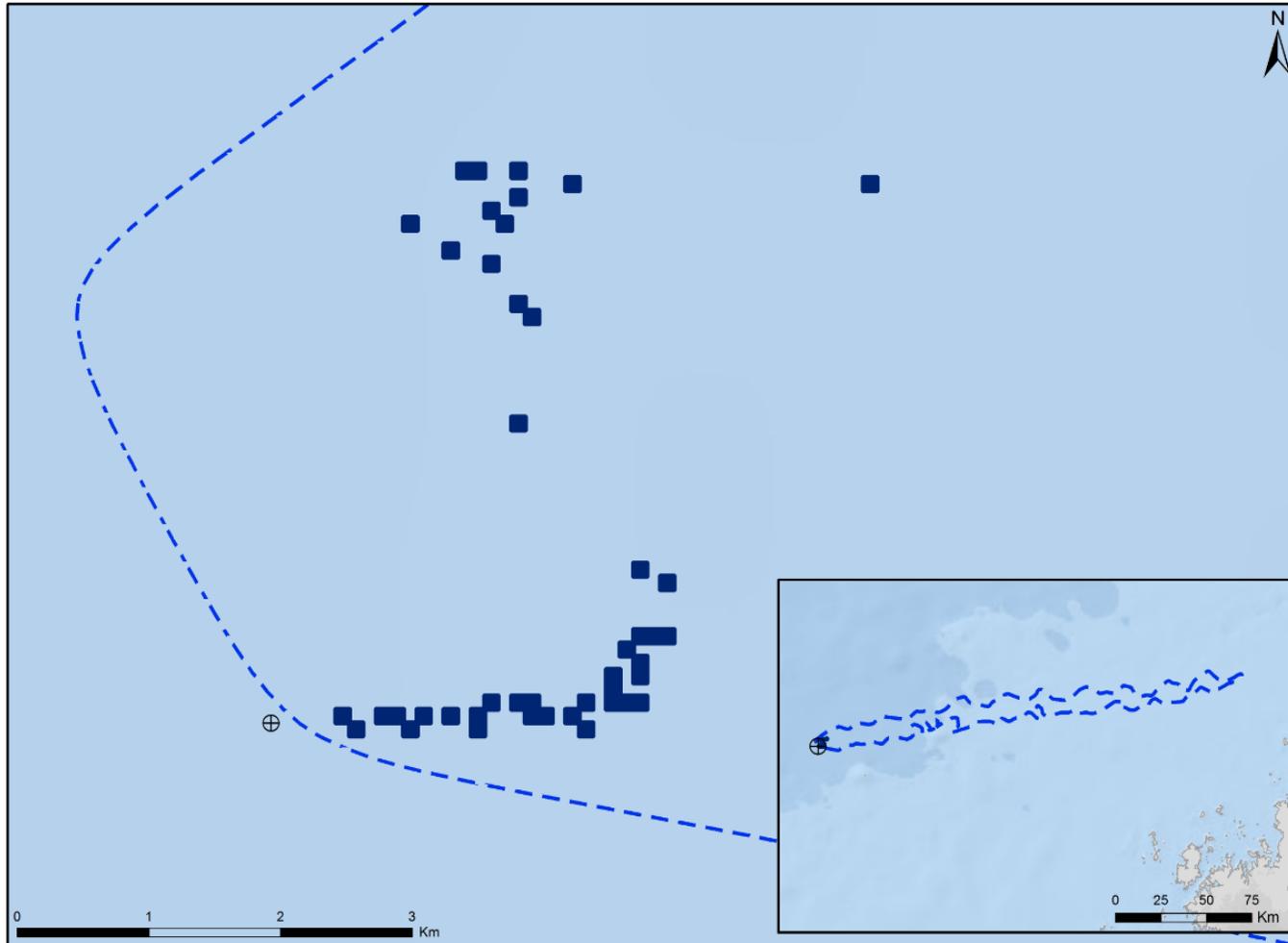


Figure 9-1: Deterministic replicate #1 – 4-day release – maximum instantaneous, and total swept area floating oil >50 g/m²

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Coordinate System: GCS WGS 1984
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Date created: 5/08/2021



Replicate 002

Instantaneous and Total Area of coverage for floating hydrocarbon concentrations at or above 50 g/m²

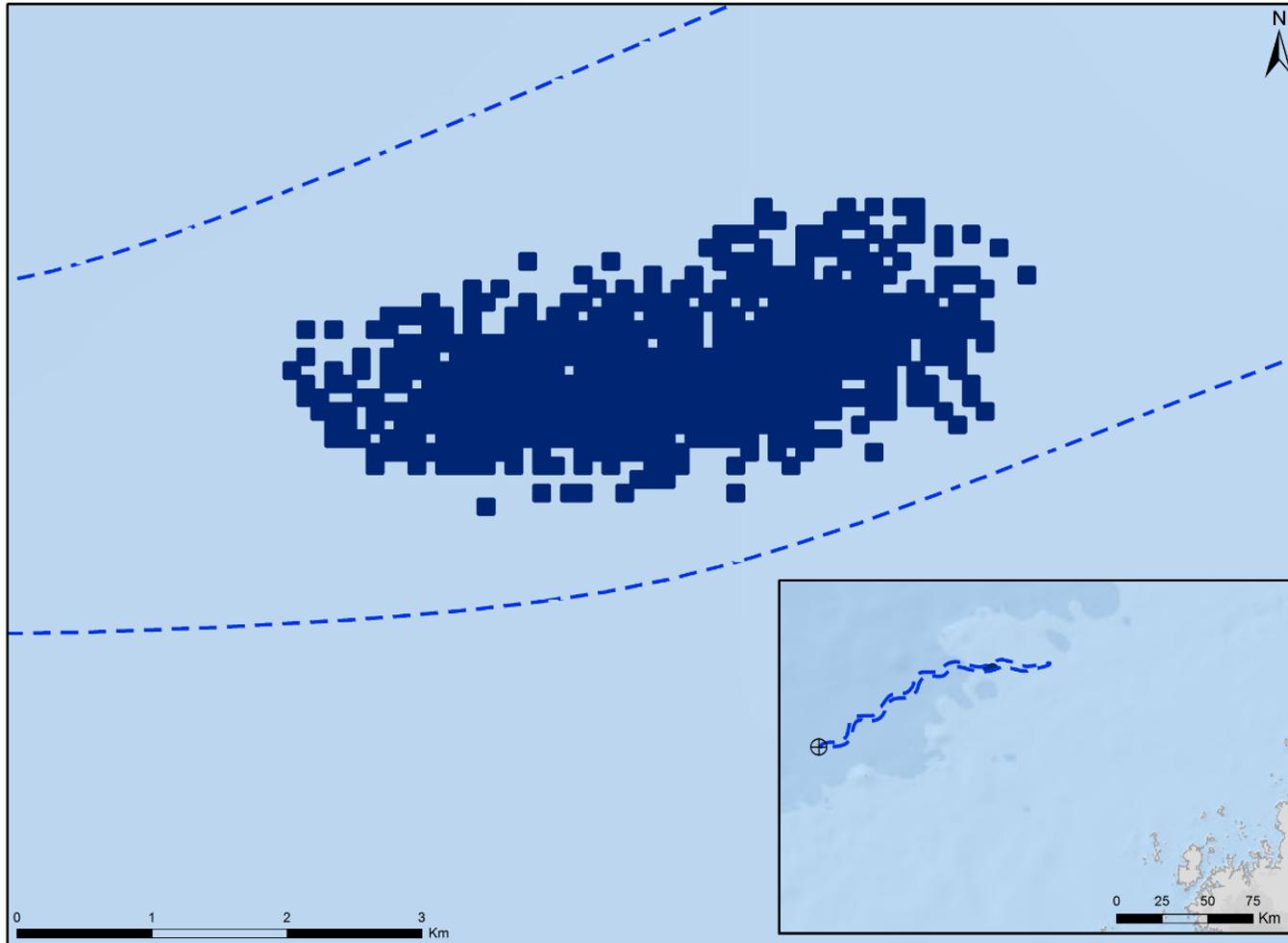
Scenario: 4-day Surface release of 776 m³ of IFO-380 at 250 m from FPSO location
Project: MAW1003J - INPEX Holonema QSRA

Legend

- ⊕ Release location
- - - Total simulation coverage
- Maximum instantaneous coverage



Figure 9-2: Deterministic replicate #2 – 4-day release – maximum instantaneous, and total swept area floating oil >50 g/m²



Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree
Date created: 5/08/2021



Replicate 001

Instantaneous and Total Area of coverage for floating hydrocarbon concentrations at or above 50 g/m²

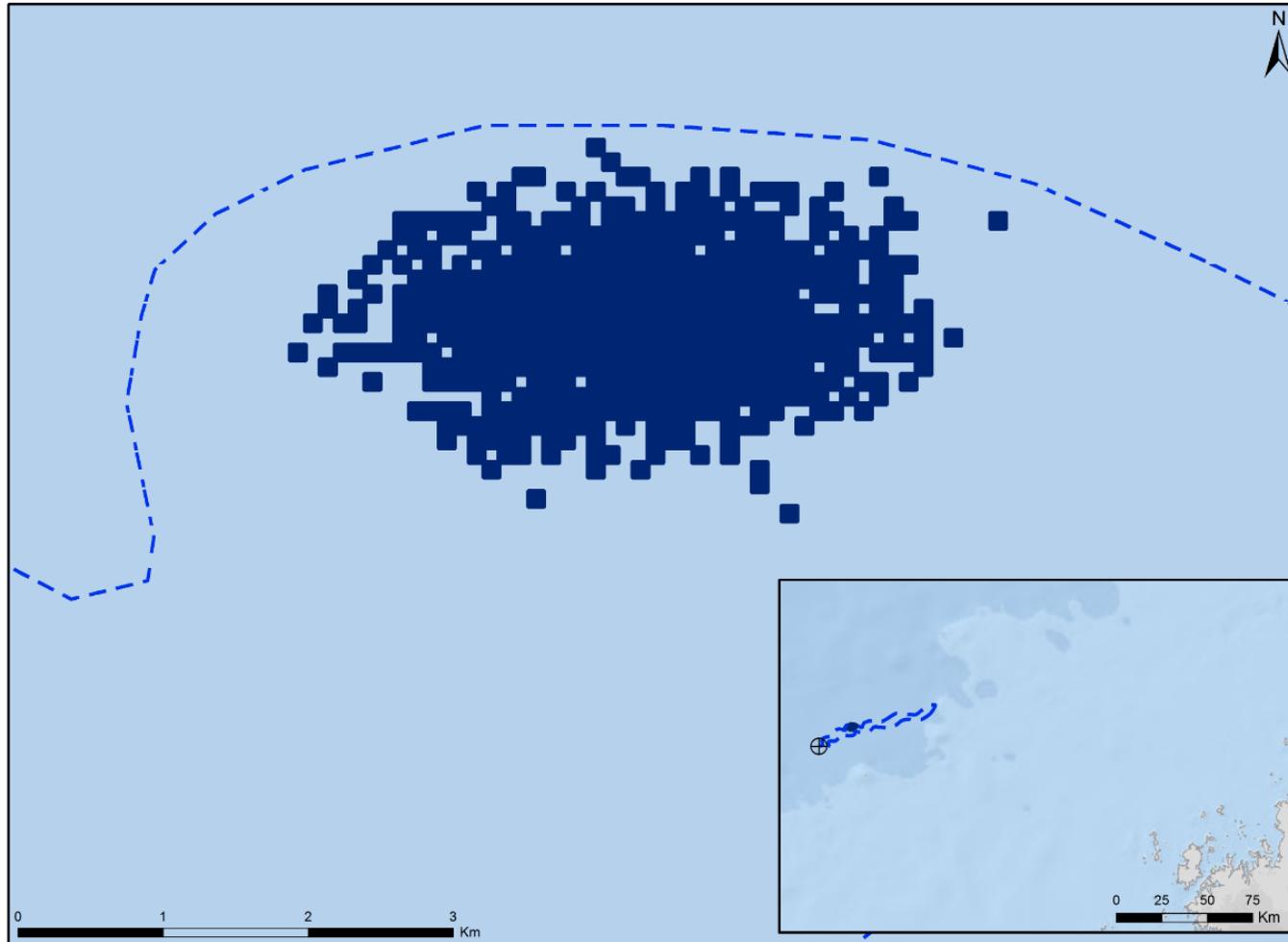
Scenario: 2-hour Surface release of 776 m³ of IFO-380 at 250 m from FPSO location
Project: MAW1003J - INPEX Holonema QSRA

Legend

- ⊕ Release location
- - - Total simulation coverage
- Maximum instantaneous coverage



Figure 9-3: Deterministic replicate #1 – 2-hour release – maximum instantaneous, and total swept area floating oil >50 g/m²



Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree
Date created: 5/08/2021



Replicate 002

Instantaneous and Total Area of coverage for floating hydrocarbon concentrations at or above 50 g/m²

Scenario: 2-hour Surface release of 776 m³ of IFO-380 at 250 m from FPSO location
Project: MAW1003J - INPEX Holonema QSRA

Legend

- ⊕ Release location
- - - Total simulation coverage
- Maximum instantaneous coverage



Figure 9-4: Deterministic replicate #2 – 2-hour release – maximum instantaneous, and total swept area floating oil >50 g/m²



A.4 Oil Spill Budget and Maximum Field Capability Statement

As summarised in Table 6 2, offshore C&R typically involved vessels, offshore booms, skimmers and offshore liquid oily waste storage. Preferred vessels for offshore containment and recovery are AHTs with a large open deck and rolled/open stern, for safe deployment of offshore boom.

Sea-state of Beaufort 1-4 is optimal (IPICA-IOGP 2015a), with the operation targeting Bonn Code 4/5 oil (>100 g/m²).

Fixed boom C&R systems (E.g., magnetic brackets and short length of boom attached to a leaking vessel) would not be a practicable option in Commonwealth waters. It would be extremely challenging to anchor/hold the boom in a suitable configuration due to the water depth (without a large number of vessels holding a single boom in position) and combined with strong currents in NW Australia, a boom fixed to a leaking vessel would not be expected to capture any significant volume of recoverable oil, as oil is likely to flush under the boom due to current speeds.

A minimum single offshore C&R operation would require a large AHT, or other similar large vessels with a rolled stern, able to deploy offshore boom from the back deck. The capability would also require deployment of suitable skimmers and some form of liquid oily waste storage capacity (E.g., inboard or deck tanks). For a single vessel operation, a boom-vane system would be required to maintain the booms configuration. If no boom-vane system was available, a second vessel (possibly slightly smaller) to tow the leading edge of the boom would also be required.

Alternatively, an advanced booming system (E.g., speed-sweep or current buster system), typically requiring 3-5 vessels could be used, which would be better for recovery of more fragmented spills, as the system can operate at higher speeds.

Regardless of the technique (traditional versus advanced) the encounter rates will vary significantly, depending on the oil behaviour. For example far higher encounter rate will occur if the oil is in very thick patches compared to if the oil has become spread-out into windrows. Chasing patches/windrows is very time consuming, due to slow vessel speeds (typically 1 knot over water for traditional, or 4 knots with advanced booming techniques).

Theoretical calculations of encounter rates for contiguous oil have been provided in Section 6.3.1. However, there is potential for significant variability in encounter and recover rates, due to variations in oil types, variation in the weathering of different products in the environment over time, changing wind and current speed and direction, all contributing to the oil spill budget calculation results being of limited accuracy.

Therefore, attempting to calculate or quantitatively define a maximum field capability statement is extremely challenging for this response strategy.

In order to achieve any significant volume of oil recovery, a theoretical maximum field capability for offshore C&R could be viewed as a Tier 2 capability (refer Table 6 2), such as three to five traditional C&R strike teams, or 1-2 advanced booming strike teams (~10 vessels plus equipment), maintained offshore at all times, either dedicated to response, or as part of other operational activities. Costs associated with maintaining a single vessel offshore, on stand-by is approximately \$20,000/day.

A.5 Operational Considerations and ALARP assessment of the Field Capability



A.5.1 Containment and Recovery – capability maintained offshore

The following sections discuss consideration of offshore vessels, and offshore storage, maintenance, training and deployment of a C&R booming system on an AHT.

AHT Routine Operations

Typically, TITLEHOLDER maintains one MODU on contract, either for production or exploration drilling activities in the BROPEP region (there may be brief periods between drilling campaigns when a MODU isn't present, between drilling campaigns).

Typically, two AHTs and a third PSV (usually with closed stern) provide vessel support to a MODU.

At all times, one AHT or PSV must remain in attendance of the MODU (i.e. close to the MODU's 500 m safety zone), as a safety vessel.

Typically, under MODU safety cases, the safety vessel is not permitted to depart from the MODU for any reason, until an alternative safety vessel can replace the vessel being released.

The other two vessels are typically either in transit, or in port, conducting resupply activities. Typically a voyage for an AHT, from Browse Basin to Broome, vessel cargo activities in port and return is approximately 72 hours based on vessel economical steaming rates (18 knots). Therefore, typically there is only one vessel at a MODU, and that vessel is unable to be immediately released.

Storage, maintenance and crew training for C&R equipment offshore

Ro-Boom and most other types of offshore boom are typically 200 m per reel. Generally, with large vessels such as AHT's, 400m (2x reels) would be appropriate for an offshore C&R set-up. In addition, there would be the other ancillaries such as power packs and control stands, skimmer, hoses and waste storage. Due to being on the back deck of a vessel (exposed to weather) and the requirement to move/load equipment, all equipment should be containerised. The complete C&R equipment package as described above would most likely require three 10-foot offshore related containers (AMOSC pers comms 2021⁸).

During routine operations, AHTs typically will have decks full of cargo, as part of route cargo transfer operations. Therefore, storage of the C&R containers mid-ships towards the stern, in a deployment ready position isn't practicable. The C&R containers would be required to be stored most likely far forward, against the gunwales, away from normal cargo operations areas.

Further, during anchor handling operations at the start of end of drilling a well, for safety/operability reasons, AHT decks are required to be clear of other cargo. Therefore, prior to conducting routine anchor handling operations, the C&R equipment containers would need to be moved onto a MODU or other vessel for temporary storage, and then off again.

During cyclone avoidance activities, AHTs should have clear decks. Therefore, for periods of cyclone avoidance, C&R equipment containers would most likely need to have sea-fastenings removed and the boom stored on a MODU or relocated back to Broome.

The permanent equipment storage on ATHs would result in a reduction deck-space available to utilise for cargo operations, resulting in additional voyages per year and additional fuel burn etc.,

⁸ Personal communication, Mr Nathan Young, Australian Marine Oil Spill Centre. Geelong, pers.comm. 07 April 2021.



resulting in additional costs due to reduced efficiency. There are also additional costs (reduced productivity), associated with regular shifting of containers between the AHT and MODU (E.g., for anchor handling/cyclone avoidance).

Maintenance (involving further additional costs) would typically involve the following (AMOSC pers comms 2021):

- 6 monthly service: contents check, minor service items, and function testing
- 12 monthly service: fluids and filters checked/changed, lubrication, corrosion inhibition, fuel replenishment/replacement and function testing (includes boom reels, power packs and ancillaries)

For successful and safe rapid boom deployment of C&R systems offshore, without the expert onsite assistance from AMOSC Core-Group, a team of trained crew members would be required. Typically, a minimum of 5 trained deck crew per shift would be required, therefore 10 trained crew onboard at all times (2 x shifts per day). Assuming 2.5 swings per vessel (25 crew), and 5 additional crew to cover the long-term crew change-over, approximately 30 personnel would be required to be trained per vessel. It would not be practical to conduct a full day of boom and skimmer deployment training (including various booming configurations, skimmer operations etc) with crews during actual operational periods, as the AHT activity schedules are very reactive/responsive to the needs to the MODU. Therefore, crew training would typically be on an 'off-swing' period.

Based on 'off-swing' 2 days training, including accommodation, flights etc., costs would equate to ~\$5,000 per selected crew member, or \$150,000 training per vessel. With a two-year refresher training requirement, the cost is \$75,000 per vessel per annum. Assuming both AHT vessels crews were required to be trained, to maximise availability of an AHT with trained crew being on available, 2 x AHT annual crew training cost is ~\$150,000.

Whilst a C&R system could be potentially stored onboard a MODU, there would be costs associated with long-term storage (deck-space utilisation), however these costs would likely be less than with an AHT. Regardless, the maintenance and AHT crew training costs incurred would remain unchanged.

In summary, there would be significant costs associated with the storage, maintenance, crew training and reduced AHT productivity, for maintaining C&R equipment on AHTs offshore.

Mobilisation/activation of C&R system stored offshore

For safe boom deployment from an AHT, the C&R equipment containers would need to be positioned on the vessel centreline, near the stern. Therefore, either due to day-to-day cargo activities or anchor handling activities, the C&R containers will be required to be relocated.

Relocating the C&R containers would typically be conducted using the MODU crane. This would also involve moving other containers/cargo around the deck and require sea-fastening of the C&R containers and all other cargo before C&R equipment deployment could occur. This activity would typically take approx. 3-5 hours.

Once the C&R equipment is positioned, it would typically take ~2 hours for 400 m of offshore boom to be deployed.

Even if the C&R containers were stored onboard a MODU, the MODU crane would still be required to move cargo around onboard an AHT to make space for the C&R equipment containers, so there



is no significant timesaving during C&R equipment mobilisation/deployment, by storing the C&R equipment on a MODU, compared with storage onboard an AHT.

Typical time for C&R equipment deployment if stored offshore would be 5-7 hours, based on the following:

- 3-5 hours for MODU crane to
 - clear cargo from AHT deck and create suitable space
 - move C&R containers (either onboard AHT or on MODU) onto centre/aft deck of AHT
 - AHT crew to sea-fasten the C&R containers into position and prepare for equipment deployment
- 2 hours for trained AHT crew to deploy 400 m offshore boom once equipment is in position and secured on the rear deck of the AHT.

A.5.2 Containment and Recovery – capability maintained onshore

C&R equipment could be stored at onshore locations, such as Broome.

There is a routine flow of vessels between Broome and the Ichthys/Prelude facilities and other offshore petroleum operations.

In event of a spill, offshore C&R equipment can be deployed from the Broome AMOSC stockpile, via Broome Port, onto a PSV or AHT.

If deployed onto an AHT, the equipment can be sea-fastened directly to the deck, and the AHT can then sail directly to site, and commence boom deployment.

If deployed onto a PSV, the equipment would need to be containerised (as additional offshore lifting is required) and the PSV would require the use of an offshore facility crane to transfer the boom system onto an AHT, adding a small amount of additional time.

Typically, the time duration for identification and mobilisation of the vessel to Broome Port, and mobilisation of equipment onto the vessel at Broome port, and then steaming to Ichthys Field is expected to take between 24-48 hours. If a vessel was already near/in Broome port, the equipment load-out and steaming back to Ichthys Field would take ~24 hours. If a vessel needed to be mobilised from Ichthys Field to Broome, and then return to Ichthys Field, it would take ~48 hours. 48 hours is the worst-case situation, as generally there is a vessel closer to, or in Broome Port.

Timing for the mobilisation of offshore C&R equipment from AMOSC Broome stockpile to Broome Port won't be on critical path, as the stockpile is located adjacent/close proximity to the Port.

During the vessel mobilisation period, AMOSC staff/core-group personnel could be in transit to Broome and mobilise directly with the C&R vessel (pending flight times) or alternatively transfer via Titleholder contracted crew-change helicopter from Broome to Ichthys Field, and then transfer via crane from a Facility onto vessel deck and commence supervision of C&R operations.

AMOSC store and maintain their C&R equipment at their various stockpile locations at no additional cost. Also, AMOSC staff and AMOSC Core-Group are already trained to conduct C&R supervision. Therefore, there is no additional cost associated with C&R equipment storage, maintenance or personnel training for the onshore C&R option.



AMSA, also maintain advancing booming systems regionally in Darwin, Karratha, and Fremantle, with additional units in other National Plan stockpiles. This equipment is accessible under National Plan arrangements, should it be required.

A.6 Containment and Recovery - ALARP Justification of Selected Field Capability

The objective of C&R is to collect oil at sea, to prevent/limit the volume of oil arriving on shoreline. Stochastic modelling results indicate that for an IFO/HFO spill at the Ichthys Field, for 50% of the year (dry season), there is a ~5% chance of oil arriving on the nearest shoreline (Browse Island) and ~20% for the other half of the year. Therefore, when evaluating the effort/cost of C&R response preparedness, the response objective, and likelihood of significant shoreline contact must be considered, compared to the costs of the various response options, as part of the ALARP evaluation.

Cost of maintaining a single large vessel with rolled sterns, C&R equipment and trained crew, on stand-by in Ichthys Field, purely for spill response activities is approximately \$20,000 per day (\$7.3M per annum), plus ~\$150,000 per annum crew training costs. These costs are not considered ALARP, even if shared with a near-by operator, such as Shell/Prelude. Therefore, the 'maximum field capability statement' of multiple dedicated spill response vessels with C&R equipment offshore, ready to respond, is not considered ALARP, due to the very large costs, compared with typically expected oil recovery rates for C&R systems.

When considering vessels already available as part of routine drilling and production activities, PSVs, OSVs and other commonly used offshore vessels such as inspection/maintenance and repair vessels do not have rolled sterns. This limits the available primary C&R vessels to AHTs.

MODUs are typically supported by 2 x AHTs with rolled sterns, plus a third standard PSV (non-rolled stern). However, AHTs are not always at the MODU location during drilling activities. When not conducting anchor handling activities, AHTs are conducting re-supply runs between the MODU and port (typically Broome).

A single vessel (either an AHT or PSV) must remain on station adjacent/near-by the MODU as a safety vessel at all times during drilling activities. The other two vessels are typically conducting re-supply runs. Therefore, if an AHT is undertaking safety vessel duties at the MODU, there is no guarantee of its immediate release. It could be perhaps 12/24 hours before the next vessel in the MODU fleet arrives on location at the MODU, to take over safety vessel duties and release an AHT for C&R activities. Therefore, even though AHTs may be available, they can't be relied upon to be activated as an immediate C&R strike team.

Even if an AHT was available to be released immediately, (and the crew were fully trained, at the training cost specified above), and C&R equipment was stored onboard the vessel, it would be a minimum 5-7 hours before boom could be deployed.

The alternative option, for onshore storage of C&R equipment in Broome, could have a single C&R strike team operational in Ichthys Field typically within 24 to 48 hours (maximum 48 hours, but more likely closer to 24 hours, as one vessel is typically close to, or in Broome Port at most points in time). The additional Exmouth AMOSC stockpile equipment and NW shelf vessels could be utilised to mobilise a second C&R strike team.



Therefore, the onshore storage option typically only results in a 12–16-hour delay (provided vessel was already in Broome Port, which is the case the majority of the time) compared to the offshore storage option.

If the weather forecast indicates C&R is likely to be a viable option (i.e. signification period of wind <20 knots over several days, to facilitate a reasonable amount of oil recovery), the slick is unlikely to move a significant distance from the location where it was spilled and is most likely going to oscillate on local currents/tidal flows, rather than drift on a rapid trajectory directly towards a sensitive receptor such as Browse Island or Scott Reef.

As presented in 6.3.1, C&R can be deployed both at the source of the spill, as well as being deployed to target slicks approaching a specific shoreline sensitivity. Therefore a C&R capability mobilised from onshore should be able to arrive on site and conduct C&R activities, targeting slicks before they arrive at a sensitive location, rather than attempting to target slicks immediately at the source.

As shown in 6.3.1, both short and long duration release scenarios are likely to result in some recoverable oil on surface after several days, especially in the longer duration release scenario (which is arguably also the more likely scenario). If the spill was an ongoing release, C&R could also be used directly near the spill source, upon arrival.

Therefore, given the logistical limitations and additional costs, the offshore storage of C&R equipment is not considered ALARP. Onshore storage of C&R equipment is considered ALARP, as under most circumstances, this option should still be able to achieve the response objective of reducing the oil volume arriving at a shoreline, with far lower costs and logistical constraints compared to the offshore storage option.

It should be noted that the encounter rate of surface dispersant use is by far the largest of any response technique (IPIECA-IOGP 2015b), and therefore a vessel-based dispersant first strike capability is considered optimal, compared to C&R, in deep, offshore waters away from sensitive shorelines.

A.7 Containment and Recover - Selected Field Capability Statement

It is considered ALARP to maintain the following as the selected capability for at sea C&R.

- Titleholder will maintain contracts/framework agreements with large vessel providers.
- Titleholder will maintain mutual aid arrangements with AMOSC, which provides access to C&R equipment for two strike-teams as part of the AMOSC Broome/Exmouth stockpiles. In addition, AMOSC can provide advancing booming systems from the Fremantle, and Geelong stockpiles.
- Titleholder will maintain access to AMOSC Core-Group personnel trained in offshore C&R.

Refer Appendix D for additional information regarding on-water response strategy implementation planning (including the combined use of at-sea containment and recovery, vessel dispersant and aerial dispersant) for Group IV spills, including short and long duration spills.



Shell Australia

APPENDIX B: FIELD CAPABILITY ASSESSMENT – VESSEL DISPERSANT

Appendix B provides a detailed field capability assessment for vessel-based dispersant operations, in response to a 776 m³ IFO/HFO WCSS at the Ichthys Field location.

B.1 SIMA outcomes

Strategic SIMA for IFO/HFO determined C&R and surface dispersant application would both have positive effect for majority of values and sensitivities in Commonwealth waters. Nearest shoreline sensitivity is Browse Island (33 km from FPSO), and Scott Reef (100 km from FPSO).

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 surface marine fauna and shoreline/intertidal sensitivities. Depending on sea-state, atmospheric conditions, weathering and emulsification of Group IV spills the 'window of opportunity' for effective dispersant application is generally limited – from a few hours, to a few days (ITOPF 2013).

Dispersant is less likely to be effective against HFO, however more likely effective against IFO and LSHFO. In addition, due to the warm temperatures of northern Australian waters, the likely window for successful dispersant application may be extended, compared to colder climates. If a spill is ongoing, i.e. leaking from a vessel over several days, the window of opportunity for dispersant application will likely be significantly extended, due to the ongoing release of fresh oil.

B.2 Cone of response

Refer Appendix A.2 – Cone of response

B.3 Basis of Design - WCSS Modelling Overview

Refer Appendix A.3 – Basis of Design – WCSS Modelling Overview

B.4 Oil Spill Budget and Maximum Field Capability Statement

Preferred vessels for vessel dispersant in Commonwealth waters would:

- be a minimum 20 m length – depending on operating environment and expected sea conditions
- have deck space for IBCs or single 10 m³ ISO-tank
- be capable of utilising dispersant spray systems, such as fixed spray booms or AFEDO units

For an instantaneous spill in the BROPEP region (tropical water temperatures), IFO/HFO typically increases in viscosity to become not amendable to dispersant within 6-24 hours (faster for HFO, slower for IFO, and more rapidly with increasing wind speeds).

To fully treat the HFO WCSS, the vessel dispersant oil spill budget calculations are as follows:

- 776 m³ spill is treated at 20:1 oil to dispersant ratio = 40 m³ dispersant required
- Single vessel using an AFEDO system, using the standard AFEDO dispersant flowrate of 40 L/min = flowrate of 2.4 m³ per hour



- Assume 60% operational spraying time per hour = 1.5 m³ dispersant per hour
- Assume a single vessel can conduct spray operations for 8 hours per operational daylight period = a maximum of 12 m³ dispersant sprayed per daylight operational period.

Based on the above calculation, ~3-4 vessels, on stand-by with 40 m³ dispersant in Ichthys Field would be required to fully treat the 776 m³ IFO/HFO WCSS in the first 24 hours (first 12-hour daylight window).

B.5 Operational Considerations and ALARP assessment of the Field Capability

The following sections discuss consideration of offshore storage, maintenance, training and deployment of a vessel-based dispersant system offshore.

B.5.1 Vessel Dispersant – capability maintained offshore

Titleholder's production activities require support from a fleet of support vessels, including an OSV, PSVs, AHTs and IMR vessels.

Whilst not all OSVs, PSVs or IMR vessels will be maintained in the Ichthys Field at any time (the only location with the Group IV spill risk at the time of preparation of this BROPEP), certain vessels have a higher likelihood of being present. Typically, the OSV will be present majority of the time, including all condensate tanker operations. The OSV is only in Broome for crew-change approximately once per month. The AHTs, PSVs are often transiting between the facilities and port, and very occasionally in port for longer durations for maintenance. IMR vessels are only occasionally mobilised, for short duration inspection and maintenance campaigns.

Therefore, maintaining vessel dispersant spray capability on OSV and PSVs provides the highest likelihood that one or more dispersant spray systems can be mobilised, if required, at short notice.

In addition, by maintaining a mobile dispersant system (E.g., an AFEDO system), a dispersant stockpile and trained personnel onboard a facility, any available vessel, including the AHTs, can easily be converted and used for vessel-based dispersant spray activities.

Training of offshore personnel in dispersant spray systems is relatively easy compared to training for offshore containment and recovery. The equipment is simpler, lighter with far fewer safety hazards, and deployment drills can be conducted without significant disruption to routine activities.

B.5.2 Vessel Dispersant – capability maintained onshore

Vessel dispersant equipment could be stored at onshore locations, such as Broome.

There is a routine flow of AHTs, PSVs, OSVs and other vessels between offshore facilities and Broome. There are also other smaller vessels which are also suitable for vessel-based dispersant application which typically berth in Roebuck Bay (Broome Port). In event of spill, vessel dispersant spray systems and dispersant stocks could be deployed from a Broome supply base, via Broome Port, onto any suitable vessel (movement of equipment will not be a critical path activity). Once the equipment is onboard, the vessel can then sail directly to site, and commence dispersant spray activities. Total duration for equipment transport, loadout and commencement of sailing to site is typically <24 hours for small vessels, would also generally be <24 hours for larger vessels (provided vessel was already near Broome Port).

During the equipment transit, AMOSC staff/core-group personnel could be in transit to Broome and mobilise directly with a vessel (pending flight times) or alternatively transfer via Titleholder



contracted crew-change helicopter to the offshore facility, and then transfer via crane from Facility onto vessel deck and commence supervision of vessel dispersant operations.

The AMOSC Broome and Exmouth equipment stockpile already contains vessel-based dispersant equipment and dispersant stockpiles

The cost of equipment storage/maintenance onshore is slightly reduced compared to offshore. AMOSC Core-Group personnel already maintain training for vessel dispersant supervision. Therefore, there would be no additional cost associated with vessel dispersant equipment storage, maintenance or training, for the onshore option compared to the offshore option.

B.6 Vessel Dispersant - ALARP Justification of Selected Field Capability

The cost of maintaining additional vessels equipped with dispersant spray systems, dispersant stockpiles and trained crew, on stand-by in Ichthys Field, purely for spill response activities is not considered ALARP, even if shared with a near-by operator, such as Shell/Prelude, given existing Ichthys/Prelude vessels can be/are already equipped with vessel-based dispersant capabilities.

IFO/HFO/LSHFO slicks will increase in viscosity over time. Therefore, early dispersant application is required to maximise the likelihood of success of this response strategy.

The encounter rate of dispersant use is by far the largest of any response technique and is therefore preferentially selected as the most suitable first-strike response strategy compared to C&R (IPIECA-IOGP 2015b).

To ensure the fastest possible vessel dispersant response, spray systems, dispersant stockpiles and trained personnel should be maintained on vessels which have the highest likelihood of being near the Ichthys production assets. Whilst there can be no guarantee that a PSV or OSV will be present in Ichthys Field at all times, an AFEDO system on the FPSO provides redundancy, for use on any other available support vessel.

Due to the long duration for mobilisation of vessel dispersant systems from Broome to the Ichthys Field, onshore storage is not considered an appropriate primary option. However, not all spills are instantaneous, and the majority of spills from vessels actually release over multiple days. Therefore, maintenance of an onshore capability, to provide additional/surge vessel dispersant capacity is considered appropriate.

Therefore, given the availability of suitable offshore vessels and associated storage capacity, it is considered ALARP and acceptable to maintain a vessel dispersant capability in the Ichthys Field.

Additional redundancy/mutual aid capability (Tier 2 capability) including Prelude vessel dispersant capability and Broome/onshore stored capability can also be readily activated, if required.

B.7 Selected Field Capability Statement

It is considered ALARP to maintain the following as the selected capability for vessel dispersant.

Titleholder will maintain a vessel dispersant capability to respond to Group IV spills in the Ichthys Field, including the following:

- FPSO Venturer – 16 m³ dispersant and AFEDO system and dispersant spray trained personnel
- Ichthys 3 x OSV/PSVs – equipped with dispersant spray systems and trained personnel

Titleholder will maintain mutual aid arrangements with Shell and AMOSC, which provide access to:



- Prelude FLNG facilities support vessels – including vessel dispersant spray systems, dispersant stockpiles and trained personnel
- AMOSC Broome & Exmouth stockpiles – including vessel dispersant spray systems and dispersant stockpiles and Core-Group trained personnel.

Refer Appendix D for additional information regarding on-water response strategy implementation planning (including the combined use of at-sea containment and recovery, vessel dispersant and aerial dispersant) for Group IV spills, including short and long duration spills.



APPENDIX C: FIELD CAPABILITY ASSESSMENT – AERIAL DISPERSANT

Appendix C provides a detailed field capability assessment for fixed wing aerial dispersant (FWAD) operations, in response to a 776 m³ IFO/HFO WCSS at the Ichthys Field location.

C.1 SIMA outcomes

The Strategic SIMA for IFO/HFO determined C&R and surface dispersant application would both have positive effect for majority of values and sensitivities in Commonwealth waters. The nearest shoreline receptors are Browse Island (33 km from FPSO) and Scott Reef (100 km from FPSO).

C.2 Cone of response

Refer Appendix A.2 – Cone of response

C.3 Basis of Design - WCSS Modelling Overview

Refer Appendix A.3 – Basis of Design – WCSS Modelling Overview

C.4 Oil Spill Budget and Maximum Field Capability Statement

For an instantaneous spill in the BROPEP region (tropical water temperatures), Group IV (IFO/HFO/LSHFO) spills will typically increase in viscosity to become not amendable to dispersant within 6-24 hours; faster for HFO, slower for IFO and LSHFO, but more rapidly for any fuel type with increasing wind speeds. However, for a long duration release, fresh oil, still amendable to dispersant use would be available for several days. The longer duration release is also likely to result in longer thin 'streamers' of fresh oil which could be targeted by FWAD operations.

To fully treat the HFO WCSS, the aerial dispersant oil spill budget calculations are as follows:

- 776 m³ spill is treated at 20:1 oil to dispersant ratio = 40 m³ dispersant required
- A single air-tractor can deliver 3 m³ of dispersant in a single sortie and conduct a maximum of 4 sorties per day (potentially less for significant offshore distances).
- Therefore, each air-tractor can deliver between 9 to 12 m³ dispersant per daylight period.

Based on the above calculations, 3-4 FWAD air-tractors, ready to mobilise from Truscott at no-notice would be required to fully treat the 776 m³ IFO/HFO WCSS in the first 24 hours (first 12-hour daylight period).

C.5 Operational Considerations and ALARP assessment of the Field Capability

C.5.1 FWAD –Capability

The current FWAD arrangement in place which covers the entire Australian coastline is jointly managed by AMSA & AMOSC.

AMOSC's FWADC contract provides for 'wheels up' of 6 aircraft around Australia within 4 hours of activation.

There are a significant number of additional air tractors around Australia which do not form part of the FWADC contract (40 – 50 aircraft) that can be made available within relatively short



timeframes (noting timeframes vary based on time of year and current operations, E.g., fire-fighting and crop-dusting operations).

When triggered, the FWADC contract provides the following: Air Tractor AT802, pilot, Aerotech First Response Liaison Officer, an Air Attack Supervisor, an Aircraft Loading Officer, and transportation for all personnel to the nominated location.

The Air Attack Supervisor is typically identified as a key critical path role. AMOSC maintain an Air Attack Supervisor as part of the Aerotech First Response FWADC contract. Other personnel are available via AMSA and the National Response Team (traditionally from bushfire services).

An Air Attack Supervisor platform (helicopter or fixed wing) will need to be supplied by Titleholder, in the event Titleholder is the Control Agency for the spill. Aerotech First Response also have the capability to source this capability, if required. Titleholder would typically utilise a crew-change helicopter as the Air Attack Supervisor platform.

Dispersant stocks would be transported from the nearest AMOSC or other mutual aid stockpile.

Given that FWAD would only be an appropriate response strategy in the event of an ongoing spill, it's reasonable to assume an ongoing spill would occur over a few days, with some vessel dispersant applied during day 1.

As shown in section 6.3.2, during a long duration release scenario, it is likely that a long streamer of oil thick enough for aerial dispersant application would be present near the release location.

Therefore, based on the use of two aircraft (Bachelor, NT and Exmouth, WA based air-tractors) applying up to 24 m³/day, and working in conjunction with vessel-based dispersant capability (applying up to 12 m³/day/vessel), the surface (vessel and FWAD) capability would be able to deliver the required 40 m³ of dispersant within the second daylight period.

C.6 Aerial Dispersant - ALARP justification of Selected Field Capability

The cost of maintaining additional air tractors, outside of the existing FWAD arrangements would not result in any significant environmental benefit, given

- all the other logistics, Air Attack Supervisor and other key personnel etc., could not be maintained at Lombadina or Mungalalu-Truscott airbases, as part of the capability, and therefore the capability would still only be operational by day 2
- a vessel-based dispersant capability exists which can deliver a significant volume of dispersant on day 1.

Therefore, the current AMOSC/FWAD capability and arrangements are considered ALARP.

C.7 Aerial Dispersant - Selected Capability

It is considered ALARP to maintain the following as the selected capability for aerial dispersant.

- Titleholder will maintain mutual aid arrangements with AMOSC, which provide access to the AMOSC contracted FWAD capability.

Refer Appendix D for additional information regarding on-water response strategy implementation planning (including the combined use of at-sea containment and recovery, vessel dispersant and aerial dispersant) for Group IV spills, including short and long duration spills.



APPENDIX D: ON WATER RESPONSE STRATEGY IMPLEMENTATION PLAN FOR GROUP IV (IFO/HFO) SPILLS

This appendix provides a general discussion regarding the phasing and implementation of on-water response strategies for Group IV spill scenarios, including short and long duration releases.

As shown in Appendix A.3, the short duration release scenario is likely to result in a slick which remains relatively compact with a large single patch, or area of ocean surface exposed to floating oil >50 g/m². The longer duration (4 day) release scenario demonstrated that there is likely to be a longer, narrow streamer of oil >50 g/m² which would be expected due to the slower release rate, but longer release duration.

The longer duration release scenario will also result in more fresh oil which is still amendable to dispersant use for several days whilst the spill is congoing, compared to the short duration release scenario, where an increase in viscosity of the slick (rendering dispersant inoperable) will likely occur within the first 24 hours.

The field capabilities to be implemented for each on-water response strategy described below are based on the Selected Field Capability Statements provided in Appendices A, B and C.

D.1 Group IV spill from vessel – short-duration release

This scenario assumes that the Group IV spill from the vessel has stopped after a few hours. Due to weathering, the oil will most likely not be amendable to dispersant operations after the first day. The below activity descriptions assume that weather conditions are conducive for at-sea response operations.

Day 1

- SMV mobilised to confirm spill and gain/maintain ongoing situational awareness
- Vessel-based dispersant is activated – test spray confirms efficacy and dispersant spray operations commenced
- Additional dispersant stocks are mobilised from Broome (or other stockpiles) to support potential for ongoing vessel-based dispersant operations
- Additional vessels, (contracted or vessels of opportunity) sourced for potential for ongoing vessel-based dispersant operations
- FWAD capability not activated – ruled out based on time to deploy versus the window of opportunity for effective dispersant application
- Identification of vessels for C&R, and commencement of mobilisation of vessels, equipment and personnel to Broome Port and when possible, commence steaming to site.

Note - window of opportunity for dispersant application from a short duration spill may result in ongoing dispersant operations being stood down on day 1.

Day 2

- SMV operations utilised to maintain ongoing situational awareness
- Where possible, vessel-based dispersant activities continue until they are no-longer effective due to increased oil viscosity.
- C&R vessels steaming to site/commence C&R activities on location



Day 3 onwards

- SMV operations utilised to maintain ongoing situational awareness
- C&R vessels continues C&R activities on location.

D.2 Group IV spill from vessel – long-duration release

This scenario assumes fresh Group IV oil is continuing to release from the vessel over a duration of several days, providing ongoing source of oil amenable to dispersant operations, and prolonged effectiveness of C&R operations.

Below activity descriptions assume that weather conditions are conducive for at-sea response operations.

Day 1

- SMV mobilised to confirm spill and gain/maintain ongoing situational awareness
- Vessel-based dispersant is activated – test spray confirms efficacy and dispersant spray operations commenced
- Additional dispersant stocks are mobilised from Broome (or other stockpile) to support the potential for ongoing vessel-based dispersant operations
- Additional vessels, (contracted or vessels of opportunity) sourced for potential for ongoing vessel-based dispersant operations
- FWAD capability is mobilised to the nominated airfield (E.g., Lombadina/Mungalalu-Truscott airfield)
- Additional dispersant is mobilised to the nominated airbase to support potential for ongoing FWAD operations
- Identification of vessels for C&R, and commence mobilisation of vessels, equipment and personnel to Broome Port and when possible, commence steaming to site.

Day 2

- SMV operations utilised to maintain ongoing situational awareness
- Vessel-based dispersant operations continue. Resupply runs ongoing.
- FWAD surveillance flights and FWAD spray runs commence
- C&R vessels steaming to site/commence C&R activities on location

Day 3 onwards

- SMV operations utilised to maintain ongoing situational awareness
- Vessel-based dispersant operations continue. Resupply runs ongoing
- FWAD spray runs ongoing. FWAD dispersant resupply ongoing

C&R vessels continues C&R activities on location.



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Attachment 2

2 Browse Regional Oil Pollution Emergency Plan – Incident Management Team Capability Assessment

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1 Abbreviations

Abbreviation/Acronym	Definition
AMOSC	Australian Marine Oil Spill Centre
AMSA	Australian Maritime Safety Authority (Cwlth)
APPEA	Australian Petroleum Production and Exploration Association
BROPEP	Titleholder Australia Browse Regional Oil Pollution Emergency Plan (HSE_GEN_016765)
BROPEP BOD/FCA	Titleholder Australia BROPEP Basis of Design (BOD) and Field Capability Assessment Report (HSE_GEN_016764)
BROPEP IMTCA	Titleholder Australia - Browse Regional Oil Pollution Emergency Plan - Incident Management Team Capability Assessment (this document)
CMT	Crisis Management Team
COP	common operating picture
CPF	central processing facility
C&R	containment and recovery
EA/JV	External Affairs/Joint Venture
EPO	environmental performance outcome
EPS	environmental performance standard
ERP	emergency response plan
ERT	emergency response team
FOB	forward operational base
FPSO	floating production storage and offloading facility
FWAD	fixed wing aerial dispersant
GRSN	Shell Global Response Support Network



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HFO	heavy fuel oil
HSE	health, safety and environment
IAP	incident action plan
IMT	incident management team
LO	Liaison Officer
m ²	square metre
MODU	mobile offshore drilling unit
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority (Cwlth)
NT	Northern Territory
NT DIPL	Department of Infrastructure, Planning and Logistics (NT)
OIM	offshore installation manger
OM	operational monitoring program
OPICC	offshore petroleum incident coordination committee
OSMP	operational and scientific monitoring program
OSRL	Oil Spill Response Limited
OSRO	oil spill response organisation
OSTM	oil spill trajectory modelling
OWR	oiled wildlife response
PPRR	prevention, preparedness, response, recovery
P&D	protection and deflection
SAR	search and rescue
SCAT	shoreline clean-up assessment technique
SIMA	spill impact mitigation assessment
SMV	surveillance, monitoring and visualisation



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SOPEP	shipboard oil pollution emergency plan
SSDI	subsea dispersant injection
VOC	volatile organic compound
WA	Western Australia
WA DoT	Department of Transport (WA)
WCSS	Worst Credible Spill Scenario

2 Purpose

The purpose of this document is to:

- Present a summary of the outcomes of the Browse Regional Oil Pollution Emergency Plan - Basis of Design and Field Capability Assessment Report (HSE_GEN_016764), including the oil spill field capability requirements for a series of Worst Credible Spill Scenarios (WCSSs).
- Describe a generic Incident Management Team (IMT) capability assessment process.
- Present a generic IMT capability assessment for the Browse Basin WCSSs, including consideration of cross-jurisdictional response scenarios.
- Provide an overview of titleholder's IMT capability and linkages to titleholder's Crisis Management Team (CMT) and linkages to field based Emergency Response Teams (ERTs), and with mutual aid capabilities including external oil spill response organisations (OSROs).
- Provide an assessment of how the IMT capability including CMT and OSRO support can meet the capability requirements presented in the generic IMT capability assessment.
- Describe the training, testing and exercise activities related to the IMT capability and arrangements for oil spill response.

Note, the implementation strategy for the Browse Regional Oil Pollution Emergency Plan suite of documents, is described in the Browse Regional Oil Pollution Emergency Plan - Basis of Design and Field Capability Assessment Report (HSE_GEN_016764).

The inter-relationship of this document to other Browse Regional Oil Pollution Emergency Plan documentation is presented in Table 2-1 and shown in Figure 2-1.



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Table 2-1: BROPEP documentation overview

Document Title	Reference Location	Document Purpose
Titleholder Environment Plans	NOPSEMA Website	<p>All Titleholder EPs contain a detailed activity description, activity specific oil spill hazard identification, including potential release rates, volumes, locations, hydrocarbon types etc, activity specific oil spill modelling, used to inform environmental risk assessments, risk assessment of oil spills on environmental values and sensitivities and evaluations of controls to prevent oil pollution from the described activity.</p> <p>The Worst Credible Spill Scenario (WCSS) from all Titleholder EPs are included in the BROPEP Basis of Design and Field Capability Assessment (HSE_GEN_016764).</p>
Browse Region - Oil Pollution Emergency Plan (HSE_PRE_013075)	N/A	<p>This document is the tool which will be utilised by the Incident Management Team (IMT) during any impending/actual oil spill event. This document assists/guides the IMT through the process of notifications, gaining/maintaining situational awareness, response strategy evaluation and incident action plan (IAP) development, and mobilisation of field response capabilities.</p> <p>The document provides Environmental Performance Objectives (EPOs) and Environmental Performance Standard (EPSs) related to the implementation of response strategies.</p>
Browse Region Oil Pollution Emergency Plan - Basis of Design and Field Capability Assessment (HSE_GEN_016764)	Attachment 1	<p>This document presents an overview of all Titleholder's offshore (Browse/Bonaparte basin) petroleum activities and associated oil spill risks. This document evaluates modelling outcomes from a series of selected WCSSs and presents an oil spill response field capability analysis. This document also presents</p>



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Document Title	Reference Location	Document Purpose
		the EPOs and EPSs associated with the preparedness and environmental risk assessment of field response capability and arrangements.
BROPEP – Incident Management Team Capability Assessment Report – This Document.	Attachment 2	The document utilises the field capability assessments as inputs to evaluate the size and structure of the IMT necessary to mobilise and maintain the field capability. The document also presents the EPOs and EPSs associated with the IMT capability and arrangements.
Strategic Spill Impact Mitigation Assessment (SIMA)s. Condensate spill – instantaneous surface release MGO/diesel spill – instantaneous surface release Intermediate/heavy fuel oil spill – instantaneous surface release Condensate/gas well or pipeline blowout – long duration subsea release	Attachment 3	The four Titleholder Strategic SIMA documents are pre-spill planning tools used to facilitate response option selection by identifying and comparing the potential effectiveness and impacts of the various oil spill response strategies on a range of environmental values and sensitivities. The Strategic SIMAs utilise a semi-quantitative process to evaluate the impact mitigation potential of each response strategy. This method provides a transparent decision-making process for determining which response strategies are most likely to be effective at minimising oil spill impacts. The SIMA process includes environmental considerations as well as a range of shared values such as ecological, socio-economic and cultural aspects.



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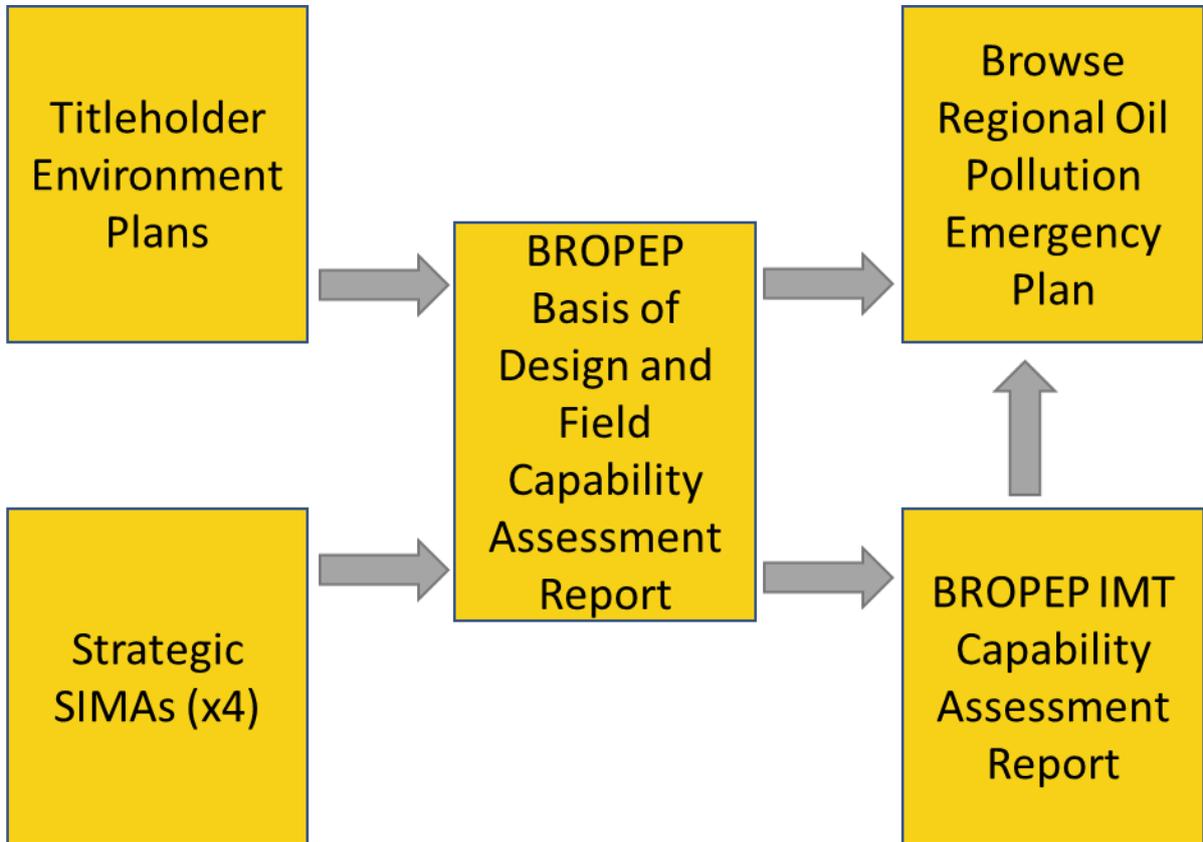


Figure 2-1: BROPEP document structure



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3 Field Capability Assessment

This section provides a summary of the outcomes of the BROPEP BOD/FCA.

As summarised in Table 2-1, the BROPEP BOD/FCA describes the following:

- a summary of exploration and production activities in Commonwealth waters offshore of Broome to Darwin, out to the Australian Exclusive Economic Zone
- a summary of the WCSS associated with the exploration and production activities
- a summary of the worst credible spill outcomes (such as the greatest area of actionable oil on water, the greatest length of shoreline oiled, the greatest volume of oil ashore) from the WCSSs
- the process used for the selection of two specific WCSSs, for detailed assessment of the required oil spill response strategies and scale of the required field response capabilities
- a 'tiered preparedness wheel' for the two selected WCSSs.

A summary of the field capability assessment outcomes is presented in Table 3-1, and the two WCSS tiered preparedness wheels (qualitative representations of the preparedness capability associated with the two selected WCSSs) are provided in Figure 3-1 and Figure 3-2.



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Table 3-1: Summary of field capability

Response Strategy	Well blow-out – condensate	Vessel collision - HFO
Aerial surveillance	<p>Tier 3</p> <ul style="list-style-type: none"> • During initial 24 hours: within 5 hours of Shell IMT activation, crew-change helicopter mobilisation to commence surveillance activities at the spill location. Second pilot using the Oil Spill Observation Guide (daylight operations only) • 24 – 72 hours: 1 x fixed wing aircraft. Multiple overflights per day. Second pilot/observer using the Oil Spill Observation Guide; or Australian Marine Oil Spill Centre (AMOSC) Core-Group trained aerial observers from 48 hours onwards. • 48 hours onwards: AMOSC Core-Group trained aerial observers available in Broome • 72 hours onwards: 2-3 x fixed wing aircraft. Multiple overflights per day, using trained aerial observers. 	<p>Tier 3</p> <ul style="list-style-type: none"> • During initial 24 hours: within 5 hours of Shell IMT activation, crew-change helicopter mobilisation to commence surveillance activities at the spill location. Second pilot using the Oil Spill Observation Guide (daylight operations only) • 24 – 72 hours: 1 x fixed wing aircraft. Multiple overflights per day. Second pilot/observer using the Oil Spill Observation Guide; or AMOSC Core-Group trained aerial observers from 48 hours onwards. • 48 hours onwards: AMOSC Core-Group trained aerial observers available in Broome • 72 hours onwards: 2 x fixed wing aircraft. Multiple overflights per day, using trained aerial observers.
Vessel surveillance	<p>Tier 1</p> <ul style="list-style-type: none"> • Opportunistic use of facilities and vessels for observations during first day or two only. • Primarily rely upon aerial surveillance and other operational monitoring strategies for situational awareness. 	<p>Tier 1</p> <ul style="list-style-type: none"> • Opportunistic use of facilities and vessels for observations during first day or two only. • Primarily rely upon aerial surveillance and other operational monitoring strategies for situational awareness.
Oil spill trajectory modelling (OSTM)	<p>Tier 3</p> <ul style="list-style-type: none"> • Multiple OSTM runs ongoing over a period of weeks/months. 	<p>Tier 3</p> <ul style="list-style-type: none"> • Multiple OSTM runs ongoing over a period of weeks.



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	<ul style="list-style-type: none"> • Volatile organic compound (VOC) modelling and dispersant effectiveness modelling also required. 	<ul style="list-style-type: none"> • Dispersant effectiveness modelling potentially also required.
Satellite tracker buoys	<p>Tier 3</p> <ul style="list-style-type: none"> • Deployment of multiple batches of tracker buoys over weeks/months. • Tracker buoys required from Australia-wide stockpiles. 	<p>Tier 2</p> <ul style="list-style-type: none"> • Deployment of locally available (e.g. Broome, Field or Darwin) batches of tracker buoys for multiple weeks.
Satellite imagery	<p>Tier 3</p> <ul style="list-style-type: none"> • Multiple satellite images required over weeks/months. 	<p>Tier 3</p> <ul style="list-style-type: none"> • Multiple satellite images required over weeks/months.
At sea containment and recovery (C&R)	Not applicable.	<p>Tier 2</p> <ul style="list-style-type: none"> • One or two basic C&R strike teams, or one or two advanced booming configuration strike teams. • Regionally sourced vessels (Western Australia (WA) or Northern Territory (NT) and regionally sources C&R equipment from Broome, Darwin and Exmouth/North-west Shelf required. • Response duration 1-2 weeks.
Surface dispersant - vessel	Not applicable.	<p>Tier 2</p> <ul style="list-style-type: none"> • Multiple locally sourced vessels conducting dispersant spraying over several days. • Regional (WA/NT based) dispersant stockpiles required for re-supply.
Surface dispersant - aerial	Not applicable.	Tier 2



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		<ul style="list-style-type: none"> • Two regionally located (Exmouth/Batchelor) fixed wing aerial dispersant (FWAD) air tractors utilised over several days. • Utilise Broome, Mungalu-Truscott or Lombadina air-bases. • Regional (WA/NT based) dispersant stockpiles required for re-supply.
Offshore subsea dispersant	<p>Tier 3</p> <ul style="list-style-type: none"> • Subsea dispersant injection (SSDI) spread required for up to one or two months, to reduce VOC risks during source control direct intervention activities such as debris clearance and capping stack deployment. • AMOSC Subsea First Response Toolkit (Fremantle) SSDI spread required. • National/international dispersant stockpile required. 	Not applicable.
Source Control	<p>Tier 3</p> <ul style="list-style-type: none"> • 1 x MODU available for relief well drilling through APPEA MOU arrangement for MODU and well-services • 1 x well-services support available through APPEA MOU arrangement for MODU and well-services • Capping systems available through OSRL <p>The Shell group have created a unit for emergency response purposes which have a specific purpose to help Operating Units such as Shell Australia throughout such incidents:</p>	Not applicable.



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	<ul style="list-style-type: none"> • The Well Control Virtual Emergency Response Team (WC-VERT) is focused on the virtual or physical mobilisation of the right people with the right skills its purpose is to provide: <ul style="list-style-type: none"> ○ Swift mobilization of an expert team to assist the local team during response to WCSS incident ○ Support both the Emergency Response and Well Engineering teams ○ Expertise in Well Control Emergency support not readily available in the region ○ Technical expertise on well control equipment and controls ○ Support for call-off and deployment of capping equipment ○ Integration with ICS Source Control and Oil Spill Expertise Centre to provide global well control support 	
Controlled in-situ burning	Not applicable.	Not applicable.
Shoreline clean-up assessment technique (SCAT)	Tier 3 <ul style="list-style-type: none"> • 1 x remote SCAT teams (including: 2 x SCAT, 1 X OWR specialist) utilising small vessel departing Broome/Darwin within 48 hours. • 2 additional x remote SCAT teams within 7 days. • Peak of 6 x remote SCAT teams operating within 30 days (3 x roving, 3 x embedded within remote shoreline response units). 	Tier 3 <ul style="list-style-type: none"> • 1 x remote SCAT teams (including 2 x SCAT, 1 X oiled wildlife response (OWR) specialist) utilising small vessel departing Broome/Darwin within 48 hours. • 2 additional x remote SCAT teams within 7 days



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		<ul style="list-style-type: none"> Peak of 6 x remote SCAT teams operating within 30 days (3 x roving, 3 x embedded within remote shoreline response unit).
Protection of sensitive resources	Not applicable.	Tier 1 <ul style="list-style-type: none"> Not expected to be used, but contingency is allowed for shoreline protection equipment to be mobilised as part of a remote shoreline response unit, if required.
Shoreline clean-up	Tier 3 <ul style="list-style-type: none"> 1 x remote shoreline response unit departing Broome/Darwin within 6 days. 2nd remote shoreline response unit mobilised within 14 days. Peak of 3 remote shoreline response units mobilised within 1 month. 	Tier 3 <ul style="list-style-type: none"> 1 x remote shoreline response unit departing Broome/Darwin within 6 days. 2nd remote shoreline response unit mobilised within 14 days. Peak of 3 remote shoreline response units mobilised within 1 month.
OWR	Tier 3 <ul style="list-style-type: none"> 1 x remote shoreline response unit departing Broome/Darwin within 6 days. 2nd remote shoreline response unit mobilised within 14 days Peak of 3 remote shoreline response units mobilised within 1 month. 	Tier 3 <ul style="list-style-type: none"> 1 x remote shoreline response unit departing Broome/Darwin within 6 days. 2nd remote shoreline response unit mobilised within 14 days Peak of 3 remote shoreline response units mobilised within 1 month.
Waste Management	Up to 4300 m ³ solid oily waste to be recovered over several months.	Up to 5500 m ³ solid oily waste to be recovered over weeks to 1-2 months.



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<p>Remote Shoreline Response Support</p>	<p>Tier 3</p> <p>Remote SCAT:</p> <ul style="list-style-type: none"> • 1 x small support vessel within 48 hours • 2nd and 3rd small support vessel within 1 week <p>Remote Shoreline Response Unit – including SCAT, Shoreline Clean-up and OWR:</p> <ul style="list-style-type: none"> • 1 x large floating remote response platform within 6 days. • 2nd large floating remote response platform within 14 days. • 3rd large floating remote response platform within 1 month. <p>Each large floating remote response platform typically consisting of:</p> <ul style="list-style-type: none"> • accommodation support vessel (10 command personnel, 50 field responders, 20 vessel support crew) • multiple small vessels/tenders/landing barges • light utility helicopter (optional). 	<p>Tier 3</p> <p>Remote SCAT:</p> <ul style="list-style-type: none"> • 1 x small support vessel within 48 hours • 2nd and 3rd small support vessel within 1 week <p>Remote Shoreline Response Unit – including SCAT, Shoreline Clean-up and OWR:</p> <ul style="list-style-type: none"> • 1 x large floating remote response platform within 6 days. • 2nd large floating remote response platform within 14 days. • 3rd large floating remote response platform within 1 month. <p>Each large floating remote response platform typically consisting of:</p> <ul style="list-style-type: none"> • accommodation support vessel (10 command personnel, 50 field responders, 20 vessel support crew) • multiple small vessels/tenders/landing barges • light utility helicopter (optional)
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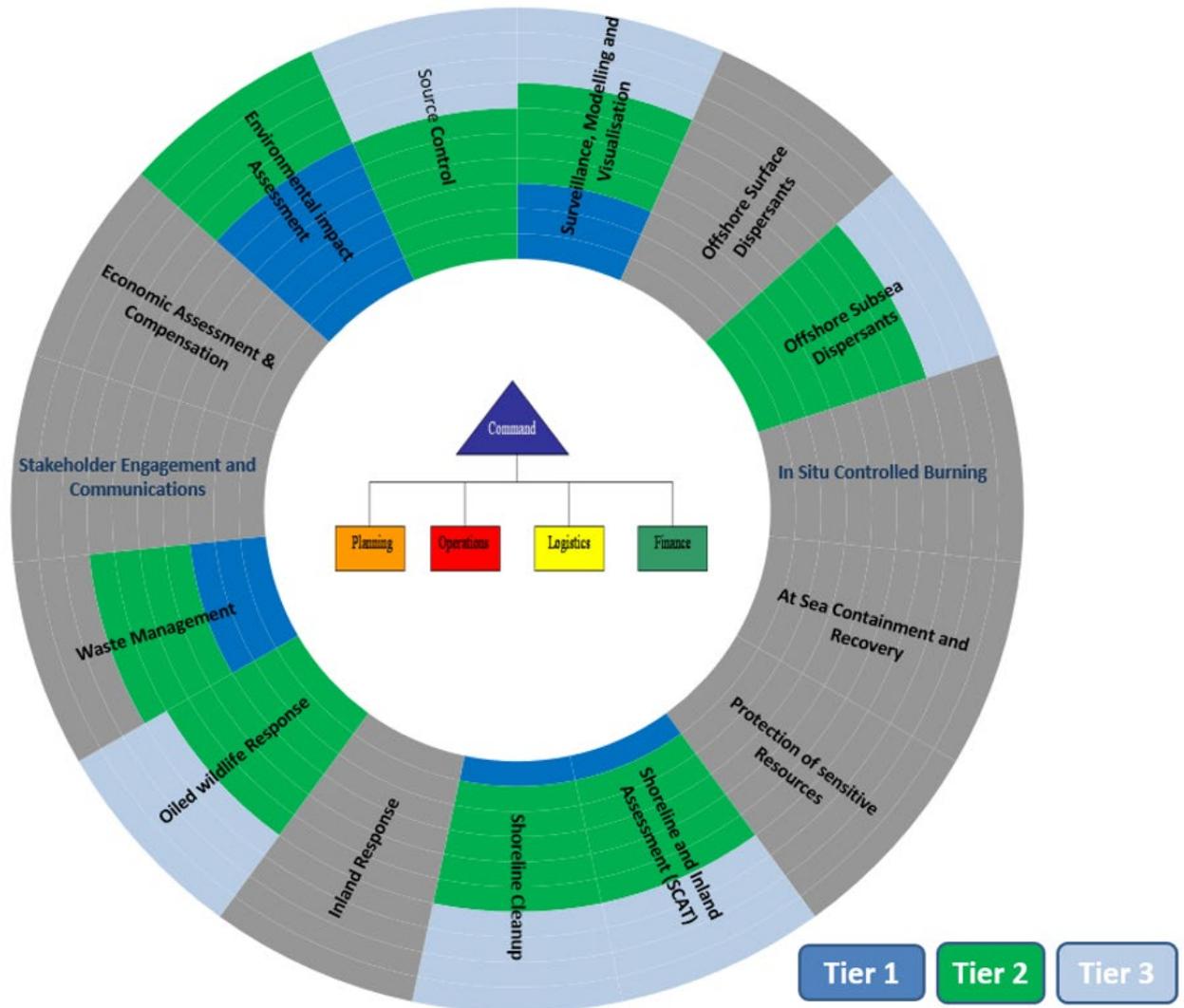


Figure 3-1: Tiered preparedness wheel – well blow-out – Brewster condensate/Prelude condensate/ Crux condensate



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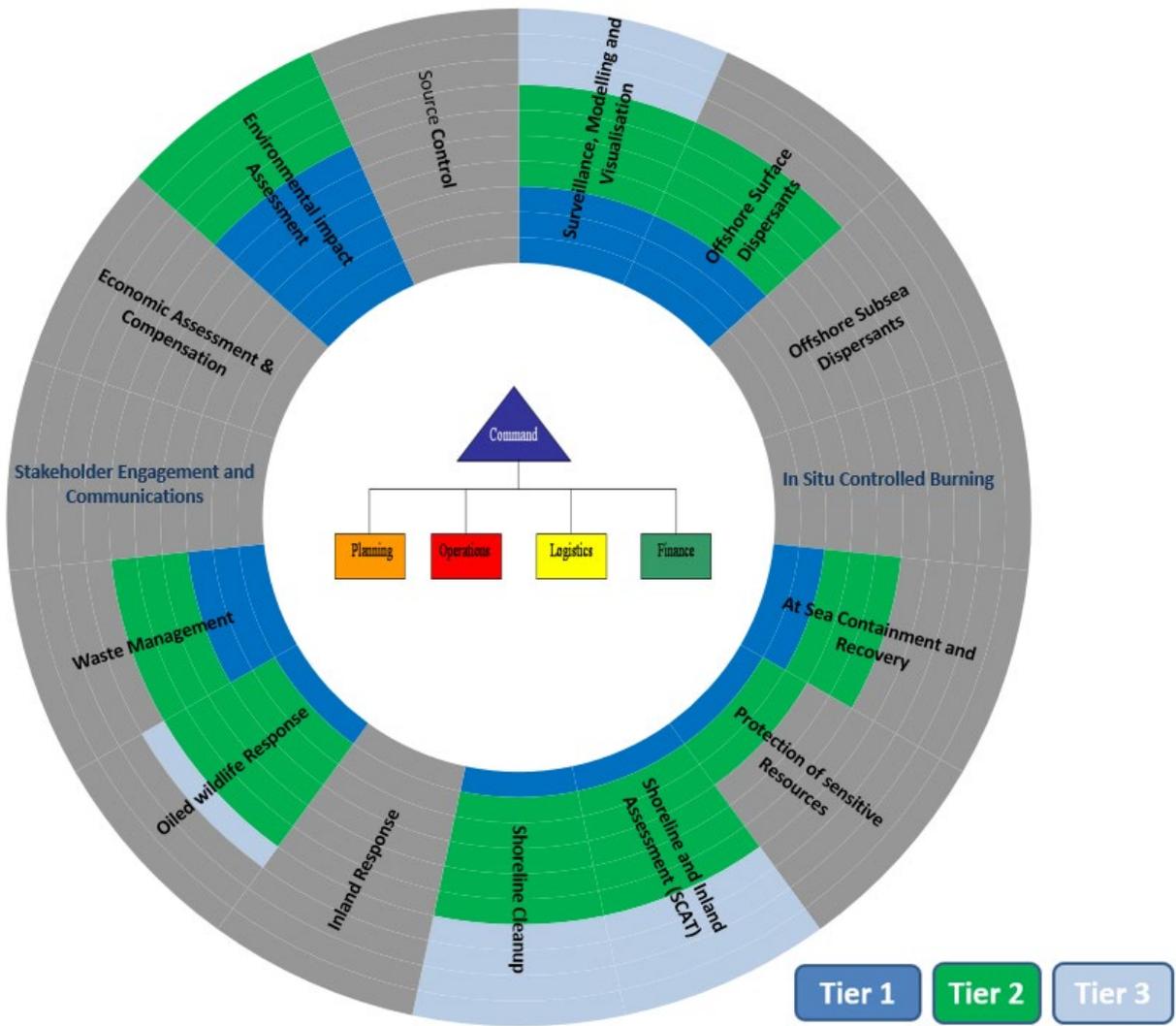


Figure 3-2: Tiered preparedness wheel – vessel collision – heavy fuel oil/Intermediate fuel oil



4 IMT Capability Assessment

This section describes the process for conducting an IMT capability assessment, presents the completed BROPEP IMT capability assessment and evaluates IMT capability requirements for a cross jurisdiction response scenario.

4.1 IMT Capability assessment process

The IMT capability assessment examines the IMT objectives and IMT outputs required to mobilise and/or maintain the required field capability at different time steps during the ramp-up of the IMT capability.

An evaluation of the IMT outputs is then conducted to determine the number of personnel required within each IMT function.

The IMT functions presented in Table 4-1 are based on the functions as defined in the Australian Petroleum Production and Exploration Association (APPEA) Guidance Document: Incident Management Teams Knowledge Requirements for Responding to Marine Oil Spills (APPEA 2021).

The IMT capability assessment process is undertaken utilising the following steps:

1. Define the IMT objectives for the first week (or until peak IMT capability would be required) for response to a WCSS (presented in Table 4-1).
2. Define the IMT outputs required at defined periods during IMT ramp-up (presented in Table 3 2). The periods defined for this IMT capability assessment are:
 - 0 – 24 hours
 - 24 – 72 hours
 - 72 hours onwards (peak/steady-state).
3. Define the number of personnel required in each IMT function, to manage the workload during the defined periods (presented in Table 4-2).

4.2 IMT Capability assessment outcome

The information presented in this section is intended to be generic in nature, presenting a generic IMT capability assessment, and generic IMT structures, as related to the two possible WCSSs (loss of well control or a vessel collision).

This section does not consider factors such as a titleholder's specific IMT structure, or other factors such as which agency (titleholder, or State/Territory government agency) is the Control Agency for the various response strategies.

Section 4.3 provides an assessment of the impact of a WA cross-jurisdiction response on the IMT capability assessment presented in Table 4-2.

In summary, the output of the generic IMT capability assessment (Table 4-2) concluded a total number of IMT personnel required for each defined period is as follows:

- 0 – 24 hours; 40 personnel
- 24 – 72 hours; 48 personnel
- 72-hours into steady-state operations – 60 personnel

Example or generic IMT structures (aligned with APPEA 2021) which could be used for the two WCSSs are presented in Figure 4-1 and Figure 4-2.



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Section 5 describes how titleholders will achieve the IMT capability requirements. Note, the number of 60 personnel required for steady-state operations does not account for IMT personnel rotations/swings into and out of the IMT. This is also addressed in Section 5.

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Table 4-1: IMT spill response objectives

Operational period	IMT spill response objectives	Rational / justification
<p>0 – 24 Hours</p>	<ol style="list-style-type: none"> 1. Establish/maintain an IMT with appropriate oil spill response trained personnel including mutual aid capabilities for specialist oil spill roles. 2. Gain situational awareness of spill trajectory, weathering, and potential environmental impact (use of response strategies/tactics including OSTM, visual surveillance, satellite imagery, SCAT surveys, and use of IMT tools including SIMA, resources at risk evaluation, and common operating picture (COP). 3. Establish forward operational Bases (FOBs)/Staging Areas for aviation, shore and marine response strategies (e.g. establish FOBs at Broome Airport, Darwin Airport, Broome Port, Darwin Port, as required). 4. Pre-deploy shoreline assessment/response capabilities including SCAT, OWR, resource protection and shoreline clean-up resources to FOB in anticipation of future deployment. 5. [Group IV spill only] – Mobilise/activate at sea response strategies, including: <ul style="list-style-type: none"> ○ Activate in-field vessel based dispersant and commence dispersant spraying ○ Mobilise FWAD capability to a nominated airfield along Kimberley coastline ○ Mobilise C&R capability at Broome/Darwin port. 	<ol style="list-style-type: none"> 1. Establishing and maintaining an IMT is required to ensure that field response activities are undertaken consistent with regulatory obligations (BROPEP) and are appropriately scaled to the spill scenario at the time. 2. This is the primary spill response needed for the first 24 – 96 hours, and then acts as a foundation/principle objective for the duration of the spill. It enables all other decisions to be made in regards to field or actions around the spilt hydrocarbon, on the basis of predicted and observed environmental and other impacts, and weathering of the spill. 3. Establishment of FOBs is required to support the mobilisation/deployment and execution of marine, aviation and shoreline response strategies. 4. The Strategic SIMA and BROPEP BOD/FAC identified that these strategies may be required to be executed early in the response (depending on the scenario). Noting the long-lead times for deployment of these response strategies, pre-deployment of equipment and personnel to a FOB will reduce timeframes between ‘need identified’ and ‘response strategy deployed’, which is especially important given the geographic isolation of the Browse/Bonaparte basins. 5. The Strategic SIMA and BROPEP BOD/FAC determined that these response strategies can (under the right circumstances) be used to reduce the environmental



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	<ol style="list-style-type: none"> 6. [Well blow-out only] – Mobilise SSDI spread to FOB. 7. Undertake risk assessments and develop health, safety and environment (HSE) plan(s). 8. Activate and mobilise OSRO's and mutual aid organisations. 9. Conduct regulatory and other stakeholder notifications. 	<p>impact of a Group IV spill. Rapid deployment provides the highest likelihood of successful use of these strategies.</p> <ol style="list-style-type: none"> 6. SSDI may be required for condensate spills, primarily to reduce VOC risks for debris clearance/capping stack deployment activities. Early mobilisation of SSDI spread ensures this activity is not on 'critical path' for other source control activities. 7. A risk assessment and HSE plan is required to be prepared, in order to assess the particular HSE risks associated with each relevant response strategy for the spill scenario. 8. OSRO's and mutual aid organisations provide expertise and additional manpower into the IMT and field response capability. 9. It is important to maintain regulatory and stakeholder relationships.
<p>24 – 72 Hours</p>	<ol style="list-style-type: none"> 1. Maintain and reinforce an IMT with appropriate oil spill response trained personnel including mutual aid capabilities for specialist oil spill roles 2. Maintain situational awareness of spill trajectory, weathering, and any potential environmental impacts. 3. Support the mobilisation/deployment of response strategies/field capabilities through FOBs. 4. Continue the pre-deployment of shoreline assessment/response capabilities including SCAT, OWR, resource protection, and shoreline clean-up resources to FOB in anticipation of future deployment. 	<ol style="list-style-type: none"> 1. As above – ongoing. 2. As above – ongoing. 3. The IMT objective has shifted from establishing the FOBs to the operational activity taking place from these locations. 4. As above – ongoing. 5. Ongoing at sea response strategy operations should continue, based on a positive demonstrable environmental outcomes and weather conditions conducive to safe operations. 6. As above – ongoing. 7. The IMT objective now includes the ongoing conduct of risk assessments and preparation of a HSE plans, as well



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	<ol style="list-style-type: none"> 5. [Group IV spill only] – Mobilise/activate at sea response strategies, including: <ul style="list-style-type: none"> ○ continue in-field vessel based dispersant spraying ○ continue mobilisation and/or commence FWAD spraying from a nominated airfield along Kimberley coastline ○ continue mobilisation of C&R capability from Broome/Darwin port – commence operations in the field if possible. 6. [Well blow-out only] – Mobilise SSDI spread to FOB. 7. Review hazard assessments and execute HSE plans for operational activities. 	<p>as the execution and ongoing review of the HSE plan for operational response strategies.</p>
<p>72 – onwards</p>	<ol style="list-style-type: none"> 1. Maintain an IMT with appropriate oil spill response trained personnel including mutual aid capabilities for specialist oil spill roles. 2. Maintain situational awareness of spill trajectory, weathering, and potential environmental impacts. 3. Support the mobilisation/deployment of response strategies/field capabilities through FOBs. 4. Continue the pre-deployment of shoreline assessment/response capabilities including SCAT, OWR, resource protection and shoreline clean-up resources to FOB in anticipation of future deployment. As directed by the relevant State/Territory Control Agency, commence deployment of shoreline assessment/response capabilities into the field. 	<ol style="list-style-type: none"> 1. As above – ongoing. 2. As above – ongoing. 3. The IMT objective has shifted from establishing the FOBs to the operational activity taking place from these locations. 4. As above – ongoing. 5. The pre-deployment of resources to the FOB is ongoing. The relevant State/Territory Control Agency will determine the timing for actual activation of shoreline assessment and response capabilities from the FOB to the field. 6. As above – ongoing. 7. As above - ongoing.



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	<p>5. [Group IV spill only] – Mobilise/activate at sea response strategies, including:</p> <ul style="list-style-type: none">○ continue in-field vessel-based dispersant spraying.○ continue mobilisation and/or commence FWAD spraying from a nominated airfield along Kimberley coastline.○ commence/continue with C&R activities in the field. <p>6. [Well blow-out only] – Mobilise SSDI spread to FOB.</p> <p>7. Review hazard assessments and execute HSE plan for operational activities.</p>	
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Table 4-2: IMT capability assessment

IMT Function	IMT Outputs 0-24 hours	IMT composition 0-24 hours	IMT Outputs 24-72 hours	IMT composition 24-72 hours	IMT Outputs 72 hours – steady state	IMT composition 72 hours – steady state
Control Leadership Function	24/7 coverage (night & day shift) Lead the IMT to safely undertake oil spill preparedness and response consistent with plans, scenario and stakeholder needs.	4 x IMT Leader personnel (1 x IMT Leader + 1 x Deputy per day shift and per night shift,	As per previous shift.	As per previous shift.	As per previous shift.	As per previous shift.
Liaison Function	Liaison Officer (LO) movement to required agencies. Ensure that operations are responsive to State/Territory and Commonwealth government's and other stakeholder needs. Ensure timely mechanisms are in place to communicate these needs between IMT and the relevant external agencies/stakeholders.	1 x LO with relevant WA/NT Control Agency 1 x LO with National Offshore Petroleum Safety and Environmental Authority (NOPSEMA)/Offshore Petroleum Incident Coordination Committee	As per previous shift. Ensure lines of communication and schedules of meetings are established. Ensure any IMT support required to relevant State/Territory Control Agency is defined. Provide ongoing briefings/updates back to the IMT.	1 x LO with relevant WA/NT Control Agency 1 x LO with NOPSEMA / OPICC	As per previous shift.	As per previous shift.
Safety Function	Initial risk assessments of surveillance, monitoring and visualisation (SMV) and at sea response strategies. Commence preparation of HSE plans for SMV and at sea response strategies.	2 x Safety Function personnel	SMV and at sea response strategy HSE Plans completed and communicated to site. Establish system for ongoing monitoring/review of safety of field response activities. As required, commence risk assessment for other response strategies (e.g. shoreline, OWR and operational and scientific monitoring program (OSMP)).	3 x Safety Function personnel (2 x day-shift and 1 x night-shift)	Continue to communicate any updated HSE plans to site. Continue to monitor/review safety of field response activities. Establish HSE communication and reporting with FOBs.	As per previous shift.
Media & Public Information Function	Preparing and releasing media holding statements. Assisting with press-conference preparation. Engagement with regulatory agency media/communications personnel. Engagement with general press-media.	2 x Media/Public Affairs personnel (day-shift only)	As per previous shift.	As per previous shift.	As per previous shift.	As per previous shift.



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Planning Function	<p>Situation awareness processes established.</p> <p>Establish chain of communication within the Planning Function, arrange meetings schedules and drive the planning 'P' process.</p> <p>Commence IAP development and distributed for the following operational period (aims, objectives, strategies, tactics, tasks and resources appropriately detailed for the scenario – typically starting with SMV and at-sea response).</p>	<p>3 x Planning Function Lead (2 x day-shift & 1 x night-shift)</p>	<p>Ongoing facilitation of planning 'P' process.</p> <p>Ongoing development/review of IAP documentation.</p> <p>As required, commence IAP process for other response strategies (e.g. shoreline, OWR and OSMP).</p> <p>Termination end points established and agreed for selected/activated response strategies.</p>	<p>As per previous shift.</p>	<p>As per previous shift.</p>	<p>As per previous shift.</p>
Intelligence/Situation Unit (including Common Operating Picture/GIS function)	<p>Gain and maintain situational awareness, via updating the situational tools.</p> <p>Establish COP including:</p> <ul style="list-style-type: none"> field assets (facilities, vessels, aviation) OSTM surveillance outputs environmental sensitivities. <p>Spill tracking buoys outputs</p> <p>Develop maps/diagrams as requested by IMT, for internal planning, and external communications.</p>	<p>2 x Intelligence/Situation Unit (1 x day-shift and 1 x night-shift)</p>	<p>Ongoing receipt, recording and distribution of infield response information updates.</p> <p>Ongoing use/update of the COP.</p> <p>Ongoing development of maps/diagrams as requested.</p>	<p>3 x Situation Unit (2 x day-shift and 1 x night-shift)</p>	<p>As per previous shift.</p>	<p>As per previous shift.</p>
Environment Function (including OSTM and Resources at Risk functions)	<p>Support initial notifications to regulators/stakeholders.</p> <p>Complete initial Operational SIMA.</p> <p>Activate OSTM, and analyse initial results.</p> <p>Support activation of other SMV (satellite tracker buoys, satellite imagery, etc.)</p> <p>Conduct resources at risk assessment.</p> <p>Assist Planning Function Lead with development of IAP tasking for SMV and at-sea response strategies.</p>	<p>3 x Environment Function (2 x day-shift and 1 x night-shift)</p>	<p>Provide SMV data to OSTM provider – ongoing OSTM runs/model validation.</p> <p>Utilise SMV, OSTM outputs and other situational awareness data to inform ongoing re-validation of Operational SIMA / response strategy selection.</p> <p>Continue to support IAP development.</p>	<p>As per previous shift.</p>	<p>As per previous shift.</p> <p>Assist Operations to monitor the ongoing effectiveness of at sea response strategies against termination criteria.</p>	<p>As per previous shift.</p>



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	<p>Review BROPEP commitments and compliance.</p> <p>Group IV spills only:</p> <ul style="list-style-type: none"> • Support Operations with activation of vessel dispersant capability. • Support Operations and Logistics with activation of FWAD capability. • Support Logistics with identification of suitable at-sea C&R vessels and mobilisation of C&R capability. 		<p>Discuss/agree termination end points for activated response strategies.</p> <p>Ongoing review of BROPEP commitments and compliance.</p>			
SCAT Function	<p>In consultation with LO, establish direct liaison with relevant State/Territory Control Agency SCAT personnel.</p> <p>Agree SCAT data recording processes, systems and tools.</p> <p>Agree industry vs State/Territory Control Agency available SCAT/shoreline response resources/personnel.</p> <p>Provide logistics with specifications of suitable remote response SCAT/shoreline vessels/platforms.</p> <p>Commence early mobilisation of SCAT/shoreline response resources/personnel to FOB.</p>	<p>1 x SCAT Function (day-shift only)</p>	<p>Support Planning and Safety with development of SCAT and shoreline response HSE plans and IAP documentation.</p> <p>Support logistics with identification/selection of suitable remote response SCAT/shoreline response vessels/platforms.</p> <p>As relevant, support ongoing mobilisation of SCAT response resources/personnel to FOB.</p> <p>Support relevant Control Agency with any requested tasks (e.g. commence sectorisation/segmentation of any potentially affected shorelines).</p>	<p>2 x SCAT Function (day-shift only)</p>	<p>Continue to support Planning and Safety with development of SCAT HSE plans and IAP documentation.</p> <p>As relevant, ongoing mobilisation of SCAT resources/personnel to FOB or into the field as required.</p> <p>Commence monitoring/assessment of incoming SCAT data, to inform shoreline response and OWR planning.</p>	<p>3 x SCAT Function (2 x day-shift and 1 x night-shift)</p>
Shoreline Response Program Function		<p>1 x Shoreline Response Program Function (day-shift only)</p>	<p>As relevant, support ongoing mobilisation of shoreline response resources/personnel to FOB.</p> <p>Support relevant Control Agency with any requested tasks (e.g. preparation of shoreline treatment recommendations, or review of tactical response plans for</p>	<p>4 x Shoreline Response Programme Function (2 x day-shift and 2 x night-shift)</p>	<p>Continue to support Planning and Safety with development of shoreline response HSE plans and IAP documentation.</p> <p>As relevant, ongoing mobilisation of shoreline response resources/personnel to FOB or into the field as required.</p> <p>Support Operations and Shoreline Response Function</p>	<p>6 x Shoreline Response Program Function (4 x day-shift and 2 x night-shift)</p>



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			potentially affected shorelines).		with ongoing execution of shoreline response activities.	
OSMP Program Coordinator	<p>Commence notification/activation of OSMP Contractor.</p> <p>Evaluate situational awareness information against OSMP activation triggers to determine relevant operational monitoring programs (OMs) for immediate activation.</p> <p>Provide logistics with specifications of suitable OSMP vessels/platforms.</p>	1 x OSMP Function (day-shift only)	<p>Support Planning and Safety with development of OSMP HSE plans and IAP documentation.</p> <p>As relevant, support ongoing mobilisation of OSMP resources/personnel to FOB.</p>	1 x OSMP Function (day-shift only)	<p>Continue to support Planning and Safety with development of shoreline response HSE plans and IAP documentation.</p> <p>As relevant, ongoing mobilisation of shoreline response resources/personnel to FOB or into the field as required.</p> <p>Support OSMP contractor with ongoing execution of OM mobilisation/activation activities.</p>	1 x OSMP Function (day-shift only)
Operations Function Lead	<p>Establish chain of communication within the Operations Function.</p> <p>Support Planning as required with the planning 'P' process.</p> <p>All spills – immediately activate SMV:</p> <ul style="list-style-type: none"> Opportunistic visual surveillance from helicopters, vessel and facilities. Coordinate satellite tracker buoy deployments. <p>Group IV spills only:</p> <ul style="list-style-type: none"> Activation of vessel-based dispersant capability. Activation of FWAD capability. Activation of at-sea C&R capability. 	3 x Operations Function Leads (2 x day-shift and 1 x night-shift)	<p>Ensure ongoing field operations are undertaken consistent with the IAP (connection from the high-level objectives / strategies to tactics / tasks / resources).</p> <p>Ensure ongoing field operations are conducted safely, in accordance with the HSE plans.</p> <p>Provide Operations Function support as part of IAP and HSE plan development for the following operational period.</p> <p>Ensure IAP and HSE plans are effectively communicated to field teams for the following operational period.</p>	As per previous shift.	As per previous shift.	As per previous shift.
Aviation Function NOTE: FWAD only required for Group IV spills	<p>Coordinate/execute opportunistic aerial surveillance during the first daylight period.</p> <p>Support Planning and Safety with development of IAP and HSE plans for ongoing aerial surveillance and</p>	2 x Aviation Function (day-shift only)	<p>Oversee/monitor execution of fixed-wing aerial surveillance flights.</p> <p>Continue mobilisation and commence execution of FWAD capability from nominated air-field.</p>	4 x Aviation Function (3 x day-shift and 1 x night-shift)	As per previous shift.	As per previous shift.



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	<p>FWAD, including development of FWAD operations/tactical plans.</p> <p>Determine and commence liaison with nominated air-field for FWAD activities.</p> <p>Consult with other relevant aviation agencies (e.g. Australian Maritime Safety Authority (AMSA) and Civil Aviation Safety Authority) as required.</p> <p>Support Logistics to identify and mobilise suitable fixed-wing aircraft for air surveillance and FWAD Air Attack and SAR platforms, and relevant air operations personnel (oil spill aerial observers, air attack supervisors, etc.).</p>		<p>Monitor aerial dispersant usage and coordinate resupply.</p> <p>Coordinate aviation support for remote shoreline response operations.</p> <p>Ensure all aviation operations are undertaken in accordance with the IAP and HSE plans.</p> <p>Provide support to Planning and Safety as part of ongoing IAP and HSE plan development/review for the following operational period.</p>			
<p>Marine Function</p> <p>NOTE: Vessel Dispersant and At-Sea Containment and Recovery only required for Group IV spills.</p>	<p>Directly supervise activation of vessel dispersant capability.</p> <p>Support Logistics with activation/mobilisation of C&R capability.</p> <p>Support Planning and Safety with development of IAP and HSE plans for ongoing marine operations.</p>	<p>2 x Marine Function (day-shift only)</p>	<p>Oversee/monitor ongoing execution of vessel-based dispersant activities.</p> <p>Monitor vessel-based dispersant usage and coordinate resupply.</p> <p>Coordinate marine support for remote shoreline response operations.</p> <p>Continue mobilisation and commence execution of at-sea C&R capability.</p> <p>Monitor and support waste recovery and backload.</p> <p>Ensure all marine operations are undertaken in accordance with the IAP and HSE plans.</p> <p>Provide support to Planning and Safety as part of ongoing IAP and HSE plan development/review for the following operational period.</p> <p>Provide support as needed / directed by relevant</p>	<p>3 x Marine Function (2 x day-shift and 1 x night-shift)</p>	<p>As per previous shift.</p> <p>Oversee/monitor ongoing execution of at-sea response strategies (dispersant / C&R).</p> <p>Support mobilisation and oversee ongoing execution of remote shoreline response activities supported by vessel logistics.</p>	<p>4 x Marine Function (3 x day-shift and 1 x night-shift)</p>



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			State/Territory Control Agency.			
Shoreline Response Function (including protection of sensitive resources, and shoreline clean-up function)	Not applicable during first operational period – covered by Planning Shoreline Response Function.	Not applicable	<p>Provide support to Planning and Safety as part of IAP and HSE plan development/review for the following operational period.</p> <p>Provide support as needed / directed by relevant State/Territory Control Agency.</p>	1 x Shoreline Response Function (day-shift only)	<p>Oversee/monitor ongoing execution of shoreline response activities.</p> <p>Monitor usage and coordinate resupply of shoreline response consumables.</p> <p>Monitor and support waste recovery and backload.</p> <p>Continue mobilisation and commence execution of at-sea C&R capability.</p> <p>Ensure all marine operations are undertaken in accordance with the IAP and HSE plans.</p> <p>Provide support to Planning and Safety as part of ongoing IAP and HSE plan development/review for the following operational period.</p>	4 x Shoreline Response Function (3 x day-shift and 1 x night-shift)
Oiled Wildlife Response Function	<p>Coordinate initial OWR personnel to support first remote SCAT team</p> <p>Interface and arrange communication protocols with relevant State/Territory Control Agency/wildlife agency</p> <p>Interface with relevant wildlife experts/subject matter experts, to assist in defining OWR priorities and provide input to SIMA processes.</p>	1 x OWR Function Day-shift only.	<p>Interface with relevant govt agencies to acquire wildlife permits</p> <p>Development OWR implementation documentation, including IAP/tasking assignments, and other key OWR implementation tools.</p> <p>Interface with HSE to assist with development of safety plans for OWR.</p> <p>Interface with waste mgt, to coordinate OWR waste management plans.</p> <p>Interface with logistics to define OWR logistical support requirements.</p> <p>Interface with OSROs and government agencies to identify and mobilise</p>	2 x OWR Function Day-shift only.	<p>As per previous shift.</p> <p>Provide ongoing support to in-field OWR activities.</p> <p>Ensure operations remain consistent with permits and other OWR IAP and implementation tools.</p> <p>Provide support to Planning and Safety as part of ongoing IAP and HSE plan development/review for the following operational period.</p>	2 x OWR Function Day-shift only.



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			additional personnel for OWR SCAT support and other OWR field response personnel.			
Waste Function	Support Marine Function and Logistics with planning and establishment of liquid waste logistics chain, in support of C&R activities.	1 x Waste Function (day-shift only)	Provide ongoing support to C&R liquid waste management. Support Planning, Operations, Shoreline Response Functions and Logistics with establishment of solid, liquid and bio-hazard waste logistics chains, in support of shoreline and wildlife response activities. Execute third-part waste management capabilities, as required for receipt of various waste streams. Provide input into IAP and HSE plans, as related to waste management issues.	As per previous shift.	Track/monitor waste volumes generated from response strategies. Provide ongoing support including oversight of third-party waste management contractors for the onshore receipt and disposal of various waste streams. Ensure operations remain compliant with relevant State/Territory waste management regulations. Provide input into IAP and HSE plans, as related to waste management issues.	As per previous shift.
Logistics Function	Establish marine, shoreline and aviation FOBs. Support execution of SMV and at-sea response strategies during first operational period. Commence sourcing/mobilisation of marine, aviation and shoreline assets, equipment and personnel, as required.	2 x Logistics Function Leads (1 x day-shift and 1 x night-shift) 8 x general logistics support personnel (all-hazards IMT training only) (4 x day-shift and 4 x night-shift)	Continue to mobilise marine, aviation and shoreline assets, equipment and personnel, as required. Ensure waste management contracts established.	As per previous shift.	As per previous shift.	As per previous shift.
Finance & Admin Section Chief	As part of all-hazards response processes: <ul style="list-style-type: none"> Ensure financial Delegation Of Authorities are in established for the duration of the response. Establish cost-codes and coordinate emergency purchase order approvals using Titleholder's Business management system processes, for the duration of the response. 	1 x Finance/Admin Lead 1 x Finance/Admin support (day-shift only).	As per previous shift. Ensure funding sources are available for long-duration response. Ensure relevant insurance arrangements are considered/activated.	As per previous shift.	As per previous shift.	As per previous shift.



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	<ul style="list-style-type: none">Establish and maintain cost-tracking processes within the Titleholder's business management system, for duration of the response.					
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Well Blowout IMT Structure

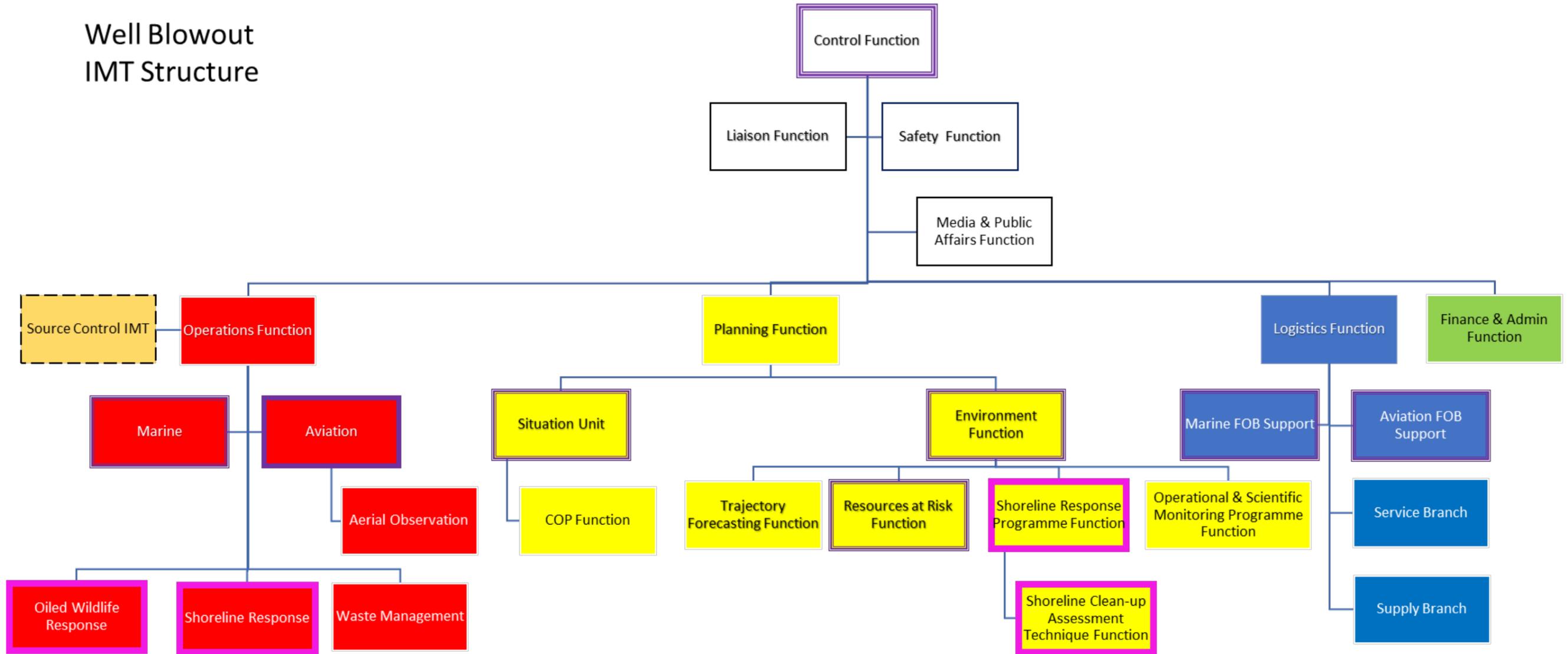


Figure 4-1: Example IMT structure – condensate well blow-out scenario



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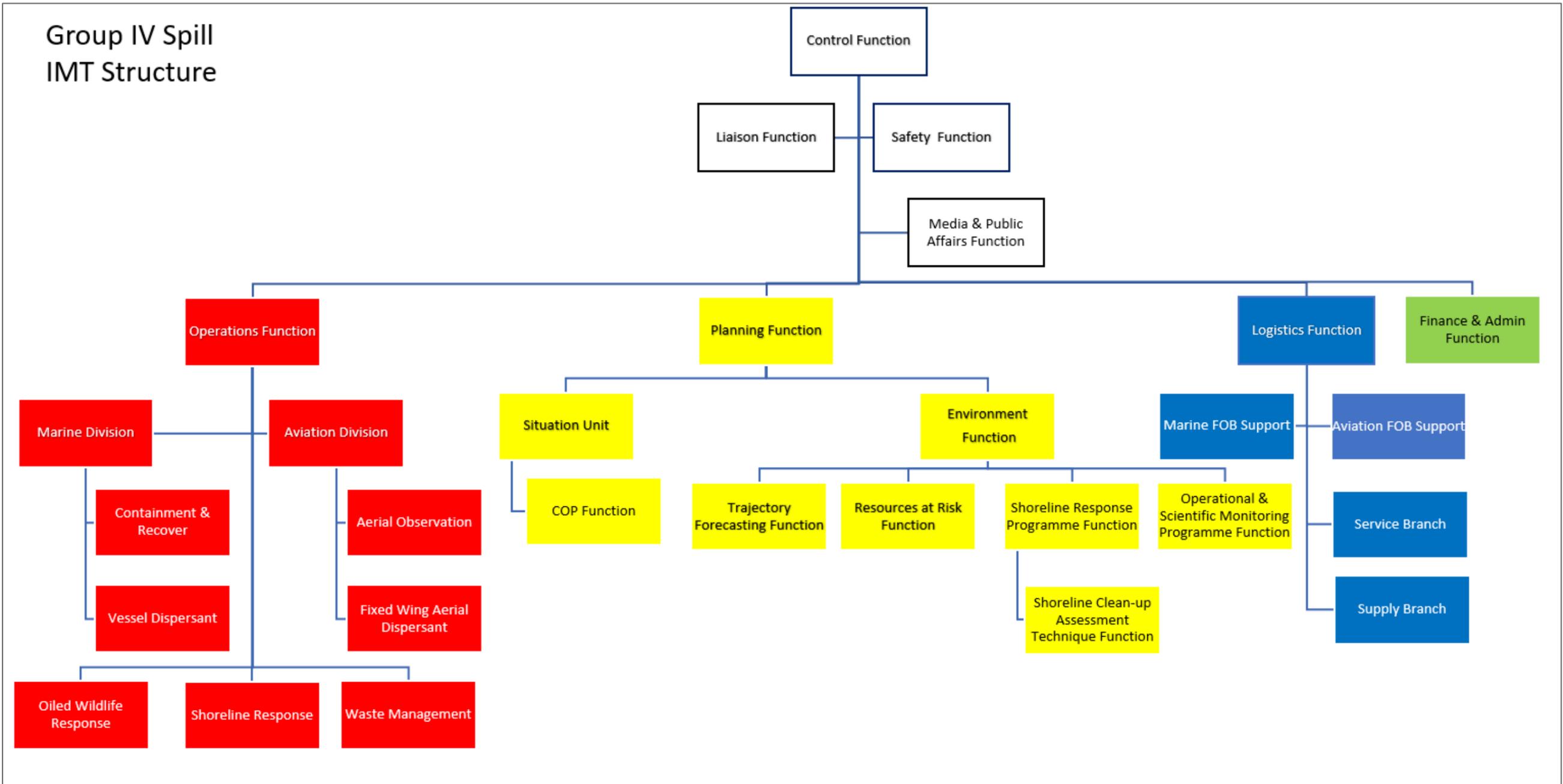


Figure 4-2: Example IMT structure – Group IV spill scenario



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4.3 WA DoT cross jurisdiction response – IMT capability evaluation

The IMT capability assessment presented in Table 4-2 has assessed the full IMT capability required to develop all the IMT outputs required to support all possible response strategies for the WCSSs, including all shoreline-based response activities. The full IMT may need to be provided by the TH IMT; for example if responding at Ashmore Reef/Cartier Island (where the TH is the Control Agency for shoreline response), or in the Northern Territory (NT) where significant IMT support from the NT government isn't expected to be provided.

However, during a WA cross-jurisdiction response scenario with a spill from TH activities entering WA State waters, the WA DoT is the Control Agency for the relevant shoreline based response strategies/tactics. Further details of WA DoT and TH responsibilities during a cross-jurisdiction response are defined in WA DoT IGN Rev 5 (WA DoT 2020), Appendix 2 IMT Functions and 'Lead IMT' Designations.

During a cross-jurisdiction response, a number of the IMT outputs and capabilities defined in Table 4-3 would typically be conducted by the WA DoT. However, the WA DoT would still be supported by with key TH IMT personnel. WA DoT (2020) Appendix 3 Initial DoT IMT Personnel Requirements upon Petroleum Titleholder specifically requires the TH to provide 11 personnel to fulfill specific roles within the WA DoT incident management structures.

Table 4-3 presents an evaluation of the impact of WA DoT (2020) Appendix 3 requirements on the IMT capability assessment previously presented in Table 4-2. Specifically, Table 4-3:

- Defines the WA DoT IMT roles to be filled by TH IMT
- Reviews IMT personnel/capability specified in Table 3 2
- Evaluates if sufficient IMT capability has already been accounted for in Table 3 2 to meet the WA DoT IMT requirements, or if additional capability would be required.

The outcome of the evaluation presented in Table 4-3 identified that additional personnel would be required in the following roles:

- Deputy Intelligence Officer
- Environment Support Officer
- Deputy Public Information Officer
- Deputy Finance Officer
- Deputy Division Commander

Table 4-3: WA DoT cross jurisdiction scenario evaluation against the IMT capability assessment

WA Requirement	DoT	Table 4-2 capability assessment	Outcome
CMT Liaison Officer		Table 4-2 already includes the WA DoT Liaison Officer role.	No additional Liaison Officer required, as sufficient depth of capability is already accounted for in Table 4-2.
Deputy Incident Controller		Table 4-2 includes 4 x IMT Lead/Deputy, of which one could be appointed to WA DoT, as related to the	No additional IMT Leaders required, as sufficient depth of capability is already accounted for in Table 4-2.



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	shoreline response elements of the response.	
Deputy Intelligence Officer	Table 4-2 provides for 3 x intelligence/situation unit personnel, managing the whole response.	One additional Intelligence Office/Situation Unit person would be required to support the WA DoT IMT.
Environment Support Officer	Table 4-2 provides for 3 x Environment Team personnel, managing the whole response.	One additional Environment Support Officer would be required to support the WA DoT IMT.
Deputy Planning Officer	Table 4-2 provides for 3 x planning function leads (two dayshift, one night-shift). However, it also provides for provides a total of 3 x Planning-SCAT and 6 x Planning - shoreline response programme function. Trained shoreline response program function personnel would be able to provide deputy planning officer support to the WA DoT for shoreline response planning activities.	No additional Planning Officer required, as sufficient depth of shoreline response planning capability is already accounted for in Table 4-2.
Deputy Public Information Officer	Table 4-2 provides for 2 x media/public affairs personnel working dayshift only managing the whole response.	One additional media/public affairs officer would be required to support the WA DoT IMT.
Deputy Logistics Officer	Table 4-2 provides for 10 x logistics personnel. One would be appointed to the WA DoT, to support shoreline response logistics.	No additional Logistics Officer required, as sufficient depth of shoreline response logistics capability is already accounted for in Table 4-2.
Deputy Finance Officer	Table 4-2 provides for 2 x Finance/Admin team managing the whole response.	One additional Finance Officer would be required to support the WA DoT IMT.
Deputy Operations Officer	Table 4-2 provides 4 x Ops – Shoreline Response Function. One would be appointed to the WA DoT, to support shoreline response operational activities.	No additional Operations Officer required, as sufficient depth of shoreline response operations capability is already accounted for in Table 4-2.



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Deputy Waste Management Coordinator	Table 4-2 provides for 1 x waste management but also 10 x logistics personnel. Logistics trained personnel typically are able to undertake/manage waste management, and therefore logistics personnel could be appointed to WA DoT.	No additional Waste Management Coordinator required, as sufficient Logistics/Waste Management capability is already accounted for in Table 4-2.
Deputy Division Commander	Not considered as part of the IMT capability assessment.	One additional Deputy Division Commander would be required to support the WA DoT IMT.

5 IMT Capability and Arrangements

Shell utilise the Incident Command System (ICS) framework for managing incidents. This enables Shell to conduct a more effective response through use of a broad range of personnel resources by using globally consistent terminology.

As part of this framework, Shell uses the 'Planning Process', commonly referred to as the 'Planning P'. The leg of the 'P' describes the initial response period which is commonly characterised by the first operational period of the response (Initial or Reactive Phase). During this period, the IMT will conduct (or assist with) initial notifications, assess the incident, prepare initial ICS Forms and consider resourcing and tactics to respond to the incident. For a short-duration response, an initial response may be all that is required, and an ICS 201, the initial response IAP may be sufficient.

5.1 IMT process overview

Titleholder maintains a trained and ready IMT and CMT and are guided by the Incident Management Team (West) (IMT(W)) Emergency Response Plan (HSE_GEN_011209). The structures and processes described in these plans are aligned to the Australian Interagency Incident Management System.

The IMT Leader is responsible, and has the financial authority, for the activation and mobilisation of all necessary emergency response capabilities under the 'manual of authority'.

The IMT provides operational management support, and the CMT provides strategic direction to protect reputation and sustain 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.

Titleholder maintains an IMT capability of over 100 personnel, between the Perth and Brisbane IMTs, all of whom are trained personnel, and selected personnel have also been provided with additional oil spill training, aligned with the IMO 3 (For Incident Management Team Leads (IMT L)) & IMO 2 for Operations, Planning Logistics Sect Chiefs & Environment Unit Leads, course, also including elements tailored to Titleholder's previous OPEP arrangements.

There are activity specific Emergency Response Plans (ERP) for activities where titleholder does not maintain operational control, where i.e. Drilling Contractor ERP and all contractor vessels that are implemented by the relevant facility/vessel ERT.



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Titleholder and contractors nominate and train workplace personnel to form facility and vessel-based ERTs. These will be coordinated by the relevant person in charge (Offshore Installation Manager (OIM) or vessel master) to ensure that there is adequate emergency service cover on board at all times.

The Titleholder senior site representatives, and Contractor OIMs and vessel masters will be the points of contact between assets within the petroleum permits and licence areas and the Titleholder IMT.

The Shell Australia Business Executive (BE) is the point of contact between the IMT and the CMT.

Contractors are required to notify the relevant Titleholder field manager/client representative of any emergency.

The Shell emergency response structure (as defined in the IMT(W)) Emergency Response Plan (HSE_GEN_011209), is presented in Figure 5-1 and Figure 5-2. The exact IMT structure which would be used during an oil spill event would be driven by a number of factors including:

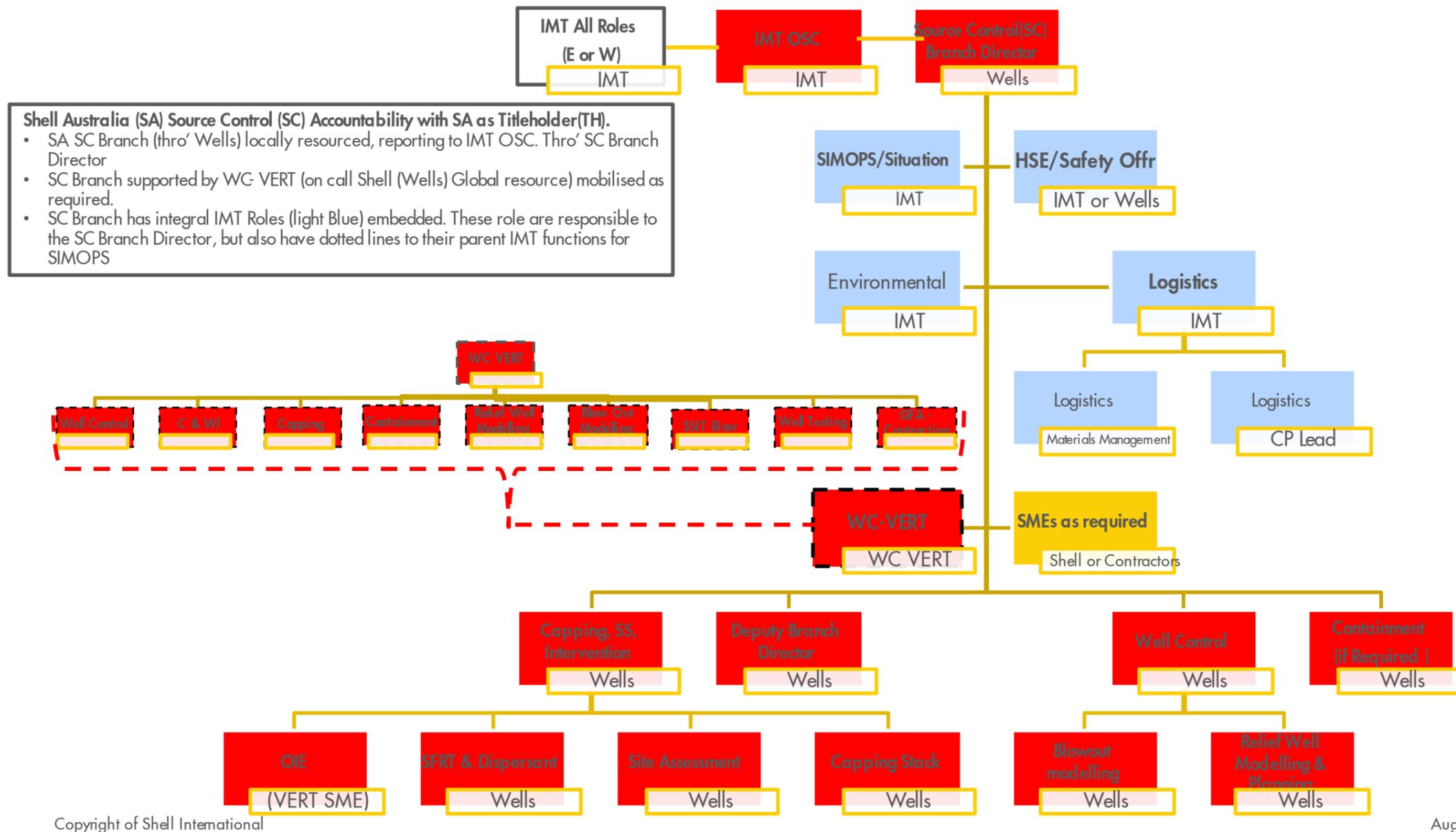
- the nature of the incident/event which caused the oil spill (and any associated safety/people related hazards being managed simultaneously)
- type, nature and scale of the oil spill event
- cross-jurisdictional situations; such as requirement for Titleholder as the Control Agency to manage shoreline response at Ashore Reef/Cartier Island, or to provide significant shoreline response IMT capability for spills on NT shorelines, compared with a WA shoreline scenario, where the WA DoT IMT will be the Control Agency for shoreline response activities.

The Shell IMT Leader may, at their discretion, appoint functional 'Deputy Lead' personnel within the Shell IMT structure, depending on the complexity, nature and scale of the event.

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Shell Australia Source Control (SC) IMT Structure



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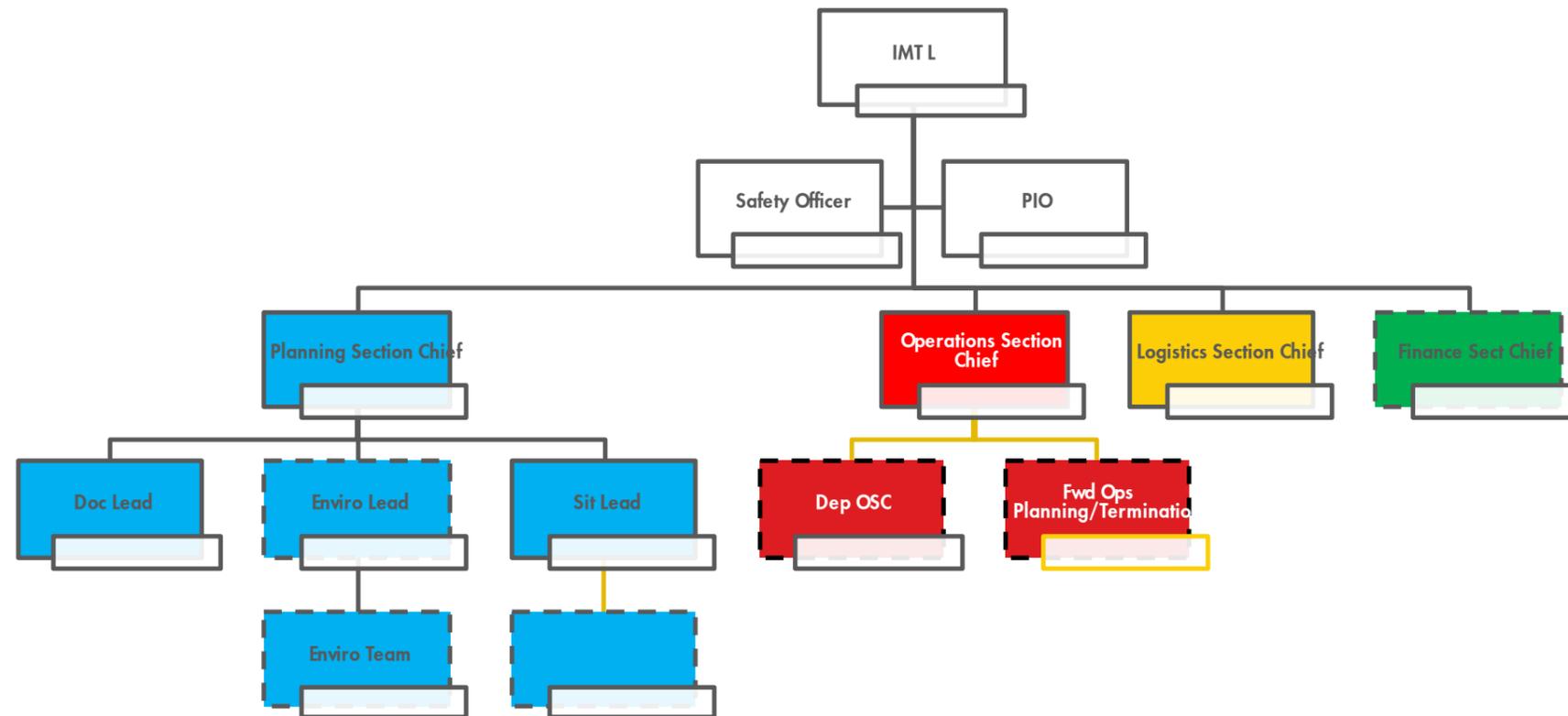
August 2020

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Figure 5-1: Example Titleholder IMT structure – Source Control incident.



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Figure 5-2: Example Titleholder IMT structure - General

* Department of Transport (WA) NT Department of Infrastructure, Planning and Logistics (NT DIPL) have the 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 WA DoT IMT Leader responsible for managing an oil spill impacting WA state waters in accordance with the State Hazard Plan Maritime Environmental Emergencies. Titleholder resources will be made available to support the WA DoT 'cross jurisdictional arrangements', as specified under the State Hazard Plan Maritime Environmental Emergencies (WA DoT 2021), if requested by WA DoT. NT DIPL will appoint a NT DIPL Incident Controller (in accordance with the NT Oil Spill Contingency Plan cross jurisdiction interim arrangements) to interface with the Titleholder IMT where NT waters may be impacted by a spill. The NT DIPL Incident Controller will become the control agency, supported by the Titleholder IMT, if a spill reaches NT shorelines.

Note, 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

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5.2 OSRO Arrangements

As presented in Section 4 of this document, Titleholder may require up to 60 personnel over a 24 hour period in the IMT, for a WCSS. Additional personnel would be required to support the WA DoT during a WA cross-jurisdiction response scenario, as discussed in Section 4.3. Under a WCSS, the response may be ongoing for several weeks/months, and therefore, a total of approximately 100 personnel may be required (assuming IMT personnel work 2 weeks on, 1 week off).

Therefore, Titleholder maintains contractual arrangements with the OSRO's of AMOSC and Oil Spill Response Limited (OSRL), which include the provision of technical specialists to supplement the IMT.

5.2.1 AMOSC Arrangements

Shell maintains an 'associate' membership with AMOSC. This arrangement provides Shell will access to the AMOSC personnel and the AMOSC Core-Group, under AMOSPlan.

The AMOSC Core-Group is an Australian industry initiative that was initially crafted in 1992. It is unique within the international context and is noted for being innovative and effective to rapidly expand and surge well trained personnel into a spill response. The AMOSC Core-Group has attended most Australian-based spills and also several offshore spills.

The AMOSC Core-Group has around 30-40 IMT personnel and 50-70 field operators.

AMOSC Core Group policy requires all Core-Group personnel to undertake initial training, followed by competency re-validation/training every 2 years.

Typically, AMOSC manage the Core-Group re-validation/training by conducting 3 x 1 week Core-Group training/workshops per year.

AMOSC coordinates the routine testing, monitoring and monthly reporting of Core-Group personnel availability.

5.2.2 OSRL Arrangements

Shell maintains a contract with OSRL. This provides all Shell global companies, including Shell Australia, with access to OSRL's additional IMT capability.

The OSRL service level statements provides for:

- 24/7 call-out arrangements.
- Guaranteed initial response from OSRL of 5 technical support personnel (IMT or field personnel) for 5 days.
- Surge to 18 OSRL personnel, upon request from the Shell IMT
- Depending on size/complexity, OSRL maintain 80 response team personnel globally, who are potentially able to be provided to support an ongoing Level 3 event, on a best-endeavours basis.

OSRL service level statement defines the types of services provided by the 18 person surge capability as:

- Technical advice and incident management coaching within the command centre.
- Development of an Incident Management Plan.
- Tier 1 / 2 equipment readiness and training of contractors.
- In-country logistics planning and support for inbound equipment.
- Impact assessment and advice on response strategy selection.



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- SCAT and aerial surveillance / quantification surveys.
- Tactical response planning.

5.3 IMT capability

Titleholder will generally maintain the in-house capability to fulfill all of the key roles expected to be needed in an oil spill, however, where specialist functions and additional resources are required, Titleholder will call upon the OSRO's and Shells Global Response Support Network (GRSN) to complete certain tasks or fulfil specific functions within the IMT.

Titleholder's general IMT structures are presented in Figure 5-1 and Figure 5-2. Titleholder's IMT structure would be amended, as required, to address the spill response scenario, depending on the nature and scale of the event. This includes the incorporation of OSRO and GRSN IMT personnel within the Titleholder IMT, and in support of other external agencies (e.g. WA DoT during a cross-jurisdiction response, as required).

Table 5-1 presents an analysis of the total IMT capability requirement, using the IMT personnel numbers defined in Table 4-2, and the additional personnel requirements defined in Table 4-3 for WA cross-jurisdiction response arrangements. The peak IMT capability column in Table 5-1 includes 1.5 x multiplication factor (rounded up to whole number), to account for a 2 week-on, 1 week-off shift arrangement. Table 5-1 also defines where the IMT personnel will be sourced, either via the Titleholder IMT or GRSN and OSRO capabilities.

Table 5-2 presents a high level overview of the responsibilities between the Titleholder IMT and OSRO personnel as related to each spill response strategy.

Figure 5-3 presents an indicative/example IMT resourcing curve, demonstrating how the Titleholder and OSRO resources could be utilised to fulfill the IMT personnel requirements. Note, the numbers presented represent the combined day-shift and night-shift, over a 5 day ramp-up only.

The initial 24 hours would be dominated by Titleholder and a small contingent of AMOSC and possibly OSRL (if required). As the IMT capability increases over the coming days, more of the OSRO support can be brought into the IMT, to facilitate the rotation of Titleholder IMT personnel in and out of the IMT (commencing two week-on and one week-off rotations).



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Table 5-1: Titleholder and External Support IMT capability requirements

Function	Total IMT Capability requirement	Titleholder IMT Capability	Titleholder IMT Personnel requirements*	OSRO or GRSN Capability requirement	OSRO/GRSN personnel requirement
Control Leadership Function /	6	Provided by Titleholder IMT Leaders.	5-8	Additional/supporting capability provided as required.	1
Liaison Function	3	Provided by Titleholder IMT/CMT Leaders.	3	Support not expected to be required.	0
Safety Function	5	Provided by Titleholder IMT Health & Safety personnel.	5-8	Support not expected to be required.	0
Media & Public Affairs Function	5	Provided the Titleholder External Affairs/Joint Venture (EA/JV) Function.	5-8	Support not expected to be required.	0
Operations Function	5	Provided by Titleholder IMT Operations Function Leads.	5-8	Additional/supporting capability provided as required.	0
Operations Marine Function	6	Provided by Titleholder IMT Operations Function personnel.	3	Additional/supporting capability provided as required.	3
Operations Aviation Function	6	Some capability provided by Titleholder IMT Operations Function personnel.	3	Majority of capability provided by OSRO (only if FWAD capability activated).	3



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Operations Shoreline Response Function	6	Not provided by Titleholder IMT.	0	Capability provided by OSRO.	6
Oiled Wildlife Response Function	3	Not provided by Titleholder IMT.	0	Capability provided by OSRO.	3
Planning Function	6	Provided by Titleholder IMT Planning Function Leads.	5-8	Support not expected to be required.	0
Environment Function (including OSTM and resources at risk)	6	Provided by Titleholder IMT Environment Function personnel.	5	Additional/supporting capability provided as required.	1
Shoreline Clean-up Assessment Technique Function	5	Not applicable.	0	Capability provided by OSRO.	5
Shoreline Response Programme Function	9	Not applicable.	0	Capability provided by OSRO.	9
Operational & Scientific	2	Provided by Titleholder IMT Environment Function personnel.	2	OSRO support not expected to be required.	0



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Monitoring Programme Function						
Situation Function (including common operating picture/GIS)	Unit	6	Provided by Titleholder IMT Situation Unit personnel.	5-8	Additional/supporting capability provided as required.	0
Logistics Function Lead		5	Provided by Titleholder IMT Logistics Function Leads.	5-8	Additional/supporting capability provided as required.	0
Logistics support		12	Provided by Titleholder IMT Logistics personnel.	6	Additional/supporting capability provided as required.	6
Finance and Admin Function		5	Provided by Titleholder IMT Finance and Admin Function personnel.	5-8	OSRO support not expected to be required.	0
TOTAL		103		62-86		37

*Range represents the target numbers maintained for each function/role within the IMT.



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Table 5-2: Titleholder and OSRO responsibilities for each response strategy

Response strategy	Titleholder IMT responsibilities	OSRO assistance tasks
Aerial surveillance	<p>IAP/operational tasking document development</p> <p>Provision of aerial surveillance platforms (rotary wing and fixed wing).</p> <p>Provision of aviation FOB.</p>	<p>Assist Titleholder IMT with IAP / operational tasking document development.</p> <p>Coordination of trained aerial observers (including AMOSC Core-Group and other industry mutual aid trained aerial observers).</p> <p>Review and interpretation of aerial surveillance reports.</p> <p>Communication of key aerial surveillance report information to Titleholder IMT Planning team.</p>
Vessel surveillance	<p>Identification and tasking of opportunistic vessel/facility surveillance platforms.</p>	<p>Review and interpretation of vessel/facility surveillance reports.</p> <p>Communication of key vessel surveillance report information to Titleholder IMT Planning team.</p>
OSTM	<p>Activate OSTM contractor through OSRO.</p> <p>Facilitate information flow between OSTM contractor and any other relevant organisations.</p>	<p>Assist Titleholder IMT with review of OSTM results, in consideration of resource protection priorities and response strategies selection (Operational SIMA).</p>
Satellite tracker buoys	<p>Activate satellite tracker buoy deployments.</p> <p>Access Titleholder tracker buoy data and provide to OSTM contractor.</p>	<p>Coordination of additional satellite tracker buoys from AMOSC or other mutual aid sources.</p> <p>Access AMOSC/other tracker buoy data and provide to OSTM contractor via Titleholder IMT.</p>
Satellite imagery	<p>Request satellite imagery acquisition via AMOSC, AMSA and/or OSRL.</p>	<p>Facilitate provision of satellite imagery from third-party satellite imagery providers.</p> <p>Assist with interpretation of the satellite imagery information, as related to response planning.</p>
Vessel Dispersant	<p>Authorise/activate initial vessel-based dispersant activities in field.</p>	<p>Provision of vessel dispersant re-supply stockpiles.</p>



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		Provision of ongoing operations support during vessel-based dispersant operations.
FWAD	Provision of FWAD air attack aircraft and SAR platform.	Provision of broader FWAD capability, and operational oversight of the FWAD activity.
SSDI	<p>Not applicable – managed by Source Control IMT, as SSDI is used by Titleholder as a safety control for other source control activities only.</p> <p>Water quality monitoring associated with SSDI is undertaken via the Titleholder OSMP, coordinated by the Titleholder IMT OSMP Function.</p>	Not applicable.
Source Control	<p>Source Control Branch (reporting to Operations within the IMT) has integral IMT roles embedded. These roles are responsible to the Source Control Branch Director, and to their parent IMT functions for SIMOPS. Once initiated, the Source Control Branch can activate a number of Task Forces, with Leads and support staff. The Task Force Leads report directly to the Source Control Branch Director together with the WC-VERT, SMEs, and IMT as applicable.</p>	Provision of specialist SME's for OSRO supplied equipment as required such as capping stacks or OIE.
At Sea Containment and Recovery	<p>Provision of support vessels with open/rolled stern, and other vessels as required.</p> <p>Overall supervision of at sea C&R activities.</p>	<p>Provision of C&R trained personnel.</p> <p>Provision of C&R equipment from OSRO stockpiles.</p> <p>Provide operational oversight of the in-field at sea C&R activities.</p>
SCAT	Not applicable.	<p>Support as requested by the relevant Control Agency.</p> <p>Provision of SCAT specialist.</p>



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Protection of Sensitive Resources	<p>Provision of labour-hire personnel for remote protection and deflection (P&D) activities.</p> <p>Support as requested by the relevant Control Agency.</p>	Provision of specialist P&D personnel.
OWR	Provision of labour-hire personnel for remote OWR activities.	<p>Provide OWR Function specialist personnel.</p> <p>Support as requested by the relevant Control Agency.</p> <p>Provision of labour-hire personnel for remote OWR activities.</p> <p>Provision of OWR equipment from OSRO stockpiles.</p>
Waste management	<p>Provision of logistical support (vessels) to transport waste from at sea or remote shoreline locations, to port.</p> <p>Provision of land-based licenced waste contractor capability for onshore treatment/disposal of oily waste.</p>	<p>Provision of planning advice regarding likely waste volumes likely to be generated.</p> <p>Provision of at sea and shoreline waste management equipment and consumables.</p>
Remote response support	<p>Provision of multiple small support vessels for remote SCAT activities.</p> <p>Provision of multiple floating remote response platforms for large remotes shoreline clean-up/OWR/P&D activities.</p>	Assist with selection of suitable vessels for remote response operations.



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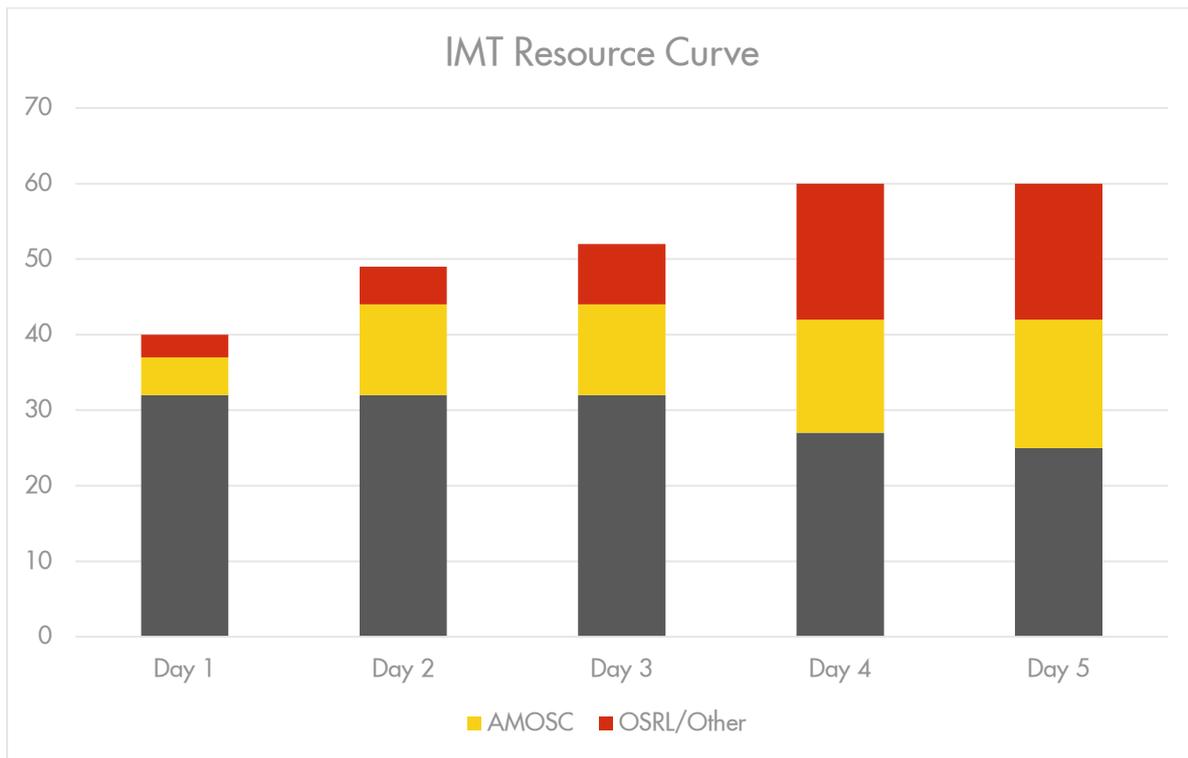


Figure 5-3: Indicative IMT resourcing curve

5.4 IMT training overview

Titleholder follows the approved ICS and IMO emergency management training requirement for ICS command and general staff. Specific competencies for ERT & IMT members are defined in the Shell Operational HSSE Competence Framework and Shell Australia Emergency Management Manual HSE_GEN_010996, which and are tracked in the Shell Open University. A summary of training requirements and core competencies for key ERT, IMT and CMT personnel are outlined in Table 5-3.

Only persons that have completed all mandatory training requirements can be placed on the IMT roster. Training status of IMT personnel is reviewed monthly (or following significant personnel or policy change by the SA Emergency Response Coordinator) and notifications issued in advance to personnel requiring re-validation by training and/or emergency response exercise participation.

Oil spill responder training requirements are outlined in Table 5-4.

Table 5-3: Exercise and Training Requirements for Key ERT, IMT and CMT Personnel

Key Roles	Exercises	Training
ERT Personnel OIM	Weekly muster alarm drill (may be combined with Level/Tier 1 exercise) 1 x Level/Tier 1 exercise per swing Level/Tier 2/3 exercise 6 monthly in accordance with 3 year exercise plan.	Some offshore roles may have AMOSC - IMO training. OIM – PMAWHS511 Manage Major Emergencies ERT Roles – PMAOMR 320 Manage Incident Response Information



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Key Roles	Exercises	Training
IMT Personnel IMT (W) Leader	It is required that 80% of personnel will participate in an IMT exercise annually.	All IMT personnel complete ICS 100, and IMT induction. IMT (W) leader undertakes - IMO3 Oil Spill Command & Control
Operations Section Chief (OSC) Planning Section Chief (PSC) Logistic Section Chief (LSC) Environment Unit Lead (EUL)	It is a target that 80% of personnel will participate in an IMT exercise annually. Participation in exercises is tracked in the Shell Australia Exercises & Training Schedule and is reviewed monthly or following significant personnel or policy change by the Shell Australia Emergency Response Coordinator.	AMOSC – IMO2 Oil Spill Management
<u>CMT Personnel</u>	Level/Tier 2/3 exercise on a biennial basis	Shell specific – Group Crisis training

Table 5-4: Oil Spill Responder Training and Resources

Key Roles	Exercises/Training	Available Resources
Shell AMOSC Core Group members	AMOSC Core Group Workshop (refresher training undertaken every 2 years) Operations stream and management stream	As defined in AMOSC contractual core group requirements
Prelude Facility ERT Personnel	Training as per Prelude Asset Training Strategy and Competence Management Plan (HRS_PRE_004622) Weekly muster alarm drill (may be combined with Level/Tier 1 exercise) 1 x Level/Tier 1 exercise per swing Level/Tier 2/3 exercise according to 3 year exercise plan (6 monthly). Level/Tier 2 and 3 exercises are planned and scheduled as per the Prelude Operations Desktop (ODT) portal.	1 per swing



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Key Roles	Exercises/Training	Available Resources
AMOSC Core Group Responders	AMOSC Core Group Workshop (refresher training undertaken every 2 years)	As defined in AMOSC contractual core group requirements
OSRL Oil Spill Response Personnel	As per OSRL training and competency matrix	As defined in OSRL Service Level Agreement
AMOSC Oil Spill Response Specialists	As per AMOSC training and competency matrix	As defined in AMOSC Master Services Agreement
Operational and Scientific Monitoring Service Providers	As defined in the Shell Australia Operational and Scientific Monitoring (OSM) Bridging Implementation Plan (HSE_PRE_16370).	As per Standby Capability and Competency Report
Oiled Wildlife Responders (Level 2-4) Shoreline clean-up personnel	As per DBCA OWR requirements (WA OWRRP) As per WA DoT requirements	As per OWR stateboard (AMOSC & DBCA) As defined in AMOSC Master Services and OSRL Service Level Agreements. Team members available through labour hire contracts (training provided prior to deployment)

Titleholder maintains an Exercise and Training Schedule as detailed in the Shell Australia Emergency Management Manual (HSE_GEN_010996) to ensure its competency in responding to and managing major incidents, including oil spills. The Exercise and Training Schedule is reviewed and revised (if required) annually.

As part of this schedule, Shell conducts a number of different exercise types, which are further described in Table 5-5.



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Table 5-5: Exercise Types, Objectives and Frequency

Exercise Type	Objective	Frequency
Notification exercise	To test all communication and notification processes to service providers and regulatory agencies defined within the OPEP	At least annually When OPEP is accepted or introduced When response arrangements have been significantly amended If a new location for the activity is added after the response arrangements have been tested
Equipment deployment exercises	To focus on Shell's deployment capability To inspect and maintain the condition of Shell's oil spill response equipment To maintain training of field response personnel	Level /Tier 1 – Annually Level/Tier 2 – Every 2 years
Tabletop exercise	To encourage interactive discussions of a simulated scenario amongst IMT members and refresh roles and responsibilities	As per Shell Australia's Exercise and Training Schedule
Incident Management Exercise	To activate IMT and establish command, control, and coordination of a simulated Level/Tier 2 or 3 incident and test response arrangements in OPEP	Minimum of one oil spill exercise per year for Shell Australia's activities. Where response arrangements are the same for a number of activity-specific OPEPs, one exercise may be used to test these response arrangements for these OPEPs at the same time
National Plan Exercises or WA DoT exercises	Participate as required to ensure alignment between National/State Response Framework and Shell Australia's Response Framework	As determined by AMSA and/or WA DoT, Shell may not be requested to participate every year
Shell Global Response Support Network (GRSN)	Test the functionality of Shell's Regional Core Group Level/Tier 3 oil spill response capabilities Target of 100% for participation of Shell Australia's Core Group	Annually Every 2 years



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Exercise Type	Objective	Frequency
	personnel in GRSN regional exercises as required.	
AMOSC Audit	To test deployment readiness and capability of AMOSC as per its Master Services Agreement with Shell	Annually
OSRL Audit	To test deployment readiness and capability of OSRL in Singapore as per OSRLs Service Level Agreement with Shell	Every 2 years

As part of the exercise process, a number of documents are prepared to ensure exercises are well planned, conducted and evaluated. To support this, the following documents are used:

- Exercise scope document – provides background context to the exercise, outlines the exercise need, aim, objectives, details of the scenario, participating groups and agencies, exercise deliverables and management structure. This document can be used to engage a third-party contractor to assist in conducting the exercise
- Exercise plan and instructions – provide instructions and ‘play’ (including any injects) for conducting the exercise
- Post exercise report – includes an after-action review of the exercise, evaluating how the exercise performed against meeting its aim and objectives.

5.4.1 Mechanism to examine the effectiveness of the testing and exercise arrangements against the objectives of testing

Titleholder routinely undertakes post-exercise debriefings following Level/Tier 2-3 OPEP exercises to evaluate effectiveness of response arrangements against the exercise objective/s, identify opportunities for improvement and communicate lessons learned. Shell sets Specific, Measurable, Achievable, Realistic and Timely (SMART) objectives for oil spill exercises so that they can be clearly evaluated as being met or not.

The assessor will make written findings and recommendations from the test for consideration by Shell to assist in identifying deficiencies with response arrangements and continually improve the overall response readiness of Shell.

Recommendations from the tests will have SMART actions put against them where appropriate and they will be tracked to closure in Shell’s Action Tracking System - Sphera. The Sphera system assigns a responsible person and due date against each action to ensure they are tracked to closure.



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6 References

Australian Petroleum Production and Exploration Association. 2021. Guidance Document; Incident Management Teams Knowledge Requirements for Responding to Marine Oil Spills. Prepared by APPEA in consultation with AMOSC. Perth. Australia. (In Prep).

WA DoT – see Department of Transport (WA)

WA DoT (2020) Offshore Petroleum Industry Guidance Note Marine Oil Pollution: Response and Consultation Arrangements. Revision 5. Prepared by WA DoT, Fremantle.

WA DoT. 2021. State Hazard Plan Maritime Environmental Emergencies. Prepared by WA Department of Transport. Approved by State Emergency Management Committee.

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Attachment 3

3 Strategic Spill Impact Mitigation Analysis (SIMA)

This Attachment includes four SIMA's including;

- Subsurface Spill – Condensate
- Surface Spill – Condensate
- Surface Spill – Intermediate Fuel Oil (IFO)/ Heavy Fuel Oil (HFO)
- Surface Spill – Marine Gas Oil (MGO)/Marine Diesel Oil (MDO)



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Resource Compartment (including values dependent on the resource compartment)	No Intervention (natural weathering)	A	Justification for Potential Relative Impact Score
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging within this habitat)</i>	Significant	4	Subtidal benthic primary producer habitat (BPPH) may be exposed to entrained and dissolved condensate above impact thresholds from a well-blowout 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). The consequence to benthic primary producer habitat is considered to be Significant.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	None / Insignificant	1	Deep water filter feeding communities (below photoic zone / 50m water depth), deep water EPBC species and KEFs are highly unlikely to be exposed to entrained and dissolved condensate, above impact thresholds (RPS 2019a) from a well-blowout in the Browse Basin. Note, below 100m, exposure above thresholds is not predicted to occur (RPS 2019a). If exposed above impact thresholds, hydrocarbons may cause chemical toxicity (i.e. lethal or sub-lethal effects, or impairing cellular functions) and ecological changes (i.e. losing key organisms then opportunistic species take over). Benthic marine invertebrates can take up oil via diffusion from dissolved oil, ingesting of contaminated food items and contact with contaminated sediment. Entrained/dissolved oil (including dispersed oil) affects the health of filter feeding communities, leading to potential accumulation (Law et al 2011) which makes them a poorer food source for higher trophic level organisms including deep water EPBC foraging species. The toxic fractions of oil can be detrimental to marine invertebrates as they are susceptible to its narcotic impacts due to their high surface to volume ratio, often resulting in outright mortality, as well as decreases in reproduction rates (Hook et al 2014), oxidative damage to macromolecules, altered lipid ratios, deleterious effects on embryo development (Lee et al 2004) and changes to community structure (CSIRO 2016). Filter feeding communities are commonly, but sparsely distributed, throughout the region and WA DoT (2018) note that they play an important role in purifying water and creating habitat. As entrained/dissolved hydrocarbons from a well blowout are expected to remain in the top 50m of the water column, the impact of an oil spill is not expected to cause any significant impact at a local or regional scale. As such, the consequence to deep sea features is considered to be Insignificant.
<i>Deep-sea unconsolidated muds and sands</i>	None / Insignificant	1	Species that inhabit or rely on deep-sea unconsolidated muds and sands are highly unlikely to be exposed to entrained and dissolved condensate above impact thresholds (RPS 2019a) from a well-blowout in the Browse Basin. Note, below 100m, exposure above thresholds is not predicted to occur (RPS 2019a). CSIRO (2016) notes that benthic marine invertebrates can take up oil via diffusion from dissolved oil, ingesting contaminated food and contact with contaminated sediment. Small invertebrates (micro and meiofauna) are considered very susceptible to the narcotic impact of oil due to their high surface to volume ratio, often resulting in outright mortality, as well as decreases in reproduction rates (Hook et al 2014). Further deleterious effects to invertebrate embryo development result from exposure to sediments affected by entrained and dissolved oil (Lee et al 2004). Montagna et al (2013) state that after the Deepwater Horizon blowout, biodiversity loss resulted in the deep-sea sediments surrounding the wellhead (i.e. severe losses occurring within 3 km and losses due to elevated TPHs and PAHs up to 17 km away from the wellhead). However, as modelling (RPS 2019a) of gas/condensate well blowouts in the Browse Basin are not expected to result in exposures above impact thresholds deeper than 50m, these types of impacts are not anticipated. Communities in the Browse Basin region are considered low in diversity and abundance, and generally common throughout the area. Large sand waves and local strong seabed currents exist in the area and are likely to move seasonally causing substrate instability that limits development of infaunal communities. Therefore, exposure to hydrocarbons above impact thresholds from a well blowout is not expected to occur at a local or regional scale. If any impacts occur, the area is expected to recover, though recovery times in the deep sea are generally slow due to the low levels of recruitment and slow growth of biota (Montagna et al 2013). The potential consequence is considered to be Insignificant.
Intertidal seabed			
<i>Intertidal Coral Reef</i>	Moderate	3	Intertidal coral reefs could be impacted by surface fresh, weathered, entrained and dissolved condensate from a well blow-out in the Browse Basin. The effect of condensate on intertidal coral is unlikely to result in significant smothering as condensate is expected to be weathered and in the form of wax flakes/residues when it arrives in intertidal coral areas. In this form, toxicity is less than fresh condensate (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 close to the permit area in isolated locations 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.
<i>Mangrove/Mudflats/Samphires</i>	Moderate	3	Mangrove, mudflats and samphire communities may be exposed to entrained/dissolved condensate above impact thresholds from a well-blowout in the Browse Basin. Given that mangroves are remote from permit areas, fresh or weathered condensate is 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 with a Moderate consequence.
<i>Sandy Beach</i>	Minor	2	Sandy beaches may be exposed to weathered waxy flakes and residues above impact thresholds in the event of a well-blowout 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.
<i>Rocky Shoreline</i>	Minor	2	Rocky shorelines may be exposed to weathered, entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. This receptor is typically characterised as being a high wind and wave energy environment (CSIRO 2016). Condensate 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 condensate (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.
<i>Macro-Algae and Seagrass</i>	Moderate	3	Macroalgae and seagrass may be exposed to entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. 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 condensate 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.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	Significant	4	Intertidal habitat may be exposed to weathered, entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. The effect of condensate 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, it is not expected that the overall population viability for any protected species would be threatened from a well blowout spill. The cumulative potential consequence is considered to be Significant.

Water column			
<i>Lower water column (below photic zone)</i>	Moderate	3	The lower water column may be exposed to entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. Note, below 100m, exposure above thresholds is not predicted to occur (RPS 2019a). EPBC species that use this habitat could be negatively impacted by entrained and dissolved oil including 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). In the Gulf of Mexico, Murawski et al (2014) found that spilled oiled resulted in an increased incidence of skin lesions in fish attributed to PAH. The lower water column has a high level of species diversity and endemism for demersal fish communities in the Browse Basin region, as cold nutrient-rich deep ocean current upwellings are found in canyon areas and attract fish aggregations, which in turn attract larger predatory fish, sharks, toothed whales and dolphins (DEWHA 2008). There is potential for short-to-medium term impacts on the environment from entrained and dissolved condensate, but it is not expected that the overall population viability for any protected species would be threatened. The potential consequence is considered to be Moderate.
<i>Upper water column (in photic zone, including plankton and EPBC foraging in the photic zone)</i>	Significant	4	The upper water column may be exposed to entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. 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. Whilst it is expected that the upper water column will recover with time, it is likely that there will be cumulative impacts such as bioaccumulation up the food chain. The consequence is considered to be Significant.
<i>Water surface, including foraging areas for EPBC listed species.</i>	Moderate	3	The water surface may be exposed to fresh and weathered surface condensate above impact thresholds from a well blowout in the Browse Basin. Fresh condensate 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 condensate. 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, 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, though there may be cumulative impacts through bioaccumulation up the food chain. The consequence is considered to be Moderate.
<i>Air</i>	Minor	2	Air may be exposed to fresh surface condensate above impact thresholds from a well blowout in the Browse Basin. RPS (2018 and 2019b) note that the ongoing nature of a condensate spill combined with the high potential for gas and oil to volatilize from the water surface 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			
<i>Commercial demersal fisheries</i>	Significant	4	Commercial demersal fisheries may be exposed to surface, weathered, entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. Note, below 100m, exposure above thresholds is not predicted to occur (RPS 2019a). The effect of condensate 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, and effects from a well blowout can vary depending on factors such as seasonal timing and natural fluctuations in species levels. Impacts to commercial demersal fisheries, shallower than 100m, are expected to be short to medium term. The real and perceived consequence is considered to be Significant.
<i>Shallow commercial fisheries (including aquaculture)</i>	Significant	4	Shallow commercial fisheries (including aquaculture) may be exposed to surface, weathered, entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. The effect of condensate 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, and effects from a well blowout can vary depending on factors such as seasonal timing and natural fluctuations in species levels. Impacts to shallow commercial fisheries (including aquaculture) are expected to be short to medium term. The real and perceived consequence is considered to be Significant.
<i>Recreational fisheries</i>	Minor	2	Recreational fisheries may be exposed to surface, weathered, entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. Note, below 100m, exposure above thresholds is not predicted to occur (RPS 2019a). The effect of condensate 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, and effects from a well blowout can vary depending on factors such as seasonal timing and natural fluctuations in species levels. Impacts to shallow recreational fisheries, shallower than 100m, are expected to be short to medium term. The real and perceived consequence is considered to be Minor.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	Minor	2	Floating condensate (which is not an adhesive oil and will rapidly evaporative) is unlikely to adhere to an offshore facility/vessel or require any post-spill cleaning. Some offshore production assets have shallow seawater intakes (hull mounted, or within <10m of ocean surface). Other facilities only have deep (>50m water depth) seawater intakes. Depending on the depth of the seawater intakes, entrained/dispersed condensate may be drawn into the intakes. Experience has shown that spill response and source control vessels/facilities associated with a large number of significant oil spills (including the 2010 Macondo/Gulf of Mexico oil spill), were exposed to significant entrained (including dispersed) oil, yet did not suffer from significant mechanical/operational issues associated with drawing entrained/dispersed oil in their internal seawater systems. Stakeholder consultation with Wild-Well, OSRL and AMOSC in 2021 has concluded that the exposure of offshore vessels/facilities to entrained/dispersed oil is unlikely to result in any significant risk to the facility. The only recommendation was for vessels/facilities to monitor, and if necessary, to conduct additional maintenance on internal seawater systems (e.g. monitor/clean the reverse-osmosis filters for potable water generation and heat-exchanger plates on cooling water systems), potentially resulting in the need for more frequent inspection/maintenance of desalination systems (reverse osmosis filters) and cooling water systems (heat exchanger plates). Given there will be entrained condensate in the shallow water column from a subsea release, the consequence is considered to be Minor.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	Minor	2	Aboriginal heritage including special places, cultural landscapes, practices and fishing/foraging along the Kimberley and NT coastline may be impacted by surface and weathered condensate above impact thresholds from a well blowout in the Browse Basin. The effect of surface condensate 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 and the potential for recovery is expected to be short to medium term and the receptor is generally remote from any potential well blow-out location. The consequence is considered to be Minor.
<i>Indonesian traditional fishing</i>	Significant	4	Indonesian traditional fishing may be impacted by weathered, entrained and dissolved condensate above impact thresholds from a well blowout in the Browse Basin. 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 condensate on these receptor could include reduction and contamination of target species such as sea cucumbers (bêche-de-mer), trochus (top shell snail), reef fish and sharks. Exclusion zones during the spill response may also affect access to fishing locations, even if the target species are not affected by the condensate. This receptor is considered to be important, and effects from a well blowout can vary depending on factors such as seasonal timing and natural fluctuations in species levels. Impacts are expected to be short to medium term. The real and perceived consequence is considered to be Significant.

HSE_GEN_016764 - Spill Impact Mitigation Assessment - Long duration Subsea Condensate Release / Well Blowout

Overall statement of likelihood of success of At Sea 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. skimming and pumping oil into temporary storage) (IPIECA 2015).

Type of slick: Surface oil is in the form of Group I floating slicks which have a low viscosity and rapidly spread into a thin sheen. Surface oil concentrations will be up to approximately 10 g/m² (~0.01mm, which equates to Bonn code 1/2) for up to approximately 250 kilometres from the spill site and weathered oil concentrations reduce down to below 1 g/m² up to approximately 1000 km from the spill site (RPS 2021).

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/m² (>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). Condensate spills from a well blowout would be unlikely to surface at >100g/m², and would rapidly evaporate and spread upon surfacing, resulting in very thin surface slicks making this technique inefficient and impractical (IPIECA 2017). Where there is any significant condensate 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 I spill.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	C&R occurs on the surface and has no impact on entrained oil affecting deep sea features.
<i>Deep-sea unconsolidated muds and sands</i>	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			
<i>Intertidal Coral Reef</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction of surface/floating oil and no effect on entrained oil at the spill location, thus resulting in no change to the amount of oil reaching the intertidal/shoreline zones.
<i>Mangrove/Mudflats/Samphires</i>	No or insignificant alteration of impact	0	
<i>Sandy Beach</i>	No or insignificant alteration of impact	0	
<i>Rocky Shoreline</i>	No or insignificant alteration of impact	0	
<i>Macro-Algae and Seagrass</i>	No or insignificant alteration of impact	0	
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	No or insignificant alteration of impact	0	
Water column			
<i>Lower water column (below photic zone)</i>	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.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	C&R occurs on the surface and would result in an insignificant reduction in condensate on the surface which could potentially become entrained in the future. Therefore C&R would result in no reduction in the volume of entrained oil affecting the upper water column.
<i>Water surface</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction of surface/floating oil on the water surface due to inability of booms and skimmers to recover very thin slicks.
<i>Air</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction of oil on surface, and therefore no significant change to the evaporation of oil into the local atmosphere. VOC concentrations at locations where fresh oil slicks are present would likely be above safe exposure levels. Collection of condensate on vessels would likely result in further increase in exposure of workers to high concentrations of VOCs, above safe exposure levels.
Socio-economic			
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to demersal fish communities.
<i>Shallow commercial fisheries (including aquaculture)</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to shallow commercial fisheries including aquaculture.
<i>Recreational fisheries</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to recreational fishing areas.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to offshore facilities.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to Aboriginal cultural heritage receptors.
<i>Indonesian traditional fishing</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to traditional fishing areas.

HSE_GEN_016764 - Spill Impact Mitigation Assessment - Long duration Subsea Condensate Release / Well Blowout

Overall statement of likelihood of success of Protect of Sensitive Resources (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 condensate 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 I oil films and no effect against subsurface entrained plumes (ITOPF 2011). Generally oil needs to be >100 g/m² (>0.1mm, which equates to Bonn Code 4/5) to feasibly corral oil with a boom (O'Brien 2002), as would be required for an oat sea containment and recovery response. However, P&D could feasibly work on lower concentration slicks, to prevent oil accumulating on a shoreline receptor. Condensate arriving on the ocean surface from a well-blowout is generally not predicted to appear in slicks >100 g/m², and would generally be <10 g/m². Even in a scenario where the best equipment is available, shoreline P&D 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 P&D 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 P&D operations 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/Bonaparte 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 protect offshore island 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 and outer Kimberley/NT 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 I 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 P&D at these locations. There would also be potential for significant damage to mangrove root-systems, if conducting P&D in mangrove environments. Any accumulated weathered condensate on rocky shorelines and sandy beaches will likely rapidly natural weather/degrade, due to generally high/very high temperatures and UV exposure in the region. As a result of the above mentioned factors, P&D would be unlikely to result in any significant deflection or recovery of Group I condensate, or tangible environmental benefit, at remote intertidal/shoreline habitats.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
Subtidal Benthic Communities		B	
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	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.
<i>Deep-sea unconsolidated muds and sands</i>	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			
<i>Intertidal Coral Reef</i>	Moderate additional impact	-2	Weathered condensate is generally non-adhesive and of low toxicity. P&D may divert some weathered condensate away from a receptor, however the weathered condensate would rapidly degrade due to heat and UV exposure in the Kimberley/NT coastline. Anchoring extensive boom arrays would most likely result in physical damage to subtidal and intertidal coral reefs.
<i>Mangrove/Mudflats/Samphires</i>	Minor additional impact	-1	Prevention of oil entering mangroves/samphires would be of benefit, however due to the thin surface slick, 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.
<i>Sandy Beach</i>	No or insignificant alteration of impact	0	Weathered condensate is generally non-adhesive and of low toxicity. P&D may divert some weathered condensate away from a receptor, however the weathered condensate would rapidly degrade due to heat and UV exposure in the Kimberley/NT coastline.
<i>Rocky Shoreline</i>	No or insignificant alteration of impact	0	Weathered condensate is generally non-adhesive and of low toxicity. P&D may divert some weathered condensate away from a receptor, however the weathered condensate would rapidly degrade due to heat and UV exposure in the Kimberley/NT coastline.
<i>Macro-Algae and Seagrass</i>	Minor additional impact	-1	Weathered condensate is generally non-adhesive and of low toxicity. P&D may divert some weathered condensate away from a receptor, however the weathered condensate would rapidly degrade due to heat and UV exposure in the Kimberley/NT coastline. Anchors/anchor chains would also most likely result in physical damage to seagrass / algal beds.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	Minor additional impact	-1	Weathered condensate is generally non-adhesive and of low toxicity. P&D may divert some weathered condensate away from a receptor, however the weathered condensate would rapidly degrade due to heat and UV exposure in the Kimberley/NT coastline. Additional impacts could also occur to sensitive habitats such as coral reefs and fragile low energy environments such as mangroves and mudflats. Therefore, additional impacts could occur to habitats which support protected species.
Water column			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	P&D does not reduce the amount of entrained oil affecting the lower water column.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	P&D does not reduce the amount of entrained oil affecting the upper water column.
<i>Water surface</i>	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.
<i>Air</i>	No or insignificant alteration of impact	0	P&D would only occur at shorelines remote from 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			
<i>Commercial demersal fisheries</i>	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.
<i>Shallow commercial fisheries (including aquaculture)</i>	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.
<i>Recreational fisheries</i>	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.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	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 offshore facilities.

Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	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.
<i>Indonesian traditional fishing</i>	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.

HSE_GEN_016764 - Spill Impact Mitigation Assessment - Long duration Subsea Condensate Release / Well Blowout

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 reaching remote shorelines will be in the form of thin floating slicks of weathered oil which could accumulate over time. Given the time to reach shorelines, a condensate spill is expected to have undergone several physical and biological weathering processes, such as photo oxidation and biodegradation. 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 I 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 I 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 I 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). ITOPIF (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. In addition, any accumulated weathered condensate on rocky shorelines and sandy beaches will likely rapidly natural weather/degrade, due to generally high/very high temperatures and UV exposure in the region.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	Shoreline clean-up will have no impact on entrained oil affecting filter feeding communities within subtidal areas.
<i>Deep-sea unconsolidated muds and sands</i>	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			
<i>Intertidal Coral Reef</i>	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 coral eco-system.
<i>Mangrove/Mudflats/Samphires</i>	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.
<i>Sandy Beach</i>	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.
<i>Rocky Shoreline</i>	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.
<i>Macro-Algae and Seagrass</i>	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.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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 condensate 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			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on entrained oil in the lower water column.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on entrained oil in the upper water column.
<i>Water surface</i>	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on thin surface slicks on the water surface.
<i>Air</i>	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			
<i>Commercial demersal fisheries</i>	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.
<i>Shallow commercial fisheries (including aquaculture)</i>	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.
<i>Recreational fisheries</i>	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.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0	There would be no reduction in entrained oil, resulting in no significant change to exposure to offshore facilities.

Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	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.
<i>Indonesian traditional fishing</i>	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.

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Overall statement of likelihood of success of Subsea Dispersant Injection:

Aim: Subsea dispersant injection (SSDI) involves using dispersant injection wands to inject dispersant into the oil/gas stream directly at the release location on the seabed. The dispersant will act to reduce the oil droplet sizes, resulting in an increase in oil entrainment in the water column. The reduction in oil droplet size will result in a reduction in oil arriving on the ocean surface, and therefore reducing the rates of evaporation, and subsequently reducing the local atmospheric concentration of Volatile Organic Carbon (VOC) around the release location (RPS 2019b).

Type of slick: Condensate (from a well-blowout) reaching the surface will form thin, patchy surface slicks within a few kilometers of the release location. Surface oil is in the form of Group I floating slicks which have a low viscosity and rapidly spread into a thin sheen. Surface oil concentrations will be up to approximately 10 g/m² (~0.01mm, which equates to Bonn code 1/2) for up to approximately 250 kilometres from the spill site and weathered oil concentrations reduce down to below 1 g/m² up to approximately 1000 km from the spill site (RPS 2021). Under very light wind conditions, weathering curves predict that up to 80% of the oil would evaporate. The remaining ~20% entraining in the top 3m of the water column, with a small fraction (<10%) undergoing biological degradation over time. With increasing wind conditions (>6 knots), a higher proportion of oil would become entrained, reducing the rates of evaporation and associated VOC exposure to the atmosphere (RPS 2019b).

Likely success/effectiveness against slick: Atmospheric modelling (RPS 2019b) of several worst-case well-blowout scenarios indicates that VOC concentrations would routinely be expected to exceed the 500 ppm VOC 15 minute short-term exposure threshold, resulting in the shut-down of any vessel activities near the well blowout location. This VOC risk would therefore potentially stop 'source control' activities, such as debris clearance or capping stack installation, potentially prolonging the duration of a well blowout and associated slicks and entrained oils. If SSDI were used during a well blow-out, for the time that SSDI was applied, modelling (RPS 2019b) indicates the rates of entrainment would increase and rates of evaporation would decrease. During light wind conditions, ~70% of the condensate would entrain in the shallow water column (top 3m), with evaporation (and associated atmospheric VOC exposure) reducing to ~30%. Under increased wind conditions (>6 knots), evaporation becomes close to zero (RPS 2019b). Therefore SSDI will cause a reduction in atmospheric VOC concentration, enabling a safe debris clearance/capping stack installation. Any impacts associated with the use of SSDI to achieve a successful well-kill using a capping stack are offset by the significant reduction in the overall duration of the blow-out (and net reduction in entrained hydrocarbons) compared to a relief well-kill scenario. The increase in entrainment from SSDI is similar to normal levels of entrainment expected to occur under higher wind conditions, and the effects of increased entrainment due to SSDI are partially offset due to a reduction in oil droplet size, resulting in a significant increase in biodegradation rates (up to 50%).

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score	Justification for Impact Modification Score	
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	No or insignificant alteration of impact	0	SSDI may result in a minor increase in entrained oil concentration in the shallow water column, therefore potentially exposing BPHH to increased entrained hydrocarbons, for the duration of SSDI use. However, any instantaneous increase in impact is likely offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	SSDI will not result in any increase in entrained hydrocarbons reaching deep water receptors.
<i>Deep-sea unconsolidated muds and sands</i>	No or insignificant alteration of impact	0	
Intertidal seabed			
<i>Intertidal Coral Reef</i>	No or insignificant alteration of impact	0	SSDI may result in a minor increase in entrained oil concentration in the shallow water column, therefore potentially exposing intertidal coral reef to increased entrained hydrocarbons for the duration of SSDI use. However, any instantaneous increase in impact is likely offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used.
<i>Mangrove/Mudflats/Samphires</i>	No or insignificant alteration of impact	0	SSDI would result in a reduction in a minor increase in entrained oil concentration in the shallow water column, therefore potentially exposing mangroves, samphires etc to increased entrained hydrocarbons for the duration of SSDI use. However, any instantaneous increase in impact is likely offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used.
<i>Sandy Beach</i>	Minor mitigation of impact	1	SSDI would result in a reduction in increased entrainment for the duration that SSDI was used, reducing oil load on beaches, for the duration which SSDI was used.
<i>Rocky Shoreline</i>	Minor mitigation of impact	1	SSDI would result in a reduction in increased entrainment for the duration that SSDI was used, reducing oil load on rocky shorelines, for the duration which SSDI was used.
<i>Macro-Algae and Seagrass</i>	No or insignificant alteration of impact	0	SSDI may result in a minor increase in entrained oil concentration in the shallow water column, therefore potentially exposing macro-algae and seagrass to increased entrained hydrocarbons, for the duration that SSDI is used. However, any instantaneous increase in impact is likely offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	No or insignificant alteration of impact	0	SSDI may have a combination of positive and negative effects to intertidal seabed habitats. As a result, a 'no or insignificant alteration of impact' has been assigned for habitats important for protected species.
Water column			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	SSDI will not result in any increase in entrained hydrocarbons reaching deep water receptors.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	SSDI may result in a minor increase in entrained oil concentration in the shallow water column, therefore potentially exposing receptors to increased entrained hydrocarbons, for the duration that SSDI was used. However, any instantaneous increase in impact is likely offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used.
<i>Water surface</i>	Major mitigation of impact	3	SSDI would result in a very significant reduction in oil arriving on the surface, resulting in a significant reduction in exposure of wildlife using the ocean surface, for the days on which SSDI was used.
<i>Air</i>	Major mitigation of impact	3	SSDI would result in a very significant reduction in VOCs in the atmosphere, making it safer for air breathing animals, including marine fauna and humans conducting the source control activities, for the days on which SSDI was used.
Socio-economic			
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0	SSDI will not result in any increase in entrained hydrocarbons reaching deep water receptors.
<i>Shallow commercial fisheries (including aquaculture)</i>	No or insignificant alteration of impact	0	SSDI may result in increased entrained oil concentration in the shallow water column, therefore potentially exposing shallow commercial fisheries to increased entrained hydrocarbons, for the duration of SSDI use. However, any instantaneous increase in impact is likely offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used.
<i>Recreational fisheries</i>	No or insignificant alteration of impact	0	SSDI may result in increased entrained oil concentration in the shallow water column, therefore potentially exposing shallow recreational fisheries to increased entrained hydrocarbons, for the duration of SSDI use. However, any instantaneous increase in impact is likely offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0	SSDI may result in increased entrained oil concentration in the shallow water column, therefore potentially exposing offshore facilities with shallow seawater intakes to increased entrained hydrocarbons, for the duration of SSDI use. Exposed facilities may be required to conduct additional monitoring/maintenance of their internal seawater systems, however this would already likely be required, as exposure to elevated entrained condensate would already be occurring from any condensate well blowout.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0	As any SSDI application would occur within offshore waters, and as there would be significant oil already entrained from any well-blowout event, SSDI application over a short period of the overall blow-out would result in an insignificant change in dispersed oil reaching traditional Aboriginal areas of the Kimberley and NT coastline. In addition, any instantaneous increase in impact is likely offset by an overall reduction in the number of days which the well blowout occurs.
<i>Indonesian traditional fishing</i>	No or insignificant alteration of impact	0	SSDI may result in a minor increase in entrained oil concentration in the shallow water column, therefore potentially exposing shallow Indonesian traditional fisheries to increased entrained hydrocarbons, for the duration of SSDI use. However, any instantaneous increase in impact is likely offset by an overall reduction in the number of days which the well blowout occurs. Any impacts are also further offset due to the significant increase in biodegradation when SSDI is used.

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Overall statement of likelihood of success of Surface 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 I floating slicks which have low viscosity and rapidly spread into a thin sheen. Surface oil concentrations will be approximately 10 g/m² for up to 250 kilometres from the spill site and weathered oil concentrations reduce down to below 1 g/m² approximately 1000 km from the spill site (RPS 2021).

Likely success/effectiveness against slick: The National Research Council (2010) 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.

Generally oil slicks needs to be >100 g/m² (>0.1mm, which equates to Bonn code 4/5) to feasibly achieve a successfully dispersant operation. However condensate arriving on the ocean surface from a well-blowout will never appear in slicks >100 g/m², and would generally be <10 g/m². Where there are any significant condensate 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. During a well blow-out, significant volumes of oil/condensate would already be entrained, therefore surface dispersant application will result in further increases in entrained oil concentration. Therefore, surface dispersant application on a condensate slick would not be a safe or effective response strategy.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	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.
<i>Deep-sea unconsolidated muds and sands</i>	No or insignificant alteration of impact	0	
Intertidal seabed			
<i>Intertidal Coral Reef</i>	Minor additional impact	-1	Dispersant is generally considered ineffective at significantly increasing entrainment of thin sheens of condensate, 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.
<i>Mangrove/Mudflats/Samphires</i>	Minor additional impact	-1	
<i>Sandy Beach</i>	Minor additional impact	-1	
<i>Rocky Shoreline</i>	Minor additional impact	-1	
<i>Macro-Algae and Seagrass</i>	Minor additional impact	-1	
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	Minor additional impact	-1	
Water column			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	No oil reaching deep water locations, regardless of dispersant application on surface.
<i>Upper water column (in photic zone)</i>	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 condensate, 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.
<i>Water surface</i>	Minor additional impact	-1	
<i>Air</i>	No or insignificant alteration of impact	0	A very slight reduction in VOCs at the point of application of surface dispersant could occur, however it would not affect the broader local atmosphere of the area around the surfacing slick over time.
Socio-economic			
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0	No oil reaching deep water locations, including demersal fish habitat, regardless of chemical dispersant application on surface.
<i>Shallow commercial fisheries (including aquaculture)</i>	Minor additional impact	-1	Chemical dispersant and additional entrained oil would result in minor additional exposure of entrained condensate during a condensate well blowout, resulting in a minor increase in impacts to shallow commercial fisheries.
<i>Recreational fisheries</i>	Minor additional impact	-1	Chemical dispersant and additional entrained oil would result in minor additional exposure of entrained condensate during a condensate well blowout, resulting in a minor increase in impacts to recreational fisheries.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0	Due to the naturally high rates of entrainment of floating condensate, surface chemical dispersant application would be unlikely to result in any significant increase in the rates of entrainment, and therefore no change to risk to an offshore facility seawater intakes.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0	As any dispersant application would occur within offshore waters, and as there would be significant oil entrained from any well-blowout event, surface dispersant application would result in an insignificant change in dispersed oil reaching traditional Aboriginal areas of the Kimberley and NT coastline.
<i>Indonesian traditional fishing</i>	Minor additional impact	-1	Chemical dispersant and additional entrained oil would 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.

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Overall statement of likelihood of success of Pre-contact OWR (hazing and translocation):

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: Floating oil is in the form of Group I slicks which have a low viscosity and rapidly spread into a thin sheen. Slicks will be approximately 10 g/m² up to approximately 250 kilometres from the spill site. Weathered oil concentrations reduce down to below 1 g/m² up to approximately 1000 km from the spill site (RPS 2021). Group I 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 condensate 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 subsea condensate well blowout, 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			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Deep-sea unconsolidated muds and sands</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Intertidal seabed			
<i>Intertidal Coral Reef</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Mangrove/Mudflats/Samphires</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Sandy Beach</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Rocky Shoreline</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Macro-Algae and Seagrass</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Water surface</i>	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.
<i>Air</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Socio-economic			
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Shallow commercial fisheries (including aquaculture)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Recreational fisheries</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Indonesian traditional fishing</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.

HSE_GEN_016764 - Spill Impact Mitigation Assessment - Long duration Subsea Condensate Release / Well Blowout

Overall statement of likelihood of success of Post-contact OWR:

Aim: Post-contact oiled wildlife response involves capturing oiled wildlife - and if necessary, cleaning, rehabilitating and releasing them.

Type of slick: Floating oil is in the form of Group I floating slicks which have a low viscosity and rapidly spread into a thin sheen. Slicks will be approximately 10 g/m² up to approximately 170 kilometres from the spill site. Weathered oil concentrations reduce down to below 1 g/m² up to approximately 1000 km from the spill site (RPS 2021). Group I 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 & Michel 2014; Woodside 2014). Note that Group I 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			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Deep-sea unconsolidated muds and sands</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Intertidal seabed			
<i>Intertidal Coral Reef</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Mangrove/Mudflats/Samphires</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Sandy Beach</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Rocky Shoreline</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Macro-Algae and Seagrass</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Water surface</i>	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.
<i>Air</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Socio-economic			
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Shallow commercial fisheries (including aquaculture)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Recreational fisheries</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Indonesian traditional fishing</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.

HSE_GEN_016764 - Spill Impact Mitigation Assessment - Long duration Subsea Condensate Release / Well Blowout

Overall statement of likelihood of success of Controlled In-situ Burning (ISB):

Aim: In-situ 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: Floating oil is in the form of Group I floating slicks which have a low viscosity and rapidly spread into a thin sheen. Slicks will be approximately 10 g/m² up to approximately 250 kilometres from the spill site, reducing to weathered oil below 1 g/m² up to approximately 1000 km from the spill site (RPS 2021).

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 I 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/m²) is required to be present. In the case of a well blowout, the surface slick is not expected to meet the required thickness (i.e. only 10 g/m² 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 condensate spill.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>			
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>			
<i>Deep-sea unconsolidated muds and sands</i>			
Intertidal seabed			
<i>Intertidal Coral Reef</i>			
<i>Mangrove/Mudflats/Samphires</i>			
<i>Sandy Beach</i>			
<i>Rocky Shoreline</i>			
<i>Macro-Algae and Seagrass</i>			
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>			
Water column			
<i>Lower water column (below photic zone)</i>			
<i>Upper water column (in photic zone)</i>			
<i>Water surface</i>			
<i>Air</i>			
Socio-economic			
<i>Commercial demersal fisheries</i>			
<i>Shallow commercial fisheries (including aquaculture)</i>			
<i>Recreational fisheries</i>			
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>			
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>			
<i>Indonesian traditional fishing</i>			

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on Assessment - Long duration Sub

None / Insignificant	1
Minor	2
Moderate	3
Significant	4

Reponse Strategy Score

Major additional impact	-3
Moderate additional impact	-2
Minor additional impact	-1
No or insignificant alteration of impact	0
Minor mitigation of impact	1
Moderate mitigation of impact	2
Major mitigation of impact	3

Resource Compartment (including values dependent on the resource compartment)	No intervention (natural weathering)	Justification for Potential Relative Impact Score
Subtidal Benthic Communities		A
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging within this habitat)</i>	Moderate	3 Subtidal benthic primary producer habitat (BPPH) may be exposed to entrained and dissolved condensate above impact thresholds from a surface release 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). The consequence to benthic primary producer habitat is considered to be Significant.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	None / Insignificant	1 Filter feeding communities, deep water EPBC species and KEFs would have only a remote likelihood of being exposed to entrained and dissolved condensate, above impact thresholds from a surface release of condensate. The depth of entrained oil from a surface spill is generally restricted to the top 30 m of the water column, with the highest percentage of entrained oil in the top 10 m of the water column. Hydrocarbons may cause chemical toxicity (i.e. lethal or sub-lethal effects, or impairing cellular functions) and ecological changes (i.e. losing key organisms then opportunistic species take over). Benthic marine invertebrates can take up oil via diffusion from dissolved oil, ingesting of contaminated food items and contact with contaminated sediment. Entrained/dissolved oil (including dispersed oil) affects the health of filter feeding communities, leading to potential accumulation (Law et al 2011) which makes them a poorer food source for higher trophic level organisms including deep water EPBC foraging species. The toxic fractions of oil can be detrimental to marine invertebrates as they are susceptible to its narcotic impacts due to their high surface to volume ratio, often resulting in outright mortality, as well as decreases in reproduction rates (Hook et al 2014), oxidative damage to macromolecules, altered lipid ratios, deleterious effects on embryo development (Lee et al 2004) and changes to community structure (CSIRO 2016). Filter feeding communities are commonly, but sparsely distributed, throughout the region and WA DoT (2018) note that they play an important role in purifying water and creating habitat. The consequence of a surface condensate spill to deep sea features is considered to be Insignificant.
<i>Deep-sea unconsolidated muds and sands</i>	None / Insignificant	1 Species that inhabit or rely on deep-sea unconsolidated muds and sands would have only a remote likelihood of being exposed to entrained and dissolved condensate, above impact thresholds from a surface release of condensate. The depth of entrained oil from a surface spill is generally restricted to the top 30 m of the water column, with the highest percentage of entrained oil in the top 10 m of the water column. CSIRO (2016) notes that benthic marine invertebrates can take up oil via diffusion from dissolved oil, ingesting contaminated food and contact with contaminated sediment. Small invertebrates (micro and meiofauna) are considered very susceptible to the narcotic impact of oil due to their high surface to volume ratio, often resulting in outright mortality, as well as decreases in reproduction rates (Hook et al 2014). Further deleterious effects to invertebrate embryo development result from exposure to sediments affected by entrained and dissolved oil (Lee et al 2004). Communities in the Browse Basin region are considered low in diversity and abundance, but generally common throughout the area. Large sand waves and local strong seabed currents exist in the area and are likely to move seasonally causing substrate instability that limits development of infaunal communities. The area is expected to recover, though recovery times in the deep sea are generally slow due to the low levels of recruitment and slow growth of biota (Montagna et al 2013). The potential consequence of a surface condensate spill to deep sea unconsolidated sands and muds is considered to be Insignificant.
Intertidal seabed		
<i>Intertidal Coral Reef</i>	Moderate	3 Intertidal coral reefs could be impacted by surface fresh, weathered, entrained and dissolved condensate from a surface release in the Browse Basin. The effect of condensate on intertidal coral is unlikely to result in significant smothering as condensate is expected to be weathered and in the form of wax flakes/residues when it arrives in intertidal coral areas. In this form, toxicity is less than fresh condensate (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 close to the permit areas in isolated locations 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.
<i>Mangrove/Mudflat/Samphires</i>	Moderate	3 Mangrove, mudflats and samphire communities may be exposed to entrained/dissolved condensate above impact thresholds from a surface condensate release in the Browse Basin. Given that mangroves are remote from permit areas, fresh or weathered condensate is 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 with a Moderate consequence.
<i>Sandy Beach</i>	Minor	2 Sandy beaches may be exposed to weathered wax flakes and residues above impact thresholds from a surface release 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 2009). 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.
<i>Rocky Shoreline</i>	Minor	2 Rocky shorelines may be exposed to weathered, entrained and dissolved condensate above impact thresholds from a surface release in the Browse Basin. This receptor is typically characterised as being a high wind and wave energy environment (CSIRO 2016). Condensate 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 condensate (Law et al 2011). CSIRO (2016) note that rocky shorelines are not considered sensitive environments, and IPECA (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.
<i>Macro-Algae and Seagrass</i>	Moderate	3 Macroalgae and seagrass may be exposed to entrained and dissolved condensate above impact thresholds from a surface release in the Browse Basin. This receptor is unlikely to come into contact with significant amounts of fresh floating surface hydrocarbons, but could potentially be exposed to weathered wax 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 condensate 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.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	Significant	4 Intertidal habitat may be exposed to weathered, entrained and dissolved condensate above impact thresholds from a surface release in the Browse Basin. The effect of condensate 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. IPECA (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 (IPECA 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 (IPECA 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 (Jensen 1994; Malcott et al. 2019) or ingested a weathered wax flakes/residues present on shorelines. There is the potential for short to medium term impacts; however, it is not expected that the overall population viability for any protected species would be threatened from a surface release. The cumulative potential consequence is considered to be Significant.

Water column			
<i>Lower water column (below photic zone)</i>	None / Insignificant	1	The lower water column would be highly unlikely to be exposed to entrained and dissolved condensate above impact thresholds from a surface release in the Browse Basin. EPBC species that use this habitat could be negatively impacted by entrained and dissolved oil including 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). In the Gulf of Mexico, Muralwski et al (2014) found that spilled oil resulted in an increased incidence of skin lesions in fish attributed to PAH. The lower water column has a high level of species diversity and endemism for demersal fish communities in the Browse Basin region, as cold nutrient-rich deep ocean current upwellings are found in canyon areas and attract fish aggregations, which in turn attract larger predatory fish, sharks, toothed whales and dolphins (DEWHA 2008). Given a surface release is highly unlikely to result in entrained/dissolved oil reaching the deep/lower water column above impact thresholds, there is very low likelihood of short-to-medium term impacts on the environment from entrained and dissolved condensate. Overall population viability for any protected species would not be threatened. The potential consequence is considered to be Insignificant.
<i>Upper water column (in photic zone, including plankton and EPBC foraging in the photic zone)</i>	Significant	4	The upper water column may be exposed to entrained and dissolved condensate above impact thresholds from a surface release in the Browse Basin. 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 BIA for marine fauna are present in the Browse Basin. Whilst it is expected that the upper water column will recover with time, it is likely that there will be cumulative impacts such as bioaccumulation up the food chain. The consequence is considered to be Significant.
<i>Water surface, including foraging areas for EPBC listed species.</i>	Moderate	3	The water surface may be exposed to fresh and weathered surface condensate above impact thresholds from a surface release in the Browse Basin. Fresh condensate 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 condensate. Spilled hydrocarbons may also foul the fibres of baleen whales impairing food gathering efficiency or fouling grey 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 (IPECA 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; Jensen 1994; IPECA 2014; ITOFF 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 (Jensen 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, though there may be cumulative impacts through bioaccumulation up the food chain. The consequence is considered to be Moderate.
<i>Air</i>	Minor	2	Air may be exposed to fresh surface condensate above impact thresholds from a surface release in the Browse Basin. Due to the high evaporation rate of condensate at the water surface, there is a high probability of 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			
<i>Commercial demersal fisheries</i>	Minor	2	Commercial demersal fisheries may, but are unlikely (due to shallow depths of entrainment from a surface spill), to be exposed to surface, weathered, entrained and dissolved condensate above impact thresholds from a surface release in the Browse Basin. The effect of condensate 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 (ITOFF 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, and effects from a spill can vary depending on factors such as seasonal timing and natural fluctuations in species levels. Due to the shallow depths of entrainment from a surface spill, contact and associated impacts to commercial demersal fisheries (if any) is expected to be highly localised, and short to medium term. The real and perceived consequence is considered to be Minor.
<i>Shallow commercial fisheries (including aquaculture)</i>	Moderate	3	Shallow commercial fisheries (including aquaculture) may be exposed to surface, weathered, entrained and dissolved condensate above impact thresholds from a surface release in the Browse Basin. The effect of condensate 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 (ITOFF 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 trachurus 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, and effects from a surface release can vary depending on factors such as seasonal timing and natural fluctuations in species levels. Impacts to shallow commercial fisheries (including aquaculture) are expected to be short to medium term. The real and perceived consequence is considered to be Moderate.
<i>Recreational fisheries</i>	Minor	2	Recreational fisheries may be exposed to surface, weathered, entrained and dissolved condensate above impact thresholds from a surface release in the Browse Basin. The effect of condensate on this receptor includes negatively impacting nets and lines (ITOFF 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, and effects from a surface release can vary depending on factors such as seasonal timing and natural fluctuations in species levels. Impacts to shallow recreational fisheries are expected to be short to medium term. The real and perceived consequence is considered to be Minor.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	Minor	2	Floating condensate (which is not an adhesive oil and will rapidly evaporate) is unlikely to adhere to an offshore facility/vessel or require any post-spill cleaning. Some offshore production assets have shallow seawater intakes (hull mounted, or within <10m of ocean surface). Other facilities only have deep (>50m water depth) seawater intakes. Depending on the depth of the seawater intakes, entrained/dispersed condensate may be drawn into the intakes. Experience has shown that spill response and source control vessels/facilities associated with a large number of significant oil spills (including the 2010 Macondo/Gulf of Mexico oil spill), were exposed to significant entrained (including dispersed) oil, yet did not suffer from significant mechanical/operational issues associated with drawing entrained/dispersed oil in their internal seawater systems. Stakeholder consultation with Wild-Well, OSR and AMOSC in 2021 has concluded that the exposure of offshore vessels/facilities to entrained/dispersed oil is unlikely to result in any significant risk to the facility. The only recommendation was for vessels/facilities to monitor, and if necessary, to conduct additional maintenance on internal seawater systems (e.g. monitor/clean the reverse-osmosis filters for potable water generation and heat-exchanger plates on cooling water systems), potentially resulting in the need for more frequent inspection/maintenance of desalination systems (reverse osmosis filters) and cooling water systems (heat exchanger plates). Due to rapid rates of entrainment of condensate into the shallow water column from any surface condensate spill, and therefore potential for some additional maintenance on seawater systems to be needed, the consequence is considered to be Minor.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	Minor	2	Aboriginal heritage including special places, cultural landscapes, practices and fishing/foraging along the Kimberley and NT coastline may be impacted by surface and weathered condensate above impact thresholds from a surface release in the Browse Basin. The effect of surface condensate 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 and the potential for surface is expected to be short to medium term and the receptor is generally remote from any potential surface release location. The consequence is considered to be Minor.
<i>Indonesian traditional fishing</i>	Moderate	3	Indonesian traditional fishing may be impacted by weathered, entrained and dissolved condensate above impact thresholds from a surface release in the Browse Basin. 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 condensate on these receptor could include reduction and contamination of target species such as sea cucumbers (bêche-de-mer), trochus (top shell snail), reef fish and sharks. Exclusion zones during the spill response may also affect access to fishing locations, even if the target species are not affected by the condensate. This receptor is considered to be important, and effects from a surface release can vary depending on factors such as seasonal timing and natural fluctuations in species levels. Impacts are expected to be short to medium term. The real and perceived consequence is considered to be Moderate.

At Sea Contain and Recovery

Overall statement of likelihood of success of At Sea 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. skimming and pumping oil into temporary storage) (IPECA 2015).

Type of slick: Surface oil reaching remote shorelines will be in the form of thin floating slicks of weathered condensate which could accumulate over time. Surface oil concentrations will be up to approximately 25 g/m² for up to 200 km, and weathered oil at 10 g/m² (~0.01mm, which equates to Bonn code 1/2) for up to 400 km and further reduced down to below 1 g/m² up to approximately 700 km from the spill site (RPS 2021). Due to the high evaporation rates from condensate, the condensate will rapidly weather, with high rates of evaporation of toxic fractions such as BTEX very early in the spill event. 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: 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/m² (~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 (JDOPF 2011). Condensate spills from a surface release in the open ocean would be unlikely to remain for a long duration at >100g/m², and would rapidly evaporate and spread, resulting in very thin surface slicks making this technique inefficient and impractical (IPECA 2017). Where there is any significant condensate 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 IPECA (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 1 spill.

Resource Compartment (including values dependent on the resource compartment)	Contain and Recovery - Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	C&R occurs on the surface and has no impact on entrained oil affecting deep sea features.
<i>Deep-sea unconsolidated muds and sands</i>	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			
<i>Intertidal Coral Reef</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction of surface/floating oil and no effect on entrained oil at the spill location, thus resulting in no change to the amount of oil reaching the intertidal/shoreline zones.
<i>Mangrove/Mudflats/Samphires</i>	No or insignificant alteration of impact	0	
<i>Sandy Beach</i>	No or insignificant alteration of impact	0	
<i>Rocks/Shoreline</i>	No or insignificant alteration of impact	0	
<i>Macro-Algae and Seagrass</i>	No or insignificant alteration of impact	0	
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	No or insignificant alteration of impact	0	
Water column			
<i>Lower water column (below photic zone)</i>	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.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	C&R occurs on the surface and would result in an insignificant reduction in condensate on the surface which could potentially become entrained in the future. Therefore C&R would result in no reduction in the volume of entrained oil affecting the upper water column.
<i>Water surface</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction of surface/floating oil on the water surface due to inability of booms and skimmers to recovery very thin slicks.
<i>Air</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction of oil on surface, and therefore no significant change to the evaporation of oil into the local atmosphere. VOC concentrations at locations where fresh oil slicks are present would likely be above safe exposure levels. Collection of condensate on vessels would likely result in further increase in exposure of workers to high concentrations of VOCs, above safe exposure levels.
Socio-economic			
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to demersal fish communities.
<i>Shallow commercial fisheries (including aquaculture)</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to shallow commercial fisheries including aquaculture.
<i>Recreational fisheries</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to recreational fishing areas.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to offshore facilities.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to Aboriginal cultural heritage receptors.
<i>Indonesian traditional fishing</i>	No or insignificant alteration of impact	0	C&R would result in an insignificant reduction in oil on surface, and no impact on entrained oil, resulting in no change to oil exposure to traditional fishing areas.

Protection of Sensitive Resources

Overall statement of likelihood of success of Protect of Sensitive Resources (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 condensate which could accumulate over time. Surface oil concentrations will be up to approximately 25 g/m² for up to 200 km, and weathered oil at 10 g/m² (<0.01mm, which equates to Bonn code 1/2) for up to 400 km and further reduced down to below 1 g/m² up to approximately 700 km from the spill site (RPS 2021). Due to the high evaporation rates from condensate, the condensate will rapidly weather, with high rates of evaporation of toxic fractions such as BTX very early in the spill event. 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 1 oil films and no effect against subsurface entrained plumes (ITOPF 2011). Generally oil needs to be >100 g/m² (<0.1mm, which equates to Bonn Code 4/5) to feasibly corral oil with a boom (O'Brien 2002), as would be required for an oat sea containment and recovery response. However, P&D could feasibly work on lower concentration slicks, to prevent oil accumulating on a shoreline receptor. A surface condensate spill not remain for a significant amount of time at >100 g/m², and would generally very rapidly spread to <10g/m². Even in a scenario where the best equipment is available, shoreline P&D 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 P&D 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 P&D operations 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/Bonaparte 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 offshore island 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 and outer Kimberley/NT 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 practical in intertidal zones. Most offshore island shorelines would be expected to 'self clean' any accumulated Group 1 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 P&D at these locations. There would also be potential for significant damage to mangrove root-systems, if conducting P&D in mangrove environments. Any accumulated weathered condensate on rocky shorelines and sandy beaches will likely rapidly natural weather/degrade, due to generally high/very high temperatures and UV exposure in the region. As a result of the above mentioned factors, P&D would be unlikely to result in any significant deflection or recovery of Group 1 condensate, or tangible environmental benefit, at remote intertidal/shoreline habitats.

Resource Compartment (including values dependent on the resource compartment)	Contain and Recovery - Impact Modification Score	Justification for Impact Modification Score	
	B		
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	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.
<i>Deep-sea unconsolidated muds and sands</i>	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			
<i>Intertidal Coral Reef</i>	Moderate additional impact	-2	Weathered condensate is generally non-adhesive and of low toxicity. P&D may divert some weathered condensate away from a receptor, however the weathered condensate would rapidly degrade due to heat and UV exposure in the Kimberley/NT coastline. Anchoring extensive boom arrays would most likely result in physical damage to subtidal and intertidal coral reefs.
<i>Mangrove/Mudflats/Samphires</i>	Minor additional impact	-1	Prevention of oil entering mangroves/samphires would be of benefit, however due to the thin surface slick, 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.
<i>Sandy Beach</i>	No or insignificant alteration of impact	0	Weathered condensate is generally non-adhesive and of low toxicity. P&D may divert some weathered condensate away from a receptor, however the weathered condensate would rapidly degrade due to heat and UV exposure in the Kimberley/NT coastline
<i>Rocky Shoreline</i>	No or insignificant alteration of impact	0	Weathered condensate is generally non-adhesive and of low toxicity. P&D may divert some weathered condensate away from a receptor, however the weathered condensate would rapidly degrade due to heat and UV exposure in the Kimberley/NT coastline
<i>Macro-Algae and Seagrass</i>	Minor additional impact	-1	Weathered condensate is generally non-adhesive and of low toxicity. P&D may divert some weathered condensate away from a receptor, however the weathered condensate would rapidly degrade due to heat and UV exposure in the Kimberley/NT coastline. Anchors/anchor chains would also most likely result in physical damage to seagrass / algal beds.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	Minor additional impact	-1	Weathered condensate is generally non-adhesive and of low toxicity. P&D may divert some weathered condensate away from a receptor, however the weathered condensate would rapidly degrade due to heat and UV exposure in the Kimberley/NT coastline. Additional impacts could also occur to sensitive habitats such as coral reefs and fragile low energy environments such as mangroves and mudflats. Therefore, additional impacts could occur to habitats which support protected species.
Water column			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	P&D does not reduce the amount of entrained oil affecting the lower water column.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	P&D does not reduce the amount of entrained oil affecting the upper water column.
<i>Water surface</i>	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.
<i>Air</i>	No or insignificant alteration of impact	0	
Socio-economic			
<i>Commercial demersal fisheries</i>	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.
<i>Shallow commercial fisheries (including aquaculture)</i>	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.
<i>Recreational fisheries</i>	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.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	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 offshore facilities.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	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.
<i>Indonesian traditional fishing</i>	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) (PIECA 2015).
Type of slick: Surface oil reaching remote shorelines will be in the form of thin floating slicks of weathered oil which could accumulate over time. Given the time to reach shorelines, a condensate spill is expected to have undergone several physical and biological weathering processes, such as photo oxidation and biodegradation. 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 1 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 (PIECA 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 1 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 1 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 (PIECA 2015). ITOFF (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. In addition, any accumulated weathered condensate on rocky shorelines and sandy beaches will likely rapidly natural weather/degrade, due to generally high/very high temperatures and UV exposure in the region.

Resource Compartment (including values dependent on the resource compartment)	Contain and Recovery - Impact Modification Score		Justification for Impact Modification Score
		8	
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	Shoreline clean-up will have no impact on entrained oil affecting filter feeding communities within subtidal areas.
<i>Deep-sea unconsolidated muds and sands</i>	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			
<i>Intertidal Coral Reef</i>	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 coral eco-system.
<i>Mangrove/Mudflats/Samphires</i>	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.
<i>Sandy Beach</i>	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.
<i>Rocky Shoreline</i>	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.
<i>Macro-Algae and Seagrass</i>	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.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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 condensate 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			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on entrained oil in the lower water column.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on entrained oil in the upper water column.
<i>Water surface</i>	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on thin surface slicks on the water surface.
<i>Air</i>	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			
<i>Commercial demersal fisheries</i>	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.
<i>Shallow commercial fisheries (including aquaculture)</i>	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.
<i>Recreational fisheries</i>	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.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drillina Rigs etc)</i>	Minor mitigation of impact	1	There would be no reduction in entrained oil, resulting in no significant change to exposure to offshore facilities.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	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.
<i>Indonesian traditional fishing</i>	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.

Surface Dispersants

Overall statement of likelihood of success of Surface Dispersants:

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 (PIECA 2015).

Type of slick: Surface oil reaching remote shorelines will be in the form of thin floating slicks of weathered condensate which could accumulate over time. Surface oil concentrations will be up to approximately 25 g/m² for up to 200 km, and weathered oil at 10 g/m² (~0.01mm, which equates to Bomm code 1/2) for up to 400 km and further reduced down to below 1 g/m² up to approximately 700 km from the spill site (RPS 2021). 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: The National Research Council (2010) 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 (PIECA 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 (PIECA 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/condensate which would become entrained as the sea-state changes.

Generally oil slicks needs to be >100 g/m² (>0.1mm, which equates to Bomm code 4/5) to feasibly achieve a successfully dispersant operation. However condensate from a surface release will be highly unlikely to appear in slicks >100 g/m², due to the rapid spreading properties of this oil, and would generally be <10 g/m². Where there are any significant condensate 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 condensate slick would not be a safe or effective response strategy.

Resource Compartment (including values dependent on the resource compartment)	Contain and Recovery - Impact Modification Score	Justification for Impact Modification Score
	B	
Subtidal Benthic Communities		
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	Minor additional impact	-1
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0
<i>Deep-sea unconsolidated muds and sands</i>	No or insignificant alteration of impact	0
Intertidal seabed		
<i>Intertidal Coral Reef</i>	Minor additional impact	-1
<i>Mangrove/Mudflats/Samphires</i>	Minor additional impact	-1
<i>Sandy Beach</i>	Minor additional impact	-1
<i>Rocky Shoreline</i>	Minor additional impact	-1
<i>Macro-Algae and Seagrass</i>	Minor additional impact	-1
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	Minor additional impact	-1
Water column		
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0
<i>Upper water column (in photic zone)</i>	Minor additional impact	-1
<i>Water surface</i>	Minor additional impact	-1
<i>Air</i>	No or insignificant alteration of impact	0
Socio-economic		
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0
<i>Shallow commercial fisheries (including aquaculture)</i>	Minor additional impact	-1
<i>Recreational fisheries</i>	Minor additional impact	-1
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0
Cultural heritage		
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0
<i>Indonesian traditional fishing</i>	Minor additional impact	-1

Pre-Contact Oiled Wildlife Response (Hazing and Translocation/Displacement)

Overall statement of likelihood of success of Pre-Contact OWR (hazing and translocation):

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. 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 (IPECA 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 (IPECA 2017).

Type of slick: Floating oil is in the form of Group I slicks which have a low viscosity and rapidly spread into a thin sheen. Surface oil reaching remote shorelines will be in the form of thin floating slicks of weathered condensate which could accumulate over time. Surface oil concentrations will be up to approximately 25 g/m² for up to 200 km, and weathered oil at 10 g/m² ("0.01mm, which equates to Bonn code 1/2) for up to 400 km and further reduced down to below 1 g/m² up to approximately 700 km from the spill site (BPS 2021). Due to the high evaporation rates from condensate, the condensate will rapidly weather, with high rates of evaporation of toxic fractions such as BTEX very early in the spill event. Group I 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). Note that Group I 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: 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 condensate and vessel masters will not approach the source of the spill, or fresh areas of slick; 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 surface condensate release, 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, IPECA (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. (IPECA 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 (Picher 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 Browne 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)	Contain and Recovery - Impact Modification Score	Justification for Impact Modification Score
	B	
Subtidal Benthic Communities		
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	No or insignificant alteration of impact	0
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0
<i>Deep-sea unconsolidated muds and sands</i>	No or insignificant alteration of impact	0
Intertidal seabed		
<i>Intertidal Coral Reef</i>	No or insignificant alteration of impact	0
<i>Mangrove/Mudflats/Samphires</i>	No or insignificant alteration of impact	0
<i>Sandy Beach</i>	No or insignificant alteration of impact	0
<i>Rocky Shoreline</i>	No or insignificant alteration of impact	0
<i>Macro-Algae and Seagrass</i>	No or insignificant alteration of impact	0
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	Minor mitigation of impact	1
<i>Water column</i>		
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0
<i>Water surface</i>	No or insignificant alteration of impact	0
<i>Air</i>	No or insignificant alteration of impact	0
Socio-economic		
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0
<i>Shallow commercial fisheries (including aquaculture)</i>	No or insignificant alteration of impact	0
<i>Recreational fisheries</i>	No or insignificant alteration of impact	0
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0
Cultural heritage		
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0
<i>Indonesian traditional fishing</i>	No or insignificant alteration of impact	0

Post Contact Oiled Wildlife Response

Overall statement of likelihood of success of Post-Contact OWR:

Aim: Post-contact oiled wildlife response involves capturing oiled wildlife - and if necessary, cleaning, rehabilitating and releasing them.

Type of slick: Floating oil is in the form of Group 1 slicks which have a low viscosity and rapidly spread into a thin sheen. Surface oil reaching remote shorelines will be in the form of thin floating slicks of weathered condensate which could accumulate over time. Surface oil concentrations will be up to approximately 25 g/m² for up to 200 km, and weathered oil at 10 g/m² (~0.01mm, which equates to Bonn code 1/2) for up to 400 km and further reduced down to below 1 g/m² up to approximately 700 km from the spill site (RPS 2021). Due to the high evaporation rates from condensate, the condensate will rapidly weather, with high rates of evaporation of toxic fractions such as BTEX very early in the spill event. Group 1 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). Note that Group 1 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; Coxall 1977; Ohlendorf et al. 1978; Chapman, 1981; Ford et al., 1982; Samuels and Lanfear, 1982; Varoujan 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)	Contain and Recovery - Impact Modification Score	Justification for impact Modification Score	
	B		
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Deep-sea unconsolidated muds and sands</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Intertidal seabed			
<i>Intertidal Coral Reef</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Manarova/Mudflats/Samphires</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Sandy Beach</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Rocky Shoreline</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Macro-Algae and Seagrass</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Water surface</i>	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.
<i>Air</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Socio-economic			
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Shallow commercial fisheries (including aquaculture)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Recreational fisheries</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drillings Rigs etc)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Indonesian traditional fishing</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.

Controlled In-situ Burning

Overall statement of likelihood of success of Controlled In-Situ Burning (ISB):

Aim: In-situ 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: Floating oil is in the form of Group 1 floating slicks which have a low viscosity and rapidly spread into a thin sheen. Slicks will be approximately 10 g/m² up to approximately 400 kilometres from the spill site, reducing to weathered oil below 1 g/m² up to approximately 700 km from the spill site (RPS 2021).

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 1 burn residue will cause smothering as this generally only occurs for heavier grades (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/m²) is required to be present. In the case of a surface condensate release, the surface slick is not expected to meet the required thickness (i.e. only 100 - 10 g/m² 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 surface condensate spill.

Resource Compartment (including values dependent on the resource compartment)	Contain and Recovery - Impact Modification Score	Justification for Impact Modification Score
	B	
Subtidal Benthic Communities		
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>		
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>		
<i>Deep-sea unconsolidated muds and sands</i>		
Intertidal seabed		
<i>Intertidal Coral Reef</i>		
<i>Mangrove/Mudflats/Samphires</i>		
<i>Sandy Beach</i>		
<i>Rocky Shoreline</i>		
<i>Macro-Algae and Seagrass</i>		
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>		
Water column		
<i>Lower water column (below photic zone)</i>		
<i>Upper water column (in photic zone)</i>		
<i>Water surface</i>		
<i>Air</i>		
Socio-economic		
<i>Commercial demersal fisheries</i>		
<i>Shallow commercial fisheries (including aquaculture)</i>		
<i>Recreational fisheries</i>		
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>		
Cultural heritage		
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>		
<i>Indonesian traditional fishing</i>		

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No Intervention	
None / Insignificant	1
Minor	2
Moderate	3
Significant	4

Reponse Strategy Score	
Major additional impact	-3
Moderate additional impact	-2
Minor additional impact	-1
No or insignificant alteration of impact	0
Minor mitigation of impact	1
Moderate mitigation of impact	2
Major mitigation of impact	3

HSE_GEN_016764 - Spill Impact Mitigation Assessment - Instantaneous IFO/HFO Surface Release

Revision	0.1
Date	22/07/2022

Location	Browse Region including adjacent WA/NT shorelines	Spill Scenario	Vessel Collision 776m3 IFO/HFO Spill
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Resource Compartment (including values dependent on the resource compartment)	SIMA Stage 2: Predict Outcomes		SIMA Stage 3: Balance Trade-Offs - Impact Modification Factors												Controlled In-situ Burning	Surveillance, Monitoring and Visualisation (SMV)
	Potential Relative Impact		Prediction of the effectiveness and impact modification potential of the response options													
	No Intervention (natural weathering)	A	At Sea Contain and Recover		Protect of Sensitive Resources		Shoreline Clean-up		Surface Dispersant		Pre-Contact Oiled Wildlife Response (Hazing & Translocation)		Post Contact Oiled Wildlife Response			
			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																
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging within this habitat)</i>	None / Insignificant	1	1	1	0	0	0	0	-1	-1	0	0	0	0		
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	None / Insignificant	1	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Deep-sea unconsolidated muds and sands</i>	None / Insignificant	1	0	0	0	0	0	0	0	0	0	0	0	0		
Intertidal seabed																
<i>Intertidal Coral Reef</i>	Moderate	3	1	3	-1	-3	-1	-3	-1	-3	0	0	0	0		
<i>Mangrove/Mudflats/Samphires</i>	Minor	2	1	2	2	4	-1	-2	1	2	0	0	0	0		
<i>Sandy Beach</i>	Minor	2	1	2	1	2	2	4	1	2	0	0	0	0		
<i>Rocky Shoreline</i>	Minor	2	1	2	1	2	1	2	1	2	0	0	0	0		
<i>Macro-Algae and Seagrass</i>	Moderate	3	1	3	-1	-3	-1	-3	-1	-3	0	0	0	0		
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	Significant	4	1	4	2	8	2	8	2	8	1	4	1	4		
Water column																
<i>Lower water column (below photic zone)</i>	None / Insignificant	1	0	0	0	0	0	0	0	0	0	0	0	0		
<i>Upper water column (in photic zone, including plankton and EPBC foraging in the photic zone)</i>	Minor	2	1	2	0	0	0	0	-1	-2	0	0	0	0		
<i>Water surface, including foraging areas for EPBC listed species</i>	Moderate	3	1	3	0	0	0	0	2	6	0	0	1	3		
<i>Air</i>	None / Insignificant	1	0	0	0	0	0	0	0	0	0	0	0	0		
Socio-economic																
<i>Commercial demersal fisheries</i>	Moderate	3	0	0	0	1	3	0	0	0	0	0	0	0		
<i>Shallow commercial fisheries (including aquaculture)</i>	Moderate	3	1	3	0	0	1	3	-1	-3	0	0	0	0		
<i>Recreational fisheries</i>	Moderate	3	1	3	0	0	1	3	-1	-3	0	0	0	0		
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	None / Insignificant	1	1	1	0	0	0	0	-1	-1	0	0	0	0		
Cultural heritage																
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	None / Insignificant	1	0	0	0	1	1	0	0	0	0	0	0	0		
<i>Indonesian traditional fishing</i>	None / Insignificant	1	1	1	0	0	1	1	-1	-1	0	0	0	0		
	Total Impact Mitigation Score			30		10		17		3		4		7		-
	Carried to Field Capability Evaluation yes/no			Yes		Yes		Yes		Yes		Yes		Yes		No

Controlled In-Situ Burning is not considered to be safe, effective or feasible.

SMV is implemented under all oil spill scenarios

Resource Compartment (including values dependent on the resource compartment)	No intervention (natural weathering)	A	Justification for Potential Relative Impact Score
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging within this habitat)</i>	None / Insignificant	1	Subtidal benthic primary producer habitat (BPPH) are unlikely to be exposed to entrained/dissolved IFO/HFO above impact thresholds from a vessel collision in the Browse Basin. HFO will result in insignificant entrained/dissolved hydrocarbon. 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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	None / Insignificant	1	No impact from surface spill of IFO/HFO below 10m (RPS APASA 2014).
<i>Deep-sea unconsolidated muds and sands</i>	None / Insignificant	1	No impact from surface spill of IFO/HFO below 10m (RPS APASA 2014).
Intertidal seabed			
<i>Intertidal Coral Reef</i>	Moderate	3	Intertidal coral reefs could be impacted by surface fresh, weathered/emulsified, but very limited (if any) entrained and dissolved hydrocarbons 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.
<i>Mangrove/Mudflats/Samphires</i>	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.
<i>Sandy Beach</i>	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.
<i>Rocky Shoreline</i>	Minor	2	Rocky shorelines may be exposed 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.
<i>Macro-Algae and Seagrass</i>	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.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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			
<i>Lower water column (below photic zone)</i>	None / Insignificant	1	No impact from surface spill of IFO/HFO below 10m (RPS 2014).
<i>Upper water column (in photic zone, including plankton and EPBC foraging in the photic zone)</i>	Minor	2	The upper water column may be exposed to entrained and dissolved hydrocarbons above impact thresholds from a vessel collision in the Browse Basin. HFO will result in no exposure above impact thresholds for entrained/dissolved 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.
<i>Water surface, including foraging areas for EPBC listed species</i>	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 (PIECA 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; ITOFF 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.
<i>Air</i>	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			
<i>Commercial demersal fisheries</i>	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.
<i>Shallow commercial fisheries (including aquaculture)</i>	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.
<i>Recreational fisheries</i>	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.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	None / Insignificant	1	Floating oil is unlikely to pose any significant hazard to offshore oil and gas exploration and production facilities, other than potentially requiring cleaning from a hull at the end of a spill response. Some offshore production assets have shallow seawater intakes (hull mounted, or within <10m of ocean surface). Other facilities only have deep (>50m water depth) seawater intakes. Depending on the depth of the seawater intakes, entrained/dispersed oil may be drawn into the intakes. Experience has shown that spill response and source control vessels/facilities associated with a large number of significant oil spills (including the 2010 Macondo/Gulf of Mexico oil spill), were exposed to significant entrained (including dispersed) oil, yet did not suffer from significant mechanical/operational issues associated with drawing entrained/dispersed oil in their internal seawater systems. Stakeholder consultation with Wild-Wel, OSRL and AMOSC in 2021 has concluded that the exposure of offshore vessels/facilities to entrained/dispersed oil is unlikely to result in any significant risk to the facility. The only recommendation was for vessels/facilities to monitor, and if necessary, to conduct additional maintenance on internal seawater systems (e.g. monitor/clean the reverse-osmosis filters for potable water generation and heat-exchanger plates on cooling water systems), potentially resulting in the need for more frequent inspection/maintenance of desalination systems (reverse osmosis filters) and cooling water systems (heat exchanger plates). IFO/HFO spills do not rapidly entrain or dissolve into the water column. Therefore, any impact to offshore facilities from IFO/HFO floating oil is likely to be Insignificant.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	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.
<i>Indonesian traditional fishing</i>	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.

At Sea Containment and Recovery

Overall statement of likelihood of success of At Sea 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 (PIECA 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/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, RPS 2021). With increasing wind conditions, IFO and HFO will rapidly increase in viscosity 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 fractions 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, RPS 2021).

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/m² (>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/m² for a reasonable period of time, making C&R a practical option (PIECA 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. PIECA (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			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	C&R occurs on the surface and has no impact on entrained oil affecting deep sea features.
<i>Deep-sea unconsolidated muds and sands</i>	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			
<i>Intertidal Coral Reef</i>	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.
<i>Mangrove/Mudflats/Samphires</i>	Minor mitigation of impact	1	
<i>Sandy Beach</i>	Minor mitigation of impact	1	
<i>Rocky Shoreline</i>	Minor mitigation of impact	1	
<i>Macro-Algae and Seagrass</i>	Minor mitigation of impact	1	
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	Minor mitigation of impact	1	
Water column			
<i>Lower water column (below photic zone)</i>	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.
<i>Upper water column (in photic zone)</i>	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.
<i>Water surface</i>	Minor mitigation of impact	1	C&R may result in a minor (5-20%) reduction in localised surface oil.
<i>Air</i>	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			
<i>Commercial demersal fisheries</i>	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 watercolumn, however would resulting in no change to oil exposure to demersal fish communities.
<i>Shallow commercial fisheries (including aquaculture)</i>	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.
<i>Recreational fisheries</i>	Minor mitigation of impact	1	
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	Minor mitigation of impact	1	Due to the insignificant impact of floating IFO/HFO on an offshore facility, C&R will not result in a significant reduction to an already minor effect of floating oil against a facility hull. It may result in slightly reduced post spill cleaning, if significant volumes of oil are prevented from contacting the facility. However over time, natural weathering and UV exposure will result in gradual degradation of any IFO/HFO stuck to facility at the waterline.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	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.
<i>Traditional Indonesian fishing</i>	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 of Sensitive Resources

Overall statement of likelihood of success of Protect of Sensitive Resources (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 (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/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, RPS 2021). With increasing wind conditions, IFO and HFO will rapidly increase in viscosity 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 fractions 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, RPS 2021).

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/m² (>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/m². 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			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	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.
<i>Deep-sea unconsolidated muds and sands</i>	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			
<i>Intertidal Coral Reef</i>	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.
<i>Mangrove/Mudflats/Samphires</i>	Moderate mitigation of impact	2	P&D is a proven method of preventing or reducing 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.
<i>Sandy Beach</i>	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.
<i>Rocky Shoreline</i>	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.
<i>Macro-Algae and Seagrass</i>	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-algae.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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 especially the case for receptors where a creek-mouth can be easily boomed to protect a large area of important habitat further upstream.
Water column			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	P&D does not reduce the amount of entrained oil affecting the lower water column.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	P&D does not reduce the amount of entrained oil affecting the upper water column.
<i>Water surface</i>	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.
<i>Air</i>	No or insignificant alteration of impact	0	P&D would only occur at shorelines remote from 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			
<i>Commercial demersal fisheries</i>	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.
<i>Shallow commercial fisheries (including aquaculture)</i>	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.
<i>Recreational fisheries</i>	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.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	Minor mitigation of impact	1	Due to the insignificant impact of floating IFO/HFO on an offshore facility, P&D will not result in a significant reduction to an already minor effect of floating oil against a facility hull. It may result in slightly reduced post spill cleaning, if significant volumes of oil are prevented from contacting the facility. However over time, natural weathering and UV exposure will result in gradual degradation of any IFO/HFO stuck to facility at the waterline.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	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.
<i>Traditional Indonesian fishing</i>	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, RPS 2021). With increasing wind conditions, IFO and HFO will rapidly increase in viscosity 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 1 day, with total volumes of oil ashore up to approx 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 adhesiveness 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). ITOFF (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
Subtidal Benthic Communities	B	
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	0	Shoreline clean-up will have no impact on entrained oil in benthic primary producer habitat within subtidal areas.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	0	Shoreline clean-up will have no impact on entrained oil affecting filter feeding communities within subtidal areas.
<i>Deep-sea unconsolidated muds and sands</i>	0	Shoreline clean-up will have no impact on entrained oil affecting deep-sea unconsolidated muds and sands in subtidal areas.
Intertidal seabed		
<i>Intertidal Coral Reef</i>	-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.
<i>Mangrove/Mudflats/Samphires</i>	-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.
<i>Sandy Beach</i>	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.
<i>Rocky Shoreline</i>	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.
<i>Macro-Algae and Seagrass</i>	-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.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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		
<i>Lower water column (below photic zone)</i>	0	Shoreline clean-up will have insignificant impact on entrained oil in the lower water column.
<i>Upper water column (in photic zone)</i>	0	Shoreline clean-up will have insignificant impact on entrained oil in the upper water column.
<i>Water surface</i>	0	Shoreline clean-up will have insignificant impact on thin surface slicks on the water surface.
<i>Air</i>	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		
<i>Commercial demersal fisheries</i>	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.
<i>Shallow commercial fisheries (including aquaculture)</i>	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.
<i>Recreational fisheries</i>	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.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	0	Shoeline clean-up results in no change to impacts of IFO/HFO on a floating facility.
Cultural heritage		
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	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.
<i>Traditional Indonesian fishing</i>	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.

Surface Dispersants

Overall statement of likelihood of success of Surface Dispersants:

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 (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/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, RPS 2021). With increasing wind conditions, IFO and HFO will rapidly increase in viscosity 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 fractions 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, RPS 2021).

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/m² (>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 potentially 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) indicates 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 received oil concentration is observed. 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			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	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.
<i>Deep-sea unconsolidated muds and sands</i>	No or insignificant alteration of impact	0	
Intertidal seabed			
<i>Intertidal Coral Reef</i>	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.
<i>Mangrove/Mudflats/Samphires</i>	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.
<i>Sandy Beach</i>	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 potentially 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).
<i>Rocky Shoreline</i>	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 potentially less oil sticking to a rocky shoreline.
<i>Macro-Algae and Seagrass</i>	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.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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			
<i>Lower water column (below photoic zone)</i>	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.
<i>Upper water column (in photic zone)</i>	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.
<i>Water surface</i>	Moderate mitigation of impact	2	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, especially for EBPC species such as avifauna and turtles, when in the vicinity of fresh/thick slicks.
<i>Air</i>	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			
<i>Commercial demersal fisheries</i>	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.
<i>Shallow commercial fisheries (including aquaculture)</i>	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 commercial fisheries to increased entrained hydrocarbons.
<i>Recreational fisheries</i>	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.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	Minor additional impact	-1	Experience has shown that source control vessels/facilities associated with a large number of significant oil spills (including the 2010 Macondo/Gulf of Mexico oil spill), were exposed to significant entrained (including dispersed) oil, yet did not suffer from significant mechanical/operational issues associated with drawing entrained/dispersed oil in their internal seawater systems. Stakeholder consultation with Wild-Well, OSRL and AMOSC in 2021 has concluded that the exposure of offshore vessels/facilities to entrained/dispersed oil is unlikely to result in any significant risk to the facility. The only recommendation was for vessels/facilities to monitor, and if necessary, to conduct additional maintenance on internal seawater systems (e.g. monitor/clean the reverse-osmosis filters for potable water generation and heat-exchanger plates on cooling water systems). Therefore, dispersing IFO/HFO in close proximity to a vessel/facility with shallow seawater intakes may require some additional maintenance/cleaning of key components of these systems.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	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.
<i>Traditional Indonesian fishing</i>	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 Oiled 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, RPS 2021). With increasing wind conditions, IFO and HFO will rapidly increase in viscosity 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 1 day, with total volumes of oil ashore up to approx 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, including 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			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Deep-sea unconsolidated muds and sands</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Intertidal seabed			
<i>Intertidal Coral Reef</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Mangrove/Mudflats/Samphires</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Sandy Beach</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Rocky Shoreline</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Macro-Algae and Seagrass</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Water surface</i>	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.
<i>Air</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Socio-economic			
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Shallow commercial fisheries (including aquaculture)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Recreational fisheries</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0	Not relevant for pre-contact oiled wildlife response.
<i>Traditional Indonesian fishing</i>	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, RPS 2021). With increasing wind conditions, IFO and HFO will rapidly increase in viscosity 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 1 day, with total volumes of oil ashore up to approx 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			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Deep-sea unconsolidated muds and sands</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Intertidal seabed			
<i>Intertidal Coral Reef</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Mangrove/Mudflats/Samphires</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Sandy Beach</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Rocky Shoreline</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Macro-Algae and Seagrass</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Water surface</i>	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.
<i>Air</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Socio-economic			
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Shallow commercial fisheries (including aquaculture)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Recreational fisheries</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Traditional Indonesian fishing</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.

Controlled In-Situ Burning

Overall statement of likelihood of success of Controlled In-situ Burning (ISB):

Aim: In-situ 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 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, RPS 2021). With increasing wind conditions, IFO and HFO will rapidly increase in viscosity and emulsify (RPS 2014).

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 during certain seasons in the Timor Sea 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/m²) 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 unlikely 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 against a short-duration release IFO/HFO spill.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>			
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>			
<i>Deep-sea unconsolidated muds and sands</i>			
Intertidal seabed			
<i>Intertidal Coral Reef</i>			
<i>Mangrove/Mudflats/Samphires</i>			
<i>Sandy Beach</i>			
<i>Rocky Shoreline</i>			
<i>Macro-Algae and Seagrass</i>			
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>			
Water column			
<i>Lower water column (below photic zone)</i>			
<i>Upper water column (in photic zone)</i>			
<i>Water surface</i>			
<i>Air</i>			
Socio-economic			
<i>Commercial demersal fisheries</i>			
<i>Shallow commercial fisheries (including aquaculture)</i>			
<i>Recreational fisheries</i>			
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>			
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>			
<i>Traditional Indonesian fishing</i>			

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No Intervention		Reponse Strategy Score	
None / Insignificant	1	Major additional impact	-3
Minor	2	Moderate additional impact	-2
Moderate	3	Minor additional impact	-1
Significant	4	No or insignificant alteration of impact	0
		Minor mitigation of impact	1
		Moderate mitigation of impact	2
		Major mitigation of impact	3

Resource Compartment (including values dependent on the resource compartment)	No Intervention (natural weathering)	A	Justification for Potential Relative Impact Score
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging within this habitat)</i>	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 (2021b) modelling of a 250m3 MGO spill confirmed that dissolved oil exceeding the 100 ppb impact threshold could occur out to approximately 420km from the spill, and up to 45m down into the water column. Therefore, the consequence to benthic primary producer habitat is considered to be Moderate.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	None / Insignificant	1	No impact from surface spill of diesel below 45m (RPS 2021b).
<i>Deep-sea unconsolidated muds and sands</i>	None / Insignificant	1	No impact from surface spill of diesel below 45m (RPS 2021b).
Intertidal seabed			
<i>Intertidal Coral Reef</i>	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 (2021b) modelling of a 250 m3 MGO spill confirmed that entrained oil exceeding the 100 ppb impact threshold could occur out to approximately 420km from the spill, and up to 45m down into the water column. 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/Bonaparte Basins and extensively along the Kimberly coastline. Corals 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.
<i>Mangrove/Mudflats/Samphires</i>	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 (2021b) modelling of a 250m3 MGO spill confirmed that entrained oil exceeding the 100 ppb impact threshold could occur out to approximately 420km from the spill, and up to 45m down into the water column. Given that mangrove habitats are typically remote from permit areas, generally located along mainland shorelines, only weathered diesel (both surface and entrained) may 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 mangrove populations along mainland shorelines. 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.
<i>Sandy Beach</i>	Minor	2	Sandy beaches could be impacted by surface fresh, weathered, entrained and dissolved diesel from a vessel collision in the Browse Basin. RPS (2021b) modelling of a 250m3 MGO spill confirmed that shoreline accumulation concentrations exceeding 3000 g/m2, and volumes up to 50 m3 could accumulate on a single shoreline. 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 also extensive on mainland shorelines and nearshore islands. Sandy beaches 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, however inshore shorelines/beaches are often finer grained. 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.
<i>Rocky Shoreline</i>	Minor	2	Rocky shorelines could be impacted by surface fresh, weathered, entrained and dissolved diesel from a vessel collision in the Browse Basin. RPS (2021b) modelling of a 250m3 MGO spill confirmed that shoreline accumulation concentrations exceeding 3000 g/m2, and volumes up to 50 m3 could accumulate on a single shoreline (if the diesel spill occurred in close proximity to the receptor). 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.
<i>Macro-Algae and Seagrass</i>	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 (2021b) modelling of a 250m3 MGO spill confirmed that entrained oil exceeding the 100 ppb impact threshold could occur out to approximately 420km from the spill, and up to 45m down into the water column. Therefore, small proportions of the overall population of this receptor in the region may potentially be affected by entrained/dissolved hydrocarbons. 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). 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. However, 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 and 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). Therefore, the potential consequence is considered to be Minor.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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 (2021b) modelling of a 250m3 MGO spill confirmed that shoreline accumulation concentrations exceeding 3000 g/m2, and volumes up to 50 m3 could accumulate on a single shoreline (if the diesel spill occurred in close proximity to the receptor). The effect of diesel on intertidal habitats 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			
<i>Lower water column (below photic zone)</i>	None / Insignificant	1	No impact from surface spill of diesel below 45m (RPS 2021b).
<i>Upper water column (in photic zone, including plankton and EPBC foraging in the photic zone)</i>	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 (2021b) modelling of a 250m3 MGO spill confirmed that entrained oil exceeding the 100 ppb impact threshold could occur out to approximately 420km from the spill, and up to 45m down into the water column. 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.
<i>Water surface, including foraging areas for EPBC listed species</i>	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.
<i>Air</i>	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			
<i>Commercial demersal fisheries</i>	None / Insignificant	1	No impact to fish stocks deeper than 45 metres (RPS 2021b). 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 (2021b) modelling of a 250m3 MGO spill confirmed that entrained oil exceeding the 100 ppb impact threshold could occur out to approximately 420km from the spill, and up to 45m down into the water column. 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.
<i>Shallow commercial fisheries (including aquaculture)</i>	None / Insignificant	1	Shallow commercial fisheries including aquaculture (shallower than 45m, (RPS 2021b)) may be exposed to surface, weathered, entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. 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 general remoteness of the shallow commercial fishing areas and aquaculture to potential release locations. Therefore, the real and perceived consequence is considered to be Insignificant.
<i>Recreational fisheries</i>	None / Insignificant	1	Recreational fisheries (shallower than 45m, (RPS 2021b)) may be exposed to surface, weathered, entrained and dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. 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 areas of the region, 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 region 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, but still at very low levels of use. 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 areas of the region. The real and perceived consequence is considered to be Insignificant.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	Minor	2	Floating diesel (which is not a particularly adhesive oil and will rapidly evaporative) is unlikely to adhere to an offshore facility/vessel or require any post-spill cleaning. Some offshore production assets have shallow seawater intakes (hull mounted, or within <10m of ocean surface). Other facilities only have deep (>50m water depth) seawater intakes. Depending on the depth of the seawater intakes, entrained/dispersed condensate may be drawn into the intakes. Experience has shown that spill response and source control vessels/facilities associated with a large number of significant oil spills (including the 2010 Macondo/Gulf of Mexico oil spill), were exposed to significant entrained (including dispersed) oil, yet did not suffer from significant mechanical/operational issues associated with drawing entrained/dispersed oil in their internal seawater systems. Stakeholder consultation with Wild-Well, OSRL and AMOSC in 2021 has concluded that the exposure of offshore vessels/facilities to entrained/dispersed oil is unlikely to result in any significant risk to the facility. The only recommendation was for vessels/facilities to monitor, and if necessary, to conduct additional maintenance on internal seawater systems (e.g. monitor/clean the reverse-osmosis filters for potable water generation and heat-exchanger plates on cooling water systems), potentially resulting in the need for more frequent inspection/maintenance of desalination systems (reverse osmosis filters) and cooling water systems (heat exchanger plates). Given some diesel from a surface spill may entrain in the shallow water column, the consequence is considered to be Minor.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	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 impact, and the recovery is expected to be short to medium term. Therefore, consequence is considered to be Insignificant.
<i>Indonesian traditional fishing</i>	None / Insignificant	1	Indonesian traditional fishing areas shallower than 45m (RPS 2021b) may be exposed to fresh, weathered surface oil and entrained/dissolved diesel above impact thresholds from a vessel collision in the Browse Basin. 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.

At Sea Containment and Recovery

Overall statement of likelihood of success of At Sea 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 50 g/m² (Bonn code 3/4) for <2km from the spill location, 10 g/m² (~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/m² up to approximately 500 km from the spill site (RPS 2021a, RPS 2021b).

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/m² (>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 spreading of MGO 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/m² 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			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	No or insignificant alteration of impact	0	If successful, C&R theoretically could result in a minor reduction in localised surface oil. However due to rapid spreading, health and safety risks it is considered that there is no reasonable chance of significant volumes of oil recovery. Therefore, there would be no or insignificant alteration in the volume of future entrained oil entering the upper water column including submerged BBPH habitat.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	C&R occurs on the surface and has no impact on entrained oil affecting deep sea features.
<i>Deep-sea unconsolidated muds and sands</i>	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			
<i>Intertidal Coral Reef</i>	No or insignificant alteration of impact	0	If successful, C&R theoretically could result in a minor reduction on oil on surface. However due to rapid spreading, health and safety risks it is considered that there is no reasonable chance of significant volumes of oil recovery. Therefore, there would be no or insignificant alteration in the volume of surface and/or entrained oil reaching intertidal zones including BHHP habitats.
<i>Mangrove/Mudflats/Samphires</i>	No or insignificant alteration of impact	0	
<i>Sandy Beach</i>	No or insignificant alteration of impact	0	
<i>Rocky Shoreline</i>	No or insignificant alteration of impact	0	
<i>Macro-Algae and Seagrass</i>	No or insignificant alteration of impact	0	
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	No or insignificant alteration of impact	0	
Water column			
<i>Lower water column (below photic zone)</i>	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.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	If successful, C&R theoretically could result in a minor reduction in localised surface oil. However due to rapid spreading, health and safety risks it is considered that there is no reasonable chance of significant volumes of oil recovery. Therefore, there would be no or insignificant alteration of the volume of future entrained oil in the upper water column.
<i>Water surface</i>	No or insignificant alteration of impact	0	If successful, C&R theoretically could result in a minor reduction in localised surface oil. However due to rapid spreading, health and safety risks it is considered that there is no reasonable chance of significant volumes of oil recovery. Therefore, there would be no or insignificant alteration of impact.
<i>Air</i>	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			
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0	Commercial demersal fisheries are unlikely to be exposed to surface or shallow entrained diesel. Therefore surface C&R will have no or insignificant alteration of impact to demersal fisheries.
<i>Shallow commercial fisheries (including aquaculture)</i>	No or insignificant alteration of impact	0	If successful, C&R theoretically could result in a minor reduction in localised surface oil. However due to rapid spreading, health and safety risks it is considered that there is no reasonable chance of significant volumes of oil recovery. Therefore, there would be no or insignificant alteration of the volume of future entrained oil in the upper water column, including on shallow commercial and recreational fisheries.
<i>Recreational fisheries</i>	No or insignificant alteration of impact	0	
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0	If successful, C&R theoretically could result in a minor reduction in localised surface oil. However due to rapid spreading, health and safety risks it is considered that there is no reasonable chance of significant volumes of oil recovery. Therefore, there would be no or insignificant alteration of the volume of future entrained oil in the upper water column, or surface oil, impacting an offshore facility.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0	If successful, C&R theoretically could result in a minor reduction in localised surface oil. However due to rapid spreading, health and safety risks it is considered that there is no reasonable chance of significant volumes of oil recovery. Therefore, there would be no or insignificant alteration of the volume of surface and future entrained oil in the upper water column which may transit from Commonwealth waters, to reach Aboriginal heritage related sites in State/Territory waters.
<i>Traditional Indonesian fishing</i>	No or insignificant alteration of impact	0	If successful, C&R theoretically could result in a minor reduction in localised surface oil. However due to rapid spreading, health and safety risks it is considered that there is no reasonable chance of significant volumes of oil recovery. Therefore, there would be no or insignificant alteration of the volume of future entrained oil in the upper water column, including on shallow traditional Indonesian fishing sites.

Protect of Sensitive Resources

Overall statement of likelihood of success of Protect of Sensitive Resources (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/m² (>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/m². 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			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	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.
<i>Deep-sea unconsolidated muds and sands</i>	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			
<i>Intertidal Coral Reef</i>	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.
<i>Mangrove/Mudflats/Samphires</i>	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.
<i>Sandy Beach</i>	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.
<i>Rocky Shoreline</i>	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.
<i>Macro-Algae and Seagrass</i>	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.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	P&D does not reduce the amount of entrained oil affecting the lower water column.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	P&D does not reduce the amount of entrained oil affecting the upper water column.
<i>Water surface</i>	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.
<i>Air</i>	No or insignificant alteration of impact	0	P&D would only occur at shorelines remote from 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			
<i>Commercial demersal fisheries</i>	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.
<i>Shallow commercial fisheries (including aquaculture)</i>	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.
<i>Recreational fisheries</i>	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.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0	Offshore facilities are located geographically a long distance from sensitive shoreline habitats, where this response strategy would be undertaken. P&D would result in insignificant reduction in oil on surface or entrained oil, resulting in no change to oil exposure to offshore facilities.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	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.
<i>Traditional Indonesian fishing</i>	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			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	Shoreline clean-up will have no impact on entrained oil affecting filter feeding communities within subtidal areas.
<i>Deep-sea unconsolidated muds and sands</i>	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			
<i>Intertidal Coral Reef</i>	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.
<i>Mangrove/Mudflats/Samphires</i>	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.
<i>Sandy Beach</i>	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.
<i>Rocky Shoreline</i>	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.
<i>Macro-Algae and Seagrass</i>	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.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on entrained oil in the lower water column.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on entrained oil in the upper water column.
<i>Water surface</i>	No or insignificant alteration of impact	0	Shoreline clean-up will have insignificant impact on thin surface slicks on the water surface.
<i>Air</i>	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.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0	Shoreline clean-up not result in any change to impacts to offshore facilities.
Socio-economic			
<i>Commercial demersal fisheries</i>	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.
<i>Shallow commercial fisheries (including aquaculture)</i>	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.
<i>Recreational fisheries</i>	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			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	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.
<i>Traditional Indonesian fishing</i>	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.

Surface Dispersants

Overall statement of likelihood of success of Surface Dispersants:

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 50 g/m² (Bonn code 3/4) for <2km from the spill location, 10 g/m² up to approximately 160 km from the spill site and approximately 1 g/m² up to approximately 500 km from the spill site (RPS 2021a, RPS 2021b).

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/m² (>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/m². 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			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	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.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	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.
<i>Deep-sea unconsolidated muds and sands</i>	No or insignificant alteration of impact	0	
Intertidal seabed			
<i>Intertidal Coral Reef</i>	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.
<i>Mangrove/Mudflats/Samphires</i>	Minor additional impact	-1	
<i>Sandy Beach</i>	Minor additional impact	-1	
<i>Rocky Shoreline</i>	Minor additional impact	-1	
<i>Macro-Algae and Seagrass</i>	Minor additional impact	-1	
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	Minor additional impact	-1	
Water column			
<i>Lower water column (below photoic zone)</i>	No or insignificant alteration of impact	0	No oil reaching deep water locations, regardless of dispersant application on surface.
<i>Upper water column (in photic zone)</i>	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 negatve impacts, due to additional chemicals on the surface and in the shallow water column.
<i>Water surface</i>	Minor additional impact	-1	
<i>Air</i>	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			
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0	No oil reaching deep water locations, including demersal fish habitat, regardless of chemical dispersant application on surface.
<i>Shallow commercial fisheries (including aquaculture)</i>	Minor additional impact	-1	Chemical dispersant and additional entrained oil would result in negative impacts to shallow commercial fisheries.
<i>Recreational fisheries</i>	Minor additional impact	-1	Chemical dispersant and additional entrained oil would result in negative impacts to recreational fisheries.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	Minor additional impact	-1	Surface chemical dispersant applciation may result in a minor increased in entrained oil concentration in the shallow water column, therefore potentially exposing offshore facilities with shallow seawater intakes to increased entrained hydrocarbons, for the duration of surface chemical dispersant use. Exposed facilities may be required to conduct additional monitoring/maintenance of their internal seawater systems.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	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.
<i>Traditional Indonesian fishing</i>	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 50 g/m² (Bonn code 3/4) for <2km from the spill location, 10 g/m² up to approximately 160 km from the spill site and approximately 1 g/m² up to approximately 500 km from the spill site (RPS 2021a, RPS 2021b). 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		
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
<i>Deep-sea unconsolidated muds and sands</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
Intertidal seabed		
<i>Intertidal Coral Reef</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
<i>Mangrove/Mudflats/Samphires</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
<i>Sandy Beach</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
<i>Rocky Shoreline</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
<i>Macro-Algae and Seagrass</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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		
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
<i>Water surface</i>	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.
<i>Air</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
Socio-economic		
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
<i>Shallow commercial fisheries (including aquaculture)</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
<i>Recreational fisheries</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
Cultural heritage		
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0
		Not relevant for pre-contact oiled wildlife response.
<i>Traditional Indonesian fishing</i>	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 50 g/m² (Bonn code 3/4) for <2km from the spill location, 10 g/m² up to approximately 160 km from the spill site and approximately 1 g/m² up to approximately 500 km from the spill site (RPS 2021a, RPS 2021b). 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			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Deep-sea unconsolidated muds and sands</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Intertidal seabed			
<i>Intertidal Coral Reef</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Mangrove/Mudflats/Samphires</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Sandy Beach</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Rocky Shoreline</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Macro-Algae and Seagrass</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>	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			
<i>Lower water column (below photic zone)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Upper water column (in photic zone)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Water surface</i>	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.
<i>Air</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Socio-economic			
<i>Commercial demersal fisheries</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Shallow commercial fisheries (including aquaculture)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Recreational fisheries</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.
<i>Traditional Indonesian fishing</i>	No or insignificant alteration of impact	0	Not relevant for post-contact oiled wildlife response.

Controlled In-Situ Burning

Overall statement of likelihood of success of Controlled In-Situ Burning (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 50 g/m² (Bonn code 3/4) for <2km from the spill location, 10 g/m² up to approximately 160 km from the spill site and approximately 1 g/m² up to approximately 500 km from the spill site (RPS 2021a, RPS 2021b).

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, polycyclic aromatic 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/m²) 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/m² 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 large fresh diesel spill.

Resource Compartment (including values dependent on the resource compartment)	Impact Modification Score		Justification for Impact Modification Score
		B	
Subtidal Benthic Communities			
<i>Benthic primary producer habitat (coral, seagrass, macro-algae and shallow water EPBC species foraging areas)</i>			
<i>Deep-sea features (filter feeding communities, deep water EPBC species foraging areas and Key Ecological Features)</i>			
<i>Deep-sea unconsolidated muds and sands</i>			
Intertidal seabed			
<i>Intertidal Coral Reef</i>			
<i>Mangrove/Mudflats/Samphires</i>			
<i>Sandy Beach</i>			
<i>Rocky Shoreline</i>			
<i>Macro-Algae and Seagrass</i>			
<i>Intertidal habitat which is important habitat for protected species (nesting / roosting / foraging)</i>			
Water column			
<i>Lower water column (below photic zone)</i>			
<i>Upper water column (in photic zone)</i>			
<i>Water surface</i>			
<i>Air</i>			
Socio-economic			
<i>Commercial demersal fisheries</i>			
<i>Shallow commercial fisheries (including aquaculture)</i>			
<i>Recreational fisheries</i>			
<i>Offshore Oil and Gas Exploration and Production Facilities (Platforms, Drilling Rigs etc)</i>			
Cultural heritage			
<i>Aboriginal heritage (cultural practices, sites and fishing / foraging)</i>			
<i>Traditional Indonesian fishing</i>			

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No Intervention	
None / Insignificant	1
Minor	2
Moderate	3
Significant	4

Reponse Strategy Score	
Major additional impact	-3
Moderate additional impact	-2
Minor additional impact	-1
No or insignificant alteration of impact	0
Minor mitigation of impact	1
Moderate mitigation of impact	2
Major mitigation of impact	3