

Bayu-Undan to Darwin Gas Export Pipeline Oil Pollution Emergency Plan

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List of acronyms

Abbreviation	Description
AIMS	Australian Institute of Marine Science
AIS	automatic identification system
ALARP	as low as reasonably practicable
AMOSOC	Australian Marine Oil Spill Centre Pty Ltd
AMP	Australian Marine Park
AMSA	Australian Marine Safety Authority
APASA	Asia-Pacific Applied Sciences Associates
API	American Petroleum Institute
APPEA	Australian Petroleum Production & Exploration Association
BAOAC	Bonn Agreement Oil Appearance Codes
BP	Boiling Point
BRUV	Baited Remote Underwater Video
CMT	Crisis Management Team
CPP	Central Production and Processing Complex
CSR	company site representative
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEPWS	Department of Environment, Parks and Water Security
DFAT	Department of Foreign Affairs and Trade
DISR	Department of Industry, Science and Resources
DITT	Department of Industry, Tourism and Trade
DoT	Department of Transport
DPIRD	Department of Primary Industries and Regional Development
EMBA	environment that may be affected
EP	Environment Plan
EPA	Environmental Protection Authority
ER	emergency response
FOB	forward operating base
GIS	geographic information system
GPS	global positioning system
HMA	Hazard Management Agency
HR	human resources

Abbreviation	Description
IAP	Incident Action Plan
ICC	incident command centre
IMMR	Inspection, Maintenance, Monitoring and Repair
IMT	Incident Management Team
IR	industrial relations
IRT	Incident Response Team
LOWC	loss of well control
MARPOL	International Convention for the Prevention of Pollution from Ships
MDO	Marine Diesel Oil
MCT	Monitoring Coordination Team
MEECC	Maritime Environmental Emergency Coordination Centre
MEER	Maritime Environmental Emergency Response
MEVA	Moderate exposure value area
MGO	Marine Gas Oil
MNES	matters of national environmental significance
MODU	mobile offshore drilling unit
MoU	Memorandum of Understanding
MSA	Master Services Agreement
MSP	monitoring service providers
NEBA	net environmental benefit analysis
NOPSEMA	National Offshore Petroleum Safety and Environment Management Authority
NT	Northern Territory
NT IC	Northern Territory Incident Controller
NT IMT	Northern Territory Incident Management Team
NTOWRP	Northern Territory Oiled Wildlife Response Plan
OPEP	Oil Pollution Emergency Plan
OPGGS(E) Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OSC	On-Scene Commander
OSCP	Oil Spill Contingency Plan
OSRO	Oil Spill Response Organisation
OSRL	Oil Spill Response Limited
OSTM	oil spill trajectory modelling
OWR	oiled wildlife response

Abbreviation	Description
RCC	Rescue Coordination Centre
ROV	remotely operated vehicle
SCAT	Shoreline Clean-up Assessment Technique
SIMA	spill impact mitigation assessment
SMP	Scientific Monitoring Plans
SMPEP	Shipboard Marine Pollution Emergency Plan
SOPEP	Shipboard Oil Pollution Emergency Plans
SSIV	subsea isolation valve
TMPC	Territory Marine Pollution Coordinator
TRP	Tactical Response Plan
VOC	volatile organic compound
VOO	vessels of opportunity
VPO	Vice President Offshore Upstream WA
WA	Western Australia
WSP	waste service provider

1 Quick reference information

Parameter	Description			Further information
Petroleum Activity	Pipeline operation and preservation, vessel-based Inspection, Maintenance, Monitoring and Repair (IMMR) activities in the Timor Sea, Commonwealth and Northern Territory waters			Section 2 - Environment Plan (EP)
Location	The Pipeline extends from the downstream flange of the subsea isolation valve, located downstream of the Bayu-Undan Facility Central Production and Processing Complex to the beach valve at the shore crossing at Wickham Point, near Darwin			Figure 3-1 Section 2 - EP
Petroleum title/s (Blocks)	Timor-Leste offshore waters (pursuant to the Treaty): BU-1-PL (former Production Sharing Contracts JPDA 03-12); Australian Commonwealth waters: WA-8-PL and NT/PL1; NT waters: NTC/PL1 and PL20			N/A
Facilities/vessels	One primary vessel and at least one support vessel (maximum of three vessels in operational area at any one time)			
Water depth	Ranges from approximately 50 m to approximately 135 m			Section 3.2.1.2 - EP
Worst-case spill scenarios	Scenario	Hydrocarbon	Worst-case volume	Section 6.1
	Vessel collision resulting in a surface marine gas oil (MGO) or Marine Diesel Oil (MDO) release	MGO/MDO	187 m ³	
Hydrocarbon properties	MGO: Density at 15 °C = 830 kg/m ³ Dynamic viscosity = 4 cP @ 25 °C API Gravity = 36.4 Oil property classification = Group 2 - Light persistence (ITOPF, 2014)	MDO: Density at 25 °C = 829 kg/m ³ Dynamic viscosity = 4 cP @ 25 °C API Gravity = 37.6° Oil property classification = Group 2 - Light persistence (ITOPF, 2014)	Appendix A	
Weathering potential	MGO is highly dispersible and spreads thinly quickly; which increases the rate of evaporation. It has poor emulsification properties. Based on the boiling point ranges, approx. 16.4% is expected to evaporate within the first 12 hours (Boiling Point (BP) < 180 °C); a further 49% is expected to evaporate within the first 24 hours (180 °C < BP < 265 °C);	MDO is a mixture of volatile and persistent hydrocarbons with low viscosity. It will spread thinly quickly, thereby increasing the rate of evaporation. Up to 60% will generally evaporate over the first two days. Approximately 5% is considered 'persistent', which are unlikely to evaporate and will decay over time.	Appendix A	

Parameter	Description		Further information
	<p>and an additional 31.9% is expected to evaporate over several days (265 °C < BP < 380 °C). Approximately 2.7% (by mass) is considered persistent compounds and is unlikely to evaporate and will decay over time.</p>		
Protection priorities	<ul style="list-style-type: none"> + Tiwi Islands + Beagle Gulf – Darwin Coast + Vernon Islands + Offshore Banks and Shoals < 30 m depth + Oceanic Shoals Marine Park 		Section 6.5

2 First-strike response actions

The initial response actions to major oil spill incidents will be undertaken by the relevant Vessel Master or the Santos Company Site Representative. The On-scene Commander (OSC) is either the Santos Company Site Representative (if present) or the Vessel Master. This will be determined during the planning stages of the activity.

Following those initial actions undertaken by the OSC to ensure the safety of personnel on the vessel and to control the source of the spill, the OSC will assess the situation based on:

- + What has caused the spill?
- + Is the source under control?
- + What type of hydrocarbon has been spilled?
- + How much has been spilled?

For spills from vessels, initial response actions to major incidents are under the direction of the Vessel Master and in accordance with vessel-specific procedures (e.g. Shipboard Oil Pollution Emergency Plans (SOPEPS)).

Response information contained within this Oil Pollution Emergency Plan (OPEP) is concerned primarily with a large scale (Level 2) hydrocarbon spill where the Perth-based Incident Management Team (IMT) and Santos Crisis Management Team (CMT) are engaged for support and implementation of response strategies. Based on the nature and scale of the worst-case spill scenario for this activity, a Level 3 activation will not occur. Level 1 spills are managed through on-site response and IMT is available to assist with regulatory requirements/notifications and support as required. Therefore, the immediate response actions listed in **Table 2-1** are relevant for any spill. Once sufficient information is known about the spill, the Incident Commander will classify the level of the spill. If the spill is classified as a Level 1 spill, then the actions related to Level 2 spills do not apply, unless specified by the Incident Commander.

Table 2-1: First-strike activations

When (indicative)	Activations		Who
	Objective	Action	
All spills			
Immediate	Manage the safety of personnel	Implement site incident response procedures or vessel-specific procedures, as applicable	On-Scene Commander
Immediate	Control the source using site resources, where possible	Control the source using available on-site resources (vessel) Refer to source control plan – Section 9	On-Scene Commander
30 minutes of incident being identified	Notify Santos Offshore Duty Manager/Incident Commander	Verbal communication to Offshore Duty Manager/Incident Commander's duty phone	On-Scene Commander
As soon as practicable	Obtain as much information about the spill as possible	Provide as much information to the IMT (Incident Commander or delegate) as soon as possible	On-Scene Commander
60 minutes	Gain situational awareness and begin on-site spill surveillance	If spill reaches marine waters gain further situational awareness by undertaking surveillance of the spill from vessel Refer to Monitor and Evaluate Plan – Section 10	On-Scene Commander Incident Commander
Refer timeframes Go to Section 7	Make regulatory notifications within regulatory timeframes	Activate the External Notifications and Reporting Procedures – Section 7	Initial notifications by Environment Unit Leader/ Safety Officer –
Level 2 spills (in addition to actions above)			
Immediately once notified of spill (to Incident Commander)	Activate IMT, if required	Notify IMT	Offshore Duty Manager/ Incident Commander

When (indicative)	Activations		Who
	Objective	Action	
IMT actions (0 to 48 hours)			
Within 90 minutes from IMT call-out	Set up IMT room	Refer to IMT tools and checklists for room and incident log set-up	Incident Commander IMT Data Manager
	Gain situational awareness and set incident objectives, strategies and tasks	Begin reactive Incident Action Planning process Go to Section 8 Review First-strike Activations (this table)	Incident Commander Planning Section Chief
Refer timeframes Section 7	Make regulatory notifications as required Notify and mobilise/put on standby external oil spill response organisations and support organisations, as required	Go to Section 7	Initial notifications by Environment Unit Lead/ Safety Officer Oil Spill Response Organisations (Australian Marine Oil Spill Centre [AMOSOC] and Oil Spill Response Ltd [OSRL]) activation by designated call-out authorities (Incident Commanders/Duty Managers)
Refer timeframes Section 10	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision making	Vessel Surveillance (Section 10.1) Aerial Surveillance (Section 10.2) Tracking Buoys (Section 10.3) Oil Spill Trajectory Modelling (Section 10.4) Initial Oil Characterisation (Section 10.6) Operational Water Quality Monitoring (Section 10.) Shoreline Clean-up Assessment (Section 10.)	Operations Section Chief Logistics Section Chief/ Supply Unit Leader Environment Unit Leader

When (indicative)	Activations		Who
	Objective	Action	
Activate on Day 1 for applicable scenarios	Source control support to stop the release of hydrocarbons into the marine environment. **Degree of IMT support will be scenario-dependent**	Go to Section 9	Operations Section Chief Logistics Section Chief/ Supply Unit Leader
Activate on Day 1 for applicable scenarios Refer Section 11	Reduce exposure of wildlife to floating oil through mechanical dispersion	Activate the Mechanical Dispersion Plan Go to Section 11	Operations Section Chief Logistics Section Chief/ Supply Unit Leader
Day 1	Identify environmental sensitivities at risk and conduct operational Net Environmental Benefit Analysis (NEBA)	Review situational awareness and spill trajectory modelling Review strategic NEBA and begin operational NEBA (Section 6.6)	Environment Unit Leader
Day 1	Develop forward operational base/s to support forward operations	Begin planning for forward operations base as per Forward Operations Plan. Appendix Q	Operations Section Chief Logistics Section Chief/ Supply Unit Leader
Day 1	Ensure the health and safety of spill responders	Identify relevant hazards controls and develop hazard register Begin preparation Site Health and Safety Management requirements Refer Oil Spill Response Health and Safety Management Manual (SO-91-RF-10016)	Safety Officer
If/when initiated Refer Section 12	Protect identified shoreline protection priorities	Activate the Shoreline Protection and Deflection Plan Go to Section 12	Operations Section Chief Logistics Section Chief /Supply Unit Leader Environment Unit Leader

When (indicative)	Activations		Who
	Objective	Action	
If/when initiated Refer Section 13	Clean-up oiled shorelines	Activate Shoreline Clean-Up resources Go to Section 13	Operations Section Chief Logistics Section Chief / Supply Unit Leader
If/when initiated Refer Section 14	Prevent or reduce impacts to wildlife	Activate the Oiled Wildlife Response Plan Go to Section 14	Environment Unit Leader Operations Section Chief Logistics Section Chief/ Supply Unit Leader
If/when initiated Refer Section 15	Safely transfer, transport and dispose of waste collected from response activities.	Activate the Waste Management Plan. Go to Section 15	Operations Section Chief Logistics Section Chief/ Supply Unit Leader
If/when initiated Refer Section 16	Assess and monitor impacts from spill and response	Activate the Scientific Monitoring Plan Go to Section 16	Environment Unit Leader Logistics Section Chief/ Supply Unit Leader Operations Section Chief
IMT Actions (48+ hours)			
Ongoing	<ul style="list-style-type: none"> + For ongoing incident management – indicatively 48 + hours – a formal incident action planning process is to be adopted to continue with spill response strategies identified above. An Incident Action Plan (IAP) is to be developed for each successive operational period. + Santos will maintain control for those activities for which it is the designated Control Agency/Lead IMT. + Depending on the specifics of the spill, the Australian Maritime Safety Authority (AMSA) and/or Northern Territory (NT) IMT may be relevant Control Agencies (see Section 4.2). 		Control agency IMT

When (indicative)	Activations		Who
	Objective	Action	
	+ Where another control agency has taken control of aspects of the response, Santos will provide support to that Control Agency. Santos’ support for the NT IMT (for an NT waters response) is detailed in Section 4.6.2		

3 Introduction

This document is the accompanying Oil Pollution Emergency Plan (OPEP) to the *Bayu-Undan to Darwin Gas Export Pipeline Environment Plan (EP)* (7710-057-EIS-0001) required by Regulation 14(8) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (OPGGS (E) Regulations).

3.1 Description of activity

Santos Energy Ltd. (Santos) propose to continue to operate and preserve the pipeline and undertake IMMR activities within the following permit areas (**Figure 3-1**):

- + Timor-Leste waters: BU-1-PL
- + Australian Commonwealth waters: WA-8-PL and NT/PL1
- + NT coastal waters: PL20 and NTC/PL-1.

During the operations the pipeline will carry dry natural gas from the Bayu-Undan Field to Darwin LNG Plant.

IMMR activities will continue during operation and preservation activities and may involve any of the following:

- + Inline inspections, acoustic surveys, external inspections, trailing wire inspections
- + Maintenance, damage assessment, non-urgent and emergency repairs
- + Environmental monitoring (e.g. sediment sampling)
- + Autonomous underwater vehicle (AUV) and remotely operated vehicle (ROV) surveys with various equipment attached, to provide information about buried objects and the existing environment (water and seabed parameters).

Refer to Section 2 of the Bayu-Undan to Darwin Gas Export Pipeline EP (7710-057-EIS-0001) for full detail on the activity.

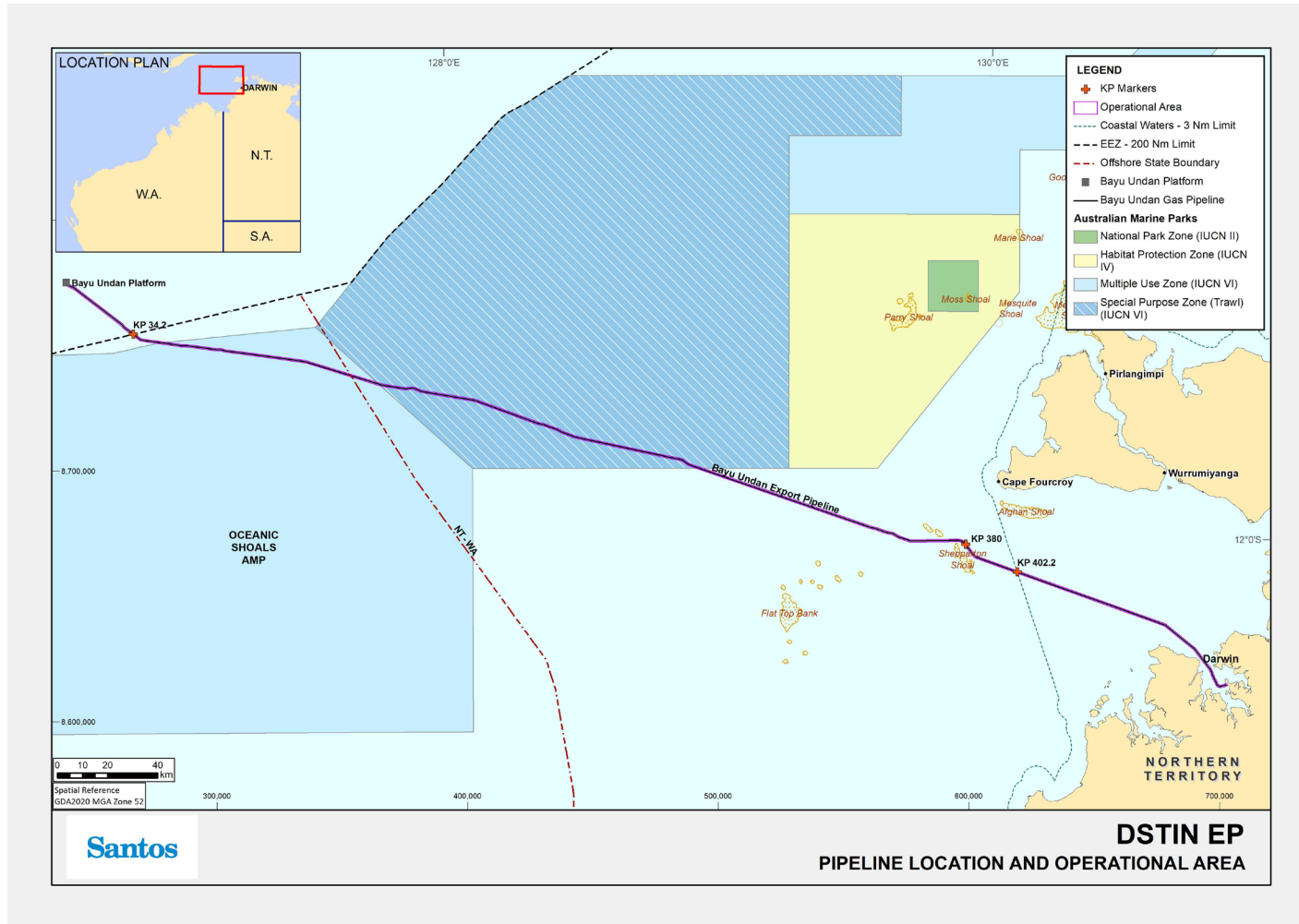


Figure 3-1: Bayu-Undan to Darwin Gas Export Pipeline Location

3.2 Purpose

The purpose of this OPEP is to describe Santos' response to a hydrocarbon spill during Bayu-Undan to Darwin Gas Export Pipeline activities.

This OPEP has been developed to meet all relevant requirements of the Commonwealth OPGGS (E) Regulations. It is consistent with the national and NT systems for oil pollution preparedness and response, being the National Plan for Maritime Environmental Emergencies (AMSA, 2020) managed by AMSA; and the NT Oil Spill Contingency Plan (NT Government, 2014).

This OPEP is to be read in conjunction with the Bayu-Undan to Darwin Gas Export Pipeline EP (7710-057-EIS-0001) when considering the existing environment, environmental impacts, risk management, performance standards and the reporting compliance requirements.

This OPEP will apply from acceptance of the Santos Bayu-Undan to Darwin Gas Export Pipeline EP (7710-057-EIS-0001) and will remain valid for the duration of life of the EP.

The response strategies outlined in this OPEP have been developed by Santos using risk assessments to identify credible worst-case hydrocarbon spill scenarios, expected/calculated release rates, known information of hydrocarbon types and behaviour, and expected partitioning of the hydrocarbon within the marine environment with an estimate of the volume of persistent oil. This information has been modelled to give a theoretical zone of dispersion that is used to identify potential sensitive receptors and response strategies required to reduce the consequences of a spill to 'as low as reasonably practicable' (ALARP). The response strategies are identified under a NEBA process so the most effective response strategies with the lowest environmental consequences can be identified, documented and prepared for.

3.3 Objectives

The aim of this OPEP is to provide detailed guidance to Santos' IMT, so that it will direct its response effort with the aim of preventing long-term significant environmental impacts by safely limiting the adverse environmental effects from an unplanned release of hydrocarbons to the marine environment to a level that is ALARP. This will be achieved through the implementation of the various strategies and spill response mechanisms presented throughout this OPEP. Through their implementation, Santos will:

- + initiate spill response immediately following a spill
- + establish source control as soon as reasonably practicable to minimise the amount of oil being spilt into the environment
- + assess the spill characteristics and understand its fate in order to be able to make informed and clear response decisions
- + monitor the spill to identify the primary marine and coastal resources requiring protection
- + remove as much oil as possible from the marine environment while keeping environmental impacts from the removal methods to ALARP
- + reduce the impacts of the remaining floating and stranded oil to ALARP

- + respond to the spill using efficient response strategies that do not damage the environment themselves
- + comply with all relevant environmental legislation when implementing this OPEP
- + conduct all responses safely without causing harm to participants
- + monitor the impacts from a spill until impacted habitats have returned to baseline conditions
- + remain in a state of 'Readiness' at all times for implementation of this OPEP by keeping resources ready for deployment, staff fully trained and completing response exercises as scheduled
- + keep stakeholders informed of the status of the hydrocarbon spill response to aid in the reduction of social and economic impacts.

3.4 Area of operation

The Bayu-Undan to Darwin pipeline extends from the subsea isolation valve (SSIV), located downstream of the Bayu-Undan Facility Central Production and Processing Complex (CPP) to the shore crossing at Wickham Point, near Darwin.

Approximately 35 km of the Pipeline in Timor-Leste waters extends from the SSIV to the Timor-Leste – Australia Maritime boundary (as established in the Treaty) at KP34.2. The Commonwealth waters section of the Pipeline extends from KP34.2 (at the Timor-Leste – Australia Maritime boundary) to KP402.2 (NT coastal waters boundary). **Section 3** of the Bayu-Undan to Darwin Gas Export Pipeline EP (7710-057-EIS-0001) includes a comprehensive description of the existing environment.

3.5 Interface with internal documents

In addition to this OPEP, a number of other Santos documents provide guidance and instruction relevant to spill response, including:

- + Incident Command and Management Manual (SO-00-ZF-00025)
- + Bayu-Undan to Darwin Gas Export Pipeline EP (7710-057-EIS-0001)
- + Incident Response Telephone Directory (SO-00-ZF-00025.020)
- + Refuelling and Chemical Management Standard (QE-91-IQ-00098)
- + Santos Offshore Source Control Planning and Response Guideline (DR-00-ZF-20001)
- + Oil Pollution Waste Management Plan (QE-91-IF-10053)
- + Oil Spill Response Health and Safety Management Manual (SO-91-RF-10016)
- + Santos Oiled Wildlife Framework Plan (SO-91-BI-20014)
- + Oil Spill Scientific Monitoring Plan (EA-00-RI-10099)
- + Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162)
- + Oil Spill Scientific Monitoring Baseline Data Review (QE-00-BI-20001)

- + Santos Offshore Division Incident and Crisis Management Training and Exercise Plan (SO-92-HG-10001)
- + Santos Offshore Division Oil Spill Response Readiness Guideline (SO-91-OI-20001)
- + Santos Oil and Water Sampling Procedures (7710-650-PRO-0008)
- + Santos Marine Vessel Requirements for Oil Spill Response (7710-650-ERP-0001).

3.6 Interface with external documents

Information from the following external documents have been used or referred to within this plan:

- + AMOSPlan – Australian Industry Cooperative Spill Response Arrangements (AMOSC, 2021)
 - details the cooperative arrangements for response to oil spills by Australian oil and associated industries.
- + Offshore Petroleum Incident Coordination Framework (DIIS, 2019)
 - provides overarching guidance on the Commonwealth Government’s role and responsibilities in the event of an offshore petroleum incident in Commonwealth waters.
- + National Plan for Maritime Environmental Emergencies and National Marine Oil Spill Contingency Plan (AMSA, 2020)
 - sets out national arrangements, policies and principles for the management of maritime environmental emergencies. The plan provides for a comprehensive response to maritime environmental emergencies regardless of how costs might be attributed or ultimately recovered.
- + Territory Emergency Plan (Territory Emergency Management Council, 2021)
 - describes the NT approach to emergency and recovery operations, the governance and coordination arrangements, and roles and responsibilities of agencies (go to https://pfes.nt.gov.au/sites/default/files/uploads/files/2021/NTES_Territory_Emergency_Plan_2021.pdf).
- + Northern Territory (NT) Oil Spill Contingency Plan (NT Government, 2014)
 - outlines the approach to management of marine oil pollution that are the responsibility of the NT Government (the NTOSCP is currently being revised in 2022).
- + NT Oiled Wildlife Response Plan (NTOWRP) (AMOSC, 2019)
 - an industry prepared plan, which is designed to ensure timely mobilisation of appropriate resources (equipment and personnel) in the event of an incident affecting wildlife in NT waters.
- + Shipboard Oil Pollution Emergency Plans
 - under International Convention for the Prevention of Pollution from Ships (MARPOL) Annex I requirements, all vessels of over 400 gross tonnage are required to have a current SOPEP. The

SOPEP includes actions to be taken by the crew in the event of an oil spill including steps taken to contain the source with equipment available onboard the vessel.

- + Shipboard Marine Pollution Emergency Plans (SMPEPs)
 - Under International Convention for the Prevention of Pollution from Ships (MARPOL) Annex II requirements, all vessels of over 150 gross tonnage certified to carry noxious liquid substances in bulk are required to have a current SMPEP. The SMPEP includes actions to be taken by the crew in the event of a spill including steps taken to contain the source with equipment available onboard the vessel.
- + OSRL Associate Agreement
 - defines the activation and mobilisation methods of OSRL spill response personnel and equipment allocated under contract.
- + Australian Government Coordination Arrangements for Maritime Environmental Emergencies (AMSA, 2017):
 - provides a framework for the coordination of Australian Government departments and agencies in response to maritime environmental emergencies.

3.7 Document review

In line with regulatory requirements, this document shall be reviewed, updated and submitted to NOPSEMA every five years from date of acceptance.

The document may be reviewed and revised more frequently, if required, in accordance with the Santos Management of Change Procedure (EA-91-IQ-10001). This could include changes required in response to one or more of:

- + when major changes have occurred that affect oil spill response coordination or capabilities
- + changes to the Environment Plan that affect oil spill response coordination or capabilities (e.g. a significant increase in spill risk)
- + following routine testing of the OPEP if improvements or corrections are identified
- + after a Level 2 spill incident.

The extent of changes made to the OPEP and resultant requirements for regulatory resubmission will be informed by the relevant Commonwealth regulations; i.e. the OPGGS (E) Regulations.

4 Spill management arrangements

4.1 Response levels and escalation criteria

Santos uses a tiered system of three incident response levels consistent with the National Plan for Maritime Environmental Emergencies (National Plan) (AMSA, 2020). Spill Response Levels help to identify the severity of an oil spill incident and the level of response required to manage the incident and mitigate environmental impacts. Incident response levels are outlined within the Santos Incident Command and Management Manual (SO-00-ZF-00025) and further detailed in **Table 4-1** for hydrocarbon spills. The spill scenarios for this activity are described in **Section 6.1**, noting that the worst-case credible spill would not exceed a Level 2.

Table 4-1: Santos oil spill response levels

Level 1	
An incident which will not have an adverse effect on the public or the environment which can be controlled by the use of resources normally available on site without the need to mobilise the Santos IMT or other external assistance.	
Oil is contained within the incident site. Spill occurs within immediate site proximity. Discharge in excess of permitted oil in water (OIW) content (15 ppm). Incident can be managed by the On-site Incident Response Team (IRT) and its resources.	Source of spill has been contained. Oil is evaporating quickly and no danger of explosive vapours. Spill likely to naturally dissipate. No media interest/not have an adverse effect on the public.
Level 2	
An incident that cannot be controlled by the use of on-site resources alone and requires external support and resources to combat the situation; or An incident that can be controlled on site but which may have an adverse effect on the public or the environment.	
Danger of fire or explosion. Possible continuous release. Concentrated oil accumulating in close proximity to the site or vessel. Potential to impact other installations.	Level 1 resources overwhelmed, requiring additional regional resources. Potential impact to sensitive areas and/or local communities. Local/national media attention/may adversely affect the public or the environment.
Level 3	
An incident which has a wide-ranging impact on Santos and may require the mobilisation of external state, national or international resources to bring the situation under control.	

Loss of well integrity. Actual or potentially serious threat to life, property, industry. Major spill beyond site vicinity. Significant shoreline environmental impact.	Level 2 resources overwhelmed, requiring international assistance. Level 3 resources to be mobilised. Significant impact on local communities. International media attention.
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4.2 Jurisdictional authorities and control agencies

The responsibility for an oil spill is dependent on location and spill origin. The National Plan for Maritime Environmental Emergencies (AMSA, 2020) sets out the divisions of responsibility for an oil spill response. Definitions of control agency and jurisdictional authority are as follows:

- + **Control agency:** the organisation assigned by legislation, administrative arrangements or within the relevant contingency plan, to control response activities to a maritime environmental emergency. Control agencies have the operational responsibility of response activities but may have arrangements in place with other parties to provide response assistance under their direction.
- + **Jurisdictional authority:** the agency which has responsibility to verify that an adequate spill response plan is prepared and, in the event of an incident, that a satisfactory response is implemented. The jurisdictional authority is also responsible for initiating prosecutions and the recovery of clean-up costs on behalf of all participating agencies.

Table 4-2 provides guidance on the designated control agency and jurisdictional authority for Commonwealth and NT waters and for vessel and facility spills.

To aid in the determination of a vessel versus a facility spill, the following guidance is adopted:

- + A vessel is a ship at sea to which to which the *Navigation Act 2012* applies. Defined by Australian Government Coordination Arrangements for Maritime Environmental Emergencies (AMSA, 2017) as a seismic vessel, supply or support vessel, or offtake tanker.
- + A petroleum activity including a fixed platform, Floating Production Storage and Offloading / Floating Storage and Offloading, MODU, subsea infrastructure, or a construction, decommissioning and pipelaying vessel. As defined by Schedule 3, Part 1, Clause 4 and Volume 2, Part 6.8, Section 640 of the *OPGGGS Act 2006*.

Table 4-2: Jurisdictional and control agencies for hydrocarbon spills

Jurisdictional boundary	Spill source	Jurisdictional authority	Control agency		Relevant documentation
			Level 1	Level 2/3	
Commonwealth waters (three to 200 nautical miles from territorial/state sea baseline)	Vessel ¹	AMSA	AMSA		Vessel SOPEP National Plan Bayu-Undan to Darwin Gas Export Pipeline OPEP (this document)
	Petroleum activities ²	NOPSEMA	Titleholder		Bayu-Undan to Darwin Gas Export Pipeline OPEP (this document)
Northern Territory (NT) waters (territorial sea baseline to three nautical miles and some areas around offshore atolls and islands)	Vessel	Department of Environment, Parks and Water Security (DEPWS)	Vessel owner	NT IMT	Vessel SOPEP Bayu-Undan to Darwin Gas Export Pipeline OPEP (this document) NT Oil Spill Contingency Plan (2014)
	Petroleum activities	DEPWS	Titleholder ³		Bayu-Undan to Darwin Gas Export Pipeline OPEP (this document)

¹ Vessels are defined by Australian Government Coordination Arrangements for Maritime Environmental Emergencies (AMSA, 2017) as a seismic vessel, supply or support vessel.

² Includes a 'facility', such as a fixed platform, FPSO/FSO, MODU, subsea infrastructure, or a construction, decommissioning and pipelaying vessel. As defined by Schedule 3, Part 1, Clause 4 of the *OPGGs Act 2006*.

³ Titleholder will be the control agency but will request approval of IAPs from the NT IC.

Jurisdictional boundary	Spill source	Jurisdictional authority	Control agency		Relevant documentation
			Level 1	Level 2/3	
					NT Oil Spill Contingency Plan (2014)
NT shorelines	Vessel	DEPWS	Vessel owner	NT IMT ⁴	Bayu-Undan to Darwin Gas Export Pipeline OPEP (this document) NT Oil Spill Contingency Plan (2014)
	Petroleum activities	DEPWS	Titleholder	NT IMT ⁴	Bayu-Undan to Darwin Gas Export Pipeline OPEP (this document) NT Oil Spill Contingency Plan (2014)
International waters	Petroleum activities	Relevant foreign authority	Santos will liaise with the Australian Government Department of Foreign Affairs and Trade (DFAT) in the event that an oil spill may enter international waters. Santos will work with DFAT and the respective governments to support response operations.		
	Vessel				

⁴ NT IMT will be the control agency but will be supported by the titleholder (additional support from AMOSC if required).

4.3 Petroleum activity spill in Commonwealth waters

For an offshore petroleum activity spill in Commonwealth waters, the jurisdictional authority is National Offshore Petroleum Safety and Environment Management Authority (NOPSEMA). NOPSEMA is responsible for the oversight of response actions to pollution events from offshore Petroleum Activities, in areas of Commonwealth jurisdiction. During a spill incident, NOPSEMA's role will be to implement regulatory processes to monitor and secure compliance with the *OPGGs Act 2006* and OPGGS (E) Regulations, including the issuing of directions as required, and investigate accidents, occurrences and circumstances involving deficiencies in environment management.

Under the OPGGS (E) Regulations and the *OPGGs Act 2006*, the petroleum titleholder (i.e. Santos) is responsible for responding to an oil spill incident as the control agency in Commonwealth waters, in accordance with its OPEP.

Santos is responsible as control agency unless NOPSEMA identifies a requirement to delegate control. In this situation, control agency responsibility may be delegated to AMSA who will assume control of the incident and respond in accordance with AMSA's National Plan. In such an occurrence, Santos would assume a Support Agency role and make available all necessary resources to support AMSA in AMSA's performance of their control agency responsibilities.

4.4 Vessel spills

AMSA manages the National Plan for Maritime Environmental Emergencies (AMSA, 2020) and is the control agency for all vessel-based spills in the Commonwealth jurisdiction. This includes vessels undertaking seismic surveys and associated supply or support vessels.

In all circumstances, the Vessel Master is responsible for implementing source control arrangements detailed in the vessel-specific SOPEP.

Once initial notifications to the control agency are made, Santos shall maintain direct contact with the control agency and act as a supporting agency throughout the response. This includes providing essential services, personnel, material or advice in support of the control agency. In addition, Santos will be required to implement monitoring activities as outlined in the Monitor and Evaluate Plan (**Section 10** and Scientific Monitoring Plan **Section 16**).

4.5 Cross-jurisdictional spills

4.5.1 Cross-jurisdictional petroleum activity spills

If a Level 2 petroleum activity spill crosses jurisdictions between Commonwealth and NT waters, the jurisdictional authority remains true to the source of the spill (i.e. NOPSEMA for Commonwealth waters; and DEPWS for NT waters).

Where a Level 2 petroleum activity spill originating in Commonwealth waters moves into NT waters, the petroleum titleholder (Santos) is the sole control agency.

4.5.2 Cross-jurisdictional vessel spills

If a Level 2 vessel spill crosses jurisdictions between Commonwealth and NT waters, two Jurisdictional Authorities will exist (AMSA for Commonwealth waters and DEPWS for NT Waters). Control agency

responsibilities will be determined by NT Government and AMSA, with Santos providing all necessary resources (including personnel and equipment) as a supporting agency, as detailed in **Section 4.6**.

4.6 Integration with government organisations

4.6.1 Australian Maritime Safety Authority

Upon notification of an incident involving a ship, AMSA will assume control of the incident and respond in accordance with the National Plan (AMSA, 2020). AMSA is to be notified immediately of all ship-source incidents through RCC Australia (Santos Incident Response Telephone Directory (SO-00-ZF-00025.020)).

AMSA manages the National Plan, Australia's key maritime emergency contingency and response plan (AMSA, 2020). AMSA fulfils its obligations under the National Plan for non-ship source pollution incidents on the formal request from the respective Offshore Petroleum Incident Controller/s (AMSA, 2021).

For any oil pollution event, Santos agrees to notify AMSA immediately in the interests of facilitating the most efficient and effective response to the incident.

4.6.2 Northern Territory – NT Government

If a Level 2 spill arises which has potential to enter Territory waters, Santos must notify the Regional Harbourmaster and the NT Pollution Response Hotline (DEPWS) which will provide the communication link to the Territory Marine Pollution Coordinator (TMPC), who will establish an NT Incident Controller (NT IC) as the ongoing point of contact.

Notification to the TMPC and Regional Harbourmaster is to be completed as soon as practicable (within the first 24 hours of spill occurring or sooner) which will allow sufficient time to accurately determine the predicted time of any potential shoreline impact. The TMPC will appoint an NT IC.

Santos will commence coordination with the NT IC, mobilising resources and personnel into Darwin.

The NT IMT with advice from NT Environment, Scientific and Technical advisors will work with AMSA (and support from Santos, if requested) to confirm protection priorities and undertake an operational NEBA to determine the most appropriate response in Territory waters.

If a Level 2 facility spill reaches the Northern Territory shoreline, the NT IMT will be the control agency for the shoreline.

The NT IMT will be established in Darwin and consist of staff from across NT Government. The NT IMT will be supported by existing NT emergency response arrangements⁵ and Santos, as supporting agency. Additional support, if required, will be provided under the provisions of the *NT Emergency Management Act 2013*, through the Territory Emergency Management Council and the NT Government Functional Groups.

At the request of the TMPC, Santos will be required to provide all necessary resources, including personnel and equipment, to assist the NT IMT in performing duties as the Control Agency. This may include the provision of personnel to work within the NT IMT located in Darwin, to assist response activities such as shoreline protection, with the required numbers to be determined based on the nature and scale of the spill and response requirements at the time.

⁵ NT Emergency Response arrangements in accordance with the NT Government – Territory Emergency Plan (February 2021)

The Territory Emergency Management Council will delegate responsibilities associated with wildlife and activities in National parks, reserves and Territory marine parks. Direct coordination will be managed through the designated NT Government Functional Group.

Relevant guidance to support an oiled wildlife response in the event of an oil spill is outlined in the Northern Territory Oiled Wildlife Response Plan (NTOWRP) (AMOSC, 2019) (**Section .1**), the plan is designed to ensure timely mobilisation of appropriate resources (equipment and personnel) in the event of an incident affecting wildlife in NT waters.

4.6.3 Department of Foreign Affairs and Trade

In the event of a spill predicted to migrate into neighbouring countries Exclusive Economic Zones, Santos will notify the Department of Foreign Affairs and Trade (DFAT) who will in turn notify the affected government(s) and engage the preferred methods for Santos to respond in order to minimise the impacts to ALARP. In most cases, NOPSEMA, Department of Industry, Science and Resources (DISR) and DFAT will form an inter-agency panel; the Australian Government Control Crisis Centre, who may request AMSA to coordinate the response operations across the trans-national boundary. Santos remains willing to respond as per the direction of the affected government(s) and designated Control Agency, following approvals established between DFAT and the affected countries government.

4.6.4 Department of Industry, Science and Resources

DISR will be the lead Commonwealth Agency for the provision of strategic oversight and Commonwealth government support to a significant offshore petroleum incident (including oil spill incidents). DISR will be notified by NOPSEMA of a significant oil pollution incident and under the Offshore Petroleum Incident Coordination Framework will stand up the Offshore Petroleum Coordination Committee as the mechanism to provide Commonwealth strategic advice and support to the incident. To facilitate information between the petroleum titleholder IMT and Offshore Petroleum Incident Coordination Committee, Liaison Officer/s will be deployed from DISR to the petroleum titleholder IMT.

For incidents that are classified at a greater level than Significant (i.e. crisis level), a whole of government crisis committee will be formed under the Australian Government Crisis Management Framework to provide strategic advice and support and the Offshore Petroleum Incident Coordination Committee will not be convened, although DISR will remain as the lead agency.

4.7 Interface with external organisations

Santos has contracts in place enabling access to Oil Spill Response Organisations (OSROs). OSROs have put specific measures in place to ensure that they are able to continue to meet their commitments to members. This support can be provided directly or remotely to aid the IMT and/or IRT.

4.7.1 Australian Marine Oil Spill Centre

Santos is a Participating Company of AMOSC and as such has access to AMOSC's Level 2 equipment and personnel as outlined in the AMOSPlan.

AMOSC has contracts with all its member companies to enable the immediate release of Core Group personnel to be made available for any Santos requirements, as outlined in Santos' *Master Service Contract* and *Principle and Agency Agreement* with AMOSC.

The mutual aid arrangements that AMOSC operates under are collaborated under the AMOSPlan. This provides the mechanism for members of AMOSC to access oil spill response capability of other members. To further enhance the mutual aid arrangements, Santos, BHP, Chevron and Woodside have signed a memorandum of understanding (MoU) that defines the group's mutual aid arrangements. Under this MoU, Santos, BHP, Chevron and Woodside have agreed to use their reasonable endeavours to assist in the provision of emergency response services, personnel, consumables and equipment.

4.7.2 Oil Spill Response Limited

Through an associate membership, Santos has access to spill response services from OSRL with offices in Perth, Singapore, UK and at other various locations around the globe. In the event of a Level 2 response, Santos could access OSRL's international personnel, equipment and dispersants to supplement resources available within Australia. Santos may also call on OSRL for technical services to support its IMT.

Response equipment and personnel are allocated on a 50% of inventory basis under OSRL's Service Level Agreement (SLA).

5 Santos incident management arrangements

5.1 Incident management structure

The Santos IMT (Perth) and CMT will be activated in the event of a Level 2 hydrocarbon spill regardless of the type of spill or jurisdiction. Santos maintains internal resources (trained personnel and equipment) across its activities that provide first strike response capability and to also support an ongoing response. Should an incident occur, the IMT Duty Manager would be notified immediately. This rostered role is on-call, filled by trained Incident Commanders and available 24 hours/day and 7 days/week. The IMT Duty Manager would then activate the IMT via an automated call-out system. Documentation required in a response is accessed via the Santos Emergency Response (ER) intranet site.

As outlined in **Section 4**, control of the response may be taken over by the relevant control agency as the incident progresses. The Santos response structure to a major emergency incident is detailed in the Santos Incident Command and Management Manual (SO-00-ZF-00025). The Incident Command and Management Manual describes response planning and incident management that would operate under emergency conditions – describing how the Santos IMT operates and interfaces with the CMT and external parties.

The first priority of an escalating oil spill response to a Level 2 spill is the formation of an IMT and establishment of an ICC⁶. The ongoing involvement of the IMT and CMT will be dependent on the severity and type of spill and the obligations of Santos and other agencies/authorities in the coordinated spill response.

Santos' incident response structure relevant to a Bayu-Undan to Darwin Gas Export Pipeline incident includes:

- + Field-based Incident Response Team (on vessel)
- + Santos IMT – Perth-based ICC to coordinate and execute responses to an oil spill incident
- + Santos Crisis Management Team (CMT) – to coordinate and manage threats to the company's reputation and to handle Santos' corporate requirements in conjunction with the Perth-based Santos – Vice President Offshore Upstream WA
- + Other field-based command, response and monitoring teams for implementing strategies outlined within the OPEP.

The Santos incident response organisational structure is defined in the Incident Command and Management Manual (SO-00-ZF-00025) and in **Figure 5-1** for reference. The Santos IMT roles and field-based teams are scalable; roles can be activated and mobilised according to the nature and scale of the incident response.

⁶ The Santos ICC is located in the Santos WA Perth office

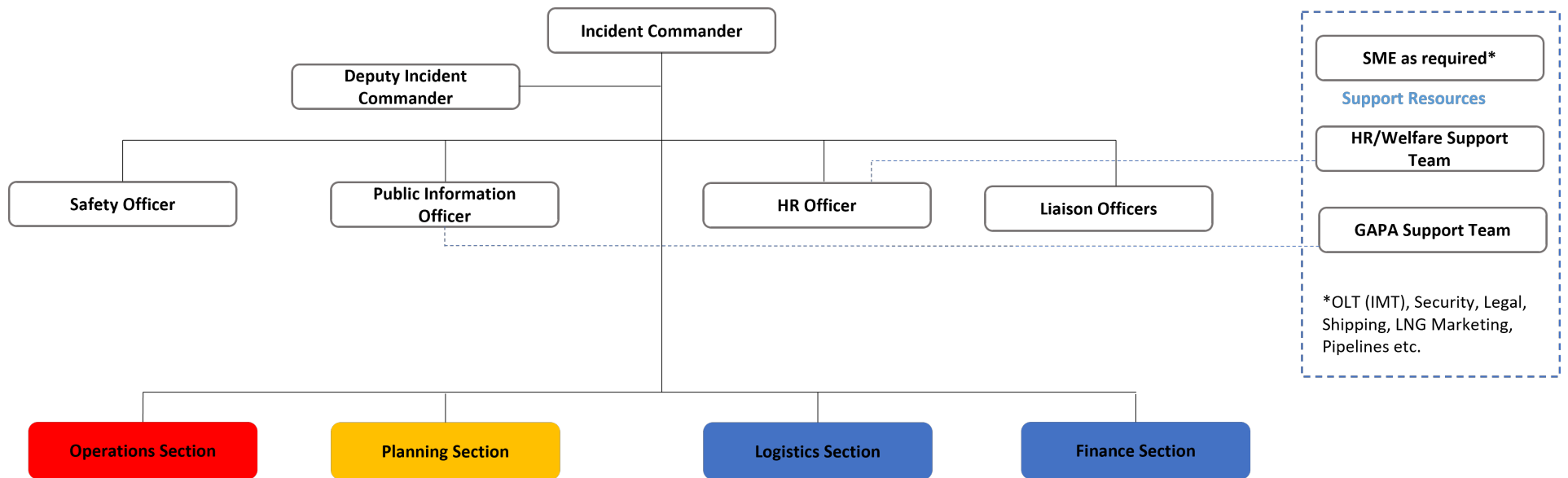


Figure 5-1: Santos incident management team organisational structure

5.2 Roles and responsibilities

The following tables provide an overview of the responsibilities of the Santos CMT (**Table 5-1**), IMT (**Table 5-2**), and field-based response team members in responding to an incident (**Table 5-3**).

Table 5-1: Roles and responsibilities in the Santos Crisis Management Team

Santos CMT Role	Main Responsibilities
Crisis Management Chair (CEO)	<p>The CM Chair (Santos Chief Executive Officer) is responsible for the following:</p> <ul style="list-style-type: none"> + leads crisis management direction + provides governance and oversight of CMT operations + provides enterprise and strategic direction to the CMT for the resolution of the crisis event + delegates the CM Lead role and accountability to the appropriate ExCom designee + engages with the CM Lead to endorse the crisis resolution plan + liaises with the Santos Board and strategic stakeholders + provides the full extent of the company's resources to bring about a resolution and recovery from the crisis impact.
CMT Leader/ Duty Manager	<p>The CMT Leader is responsible for the following:</p> <ul style="list-style-type: none"> + determines the need for establishing a Level 3 response and for activating the CMT + determines which / if any Crisis Management Support Teams (CMST) are mobilised + leads the crisis resolution process + Ensures internal and external notifications to key stakeholders + uses the crisis resolution process to determine enterprise level impacts (potential or actual) and strategic objectives + ensures a crisis resolution plan is developed and direct the CMT functions to implement strategies, action plans and tasks + determines when it is appropriate to conclude the crisis response and stand down all or a portion of the CMT.
CMT Information Management	<p>The CMT Information Managers directly support the CMT as follows:</p> <ul style="list-style-type: none"> + support the CMT during crisis management operations + set up the crisis management room, assist with set-up of communications, video conferences and information transfer within the CMT + advise on CMT operating processes and available resources + assist with reserving break out rooms for the CMT functions and CMSTs + ensure CMT crisis resolution forms are used and displayed on the monitors + provide incident action plan information when an IMT is established + monitor and manage the welfare needs of the CMT.

Santos CMT Role	Main Responsibilities
Crisis Management Advisor	<p>The Crisis Management Advisor is responsible for the following:</p> <ul style="list-style-type: none"> + provides CMT process guidance and advice to CMT Leader, Function Leaders, and CMST + supports and facilitates the crisis resolution planning process + acts as the liaison between the CMT and IMT + works with CMT Information Managers to manage roster and handovers for extended CMT operations + schedules and facilitates post crisis debriefs and after-action reviews. <p>The Crisis Management Advisor will support the CMT Leader as follows:</p> <ul style="list-style-type: none"> + facilitates CMT activation requirements with the CMT Leader + assists the CMT Leader in maintaining an ongoing assessment of incident potential and analysis of stakeholder impacts + advises the CMT Leader on CMT structure and requirements for CMST engagement + coordinates tasks delegated by CMT Leader + provides tools to the CMT Leader for review and crisis assessment meetings.
CMT Core Function Leaders	<p>CMT Core Function Leaders include Leaders for the following areas:</p> <ul style="list-style-type: none"> + Legal Counsel and Risk + Environment Health Safety and Security + COO/VP Division/ Function + People + Government and Public Affairs + Media and Communications. <p>The CMT Core Function Leaders are responsible for the following:</p> <ul style="list-style-type: none"> + participate and contribute to the crisis resolution planning process + each Function Leader shall determine critical communications pertaining to their area + mobilise and coordinate activities of the function CMST + advise the CMT Leader on strategic impacts, threats and mitigation created by the crisis event + develop and execute strategies to meet objectives endorsed by the CM Chair + provide support and resources via the CMST to divisional IMTs + ensure critical actions, decisions or points of strategic criticality are included in the CMT log + participate in the crisis management debrief and after-action reviews.

Table 5-2: Roles and responsibilities in the Santos Incident Management Team

Santos Management/ IMT Role	Main Responsibilities
Vice President Offshore (VPO) Upstream WA	<ul style="list-style-type: none"> + Depending on the level of the incident, the VPO (and/or their delegate) will act as the primary liaison to the CMT Duty Manager. + On the activation of the IMT, the VPO is advised by the Incident Commander.
Incident Commander	+ Incident Commander is responsible for the overall management of the incident. Will set response objectives and strategic directions and oversee the development and implementation of Incident Action Plans
Safety Officer	+ Safety Officer is responsible to develop and recommend measures for assuring personnel safety and to assess and/or anticipate hazardous and unsafe situations. Safety Officer may have specialists as necessary.
Public Information Officer	+ Public Information Officer is responsible for developing and releasing information about the incident to media, incident personnel and to appropriate agencies and organisations.
Human Resources Officer	+ Human Resources Officer is responsible for advising and assisting the Incident Commander, Command Staff and Section Chiefs on any human resources related aspects of an incident.
Operations Section Chief*	+ The Operation Section Chief leads the Operations Section within the IMT and is responsible for the management of all tactical operations directly applicable to the primary assignments. The Operations Section Chief activates and supervises operational elements in accordance with the IAP and directs its execution.
Planning Section Chief*	+ Planning Section Chief will lead the Planning Section within the IMT and is responsible for the collection, evaluation, dissemination and use of incident information and maintaining status of assigned resources.
Logistics Section Chief*	+ Logistics Section Chief is responsible for providing facilities, services and materials in support of the incident. The Logistics Section Chief participates in the development and implementation of the Logistics Section of the IAP.
Finance Section Chief*	+ Finance Section Chief is responsible for all the financial, administrative and cost analysis aspects of the incident and for supervising members of the Finance Section.

* Note: The Section Chiefs are supported by various other roles that will be mobilised depending on the severity of the incident.

Table 5-3: Roles and responsibilities in the field-based response team

Field-based position	Main responsibilities
On-Scene Commander⁷	<ul style="list-style-type: none"> + Assess facility-based situations / incidents and respond accordingly. + Single point of communications between facility/site and IMT. + Communicate the incident response actions and delegates actions to the Incident Commander. + Manage the incident in accordance with Facility Incident Response Plan, Third Party Incident Response Plan, and/or activity-specific Oil Spill Contingency Plan or OPEP. + Coordinate medical evacuations as required. + Refer to the Facility Incident Response Plan for detailed descriptions of roles and responsibilities.
Company Site Representative	<ul style="list-style-type: none"> + Notify the Perth-based Incident Commander of oil spills. + Coordinate on-site monitoring of oil spill and ongoing communication with Incident Commander.
Facility Incident Response Team (IRT)	<ul style="list-style-type: none"> + Manage the incident in accordance with Facility Incident Response Plan, Third Party Incident Response Plan, and/or activity-specific Oil Spill Contingency Plan or OPEP. + Coordinate forward operations response teams and activities for on-asset incidents. + Refer to the facility Incident Response Plan for detailed descriptions of roles and responsibilities within the IRT.
Medical Evacuation Team	<ul style="list-style-type: none"> + Manage all medical and transportation requirements related to injured personnel to an appropriate medical facility. + Refer to the Medical Evacuation Procedure (QE-91-IF-00020) for detailed descriptions of roles and responsibilities within the Medical Evacuation Team.
Off-Asset Oil Spill Response Teams	<ul style="list-style-type: none"> + Respond to oil spills at sea to minimise the impacts to as low as reasonably practicable. + Refer to activity-specific Oil Spill Contingency Plans (OSCP) and OPEP for detailed descriptions of roles and responsibilities within the Off-Asset Oil Spill Response Team.
Oiled Wildlife Response Branch	<ul style="list-style-type: none"> + Respond to oiled wildlife incidents to minimise the impacts to wildlife.
Monitoring Branch	<ul style="list-style-type: none"> + Monitor the impacts and recovery to sensitive receptors from an oil spill and associated response actions. + Refer to the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162) for detail on Scientific Monitoring Team roles and responsibilities.

5.3 Cost recovery

As required under Section 571(2) of the *OPGGs Act 2006*, Santos has financial assurances in place to cover any costs, expenses and liabilities arising from carrying out its petroleum activities, including major oil spills. This includes costs incurred by relevant control agencies (e.g. NT IMT) and third-party spill response service providers.

⁷ The OSC is either the Santos Company Representative (if any on board) or the Vessel Master. Detail agreed during the activity planning stage.

5.4 Training and exercises

In order to refresh IMT roles and responsibilities and provide familiarisation with OPEP processes and arrangements, IMT workshops are conducted as per the Santos Offshore Division Incident and Crisis Management Training and Exercise Plan (SO-92-HG-10001).

To familiarise the IMT with functions and processes, an OPEP Desktop and Activation Exercise is undertaken as per the Santos Offshore Division Incident and Crisis Management Training and Exercise Plan (SO-92-HG-10001). Exercise planning takes into consideration virtual/remote access requirements and government mandate boarder restrictions (e.g. Covid-19).

All workshops and exercises undertaken are recorded in the Santos EHS Toolbox, with the key recommendations recorded and tracked.

5.4.1 Incident management team training and exercises

Santos provides training to its personnel to fill all required positions within the IMT.

Competency is maintained through participation in regular response exercises and workshops. Exercise and training requirements for Santos' IMT members are summarised in **Table 5-4**.

Table 5-4: Training and exercise requirements for incident management team positions

IMT Role	Exercise	Training
Incident Commander Operations Section Chief	One Level 3 exercise annually or two Level 2 exercises annually ⁸	+ PMAOMIR320 + PMAOMIR418 + AMOSC – IMO3 Oil Spill Command and Control
Planning Section Chief Logistics Section Chief Environment Unit Leader		+ PMAOMIR320 + AMOSC – IMO2 Oil Spill Management Course
Safety Officer Supply Unit Leader GIS Team Leader Data Manager ⁹ Human Resources Officer		+ PMAOMIR320 + AMOSC – Oil Spill Response Familiarisation Training

5.4.2 Oil spill responder training

Santos has an internal capability of trained oil spill responders who can be deployed in the field in a spill response and has access to external, trained spill responder resources (**Table 5-5**).

⁸ All IMT members are required to participate in at least one Level 3 exercise every two years

⁹ Data Manager is an administrative support role, not an IMT role, but is included here for completeness

Table 5-5: Spill responder personnel resources

Responder	Role	Training	Available Number
Santos AMOSC Core Group Responders	Santos personnel trained and competency assessed by AMOSC as the AMOSC Core Group. Deployed by IMT for spill response operations.	AMOSC Core Group Workshop (refresher training undertaken every two years). AMOSC – IMO1 Oil Spill Operators Course	12 ¹⁰
Santos Facility Emergency Response Teams	Present at Facility for first-strike response to incidents.	Internal Santos training and exercises as defined in each facility's Emergency Response Plan OSC to have AMOSC – Oil Spill Response Familiarisation Training.	One Incident Response (IR) team per operational facility per shift
Santos Aerial Observers	Undertake aerial surveillance of spill. Deployed by IMT in the aerial surveillance aircrafts.	AMOSC – Aerial Surveillance Course (refresher training undertaken tri-annually).	7
AMOSC Core Group Oil Spill Responders	Industry personnel as the AMOSC Core Group, available to Santos under the AMOSPlan. For providing incident management (IMT) and operations (field response) assistance.	AMOSC Core Group Workshop (refresher training undertaken every two years). AMOSC – IMO1 Oil Spill Operators Course and/or IMO2 Oil Spill Management Course	As defined in Core Group Member Reports ¹¹ Target to maintain at least 84 members (Ref.: AMOSC Core Group Program and Policies)
OSRL Oil Spill Response Personnel	Oil Spill Response Ltd professionals, providing technical, incident management and operational advice and assistance available under Santos-OSRL contract.	As per OSRL training and competency matrix.	18 responders guaranteed
AMOSC Staff	Professionals, providing technical, incident management and operational advice and assistance available under Santos-AMOSC contract.	As per AMOSC training and competency matrix.	16
Oiled Wildlife Response Roles	Refer Section 14 and Appendix M		

¹⁰ 10 Santos Core Group members with a further 2 undergoing Core Group training (as of June 2022).

¹¹ An average of 35 personnel as of June 2022 (AMOSC Member's website), plus 16 AMOSC staff members (AMOSPlan, 2021).

Responder	Role	Training	Available Number
Monitoring Service Provider: Monitoring Coordination Team (MCT) and Scientific Monitoring Plan Teams	Monitoring Coordination Team (MCT) Scientific Monitoring Plan Teams: Technical Advisers Field Team Leader Field Team Member	As defined in the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162)	Capability defined in Monthly Capability Reports. MCT – five personnel Scientific Monitoring Plan Teams 12+ per team
Level 1 Oiled Wildlife Responders (Workforce Hire)	Provide oiled wildlife support activities under supervision.	No previous training required; on the job training provided.	Nominally over 1,000
Shoreline clean-up personnel (Workforce Hire)	Manual clean-up activities under supervision.		

In addition to the resources listed in **Table 5-5**, the following resources are available for spill response and may be activated by the relevant Control Agency:

- + National Plan: National Response Team – Trained oil spill response specialists, including aerial observers, will be deployed under the direction of AMOSC and the IMT in a response. The National Response Team is trained and managed in accordance with the National Response Team Policy, approved by the National Plan Strategic Coordination Committee (AMSA, 2013).

In the event of a spill, the trained spill responders listed in **Table 5-5** would be required to undertake various roles in key spill response operations, including operational monitoring, shoreline protection, shoreline clean-up, oiled wildlife response and scientific monitoring.

In the event of a spill, Team Leader roles for protection and deflection and shoreline clean-up would be filled through Santos' AMOSC Core Group Responders and then industry Core Group Responders.

5.5 Response testing arrangements and audits

Santos has oil spill response testing arrangements in place in accordance with the Santos Offshore Oil Spill Response Readiness Guideline (SO-91-OI-20001) which provides a process for continual monitoring of OSRO capability. This also includes regular oil spill response equipment inventory checks from the various sources. Testing of key response provider arrangements may be done as part of larger exercises or as standalone tests where the capability and availability of resources through the response provider are assessed against the performance requirement.

5.5.1 Testing arrangements

Not all spill preparedness and response arrangements will be tested simultaneously. The frequency of testing will relate to the potential spill level, spill risk and complexity of response.

Santos employs a range of tests to ensure that the various response arrangements function as required. These tests include;

1. Contract/Plan review
2. Audit
3. Notification/communication check

4. Desktop Exercise
5. Deployment exercise
6. Level 2/3 IMT Exercise

The above objectives are set for the various response arrangements and the effectiveness of the response arrangements against these objectives is examined using pre-identified Key Performance Indicators (KPIs).

All testing activities are documented, and all reports generated will be saved in Santos's EHS Toolbox system. Once completed, records of testing arrangements are entered into the Santos EHS Toolbox and any actions, recommendations or corrective actions identified are assigned a responsible party for completion and tracked to closure. The status of completion is tracked through the 'Action module' in the EHS Toolbox and communicated widely through monthly EHS KPI reporting.

5.5.2 Audits

Oil spill response audits will follow the Santos Assurance Management Standard (SMS-MS15.1) and are scheduled as per the Santos Assurance Schedule (E-910HA-20002). Audits will help identify and address any deficiencies in systems and procedures. At the conclusion of the audit, any opportunities for improvement and corrective actions (non-conformances) will be formally noted and discussed, with corrective actions developed and accepted. In some cases, audits may conclude with potential amendments to the OPEP.

The deployment readiness and capability of AMOSC's oil spill response equipment and resources in Geelong and Fremantle are audited every two years under the direction of AMOSC's participating members. The intent is to provide assurances to Santos and associated members about AMOSC's ability to respond to an oil spill incident as per the methods and responsibilities defined in OPEPs and AMOSC's Service Level Statement.

The deployment readiness and capability of OSRL's oil spill response equipment and personnel are audited every two years by the Oil Spill Response Coordinator. The intent of this audit is to provide assurances to Santos of OSRL's ability to respond to an oil spill incident as per the methods and responsibilities defined in Santos' OPEPs and OSRL's SLA.

6 Response strategy selection

6.1 Spill scenarios

This OPEP outlines strategies, actions and supporting arrangements applicable for all credible oil spill events associated with Bayu-Undan to Darwin Gas Export Pipeline activities. Of the credible spill scenarios, one has been selected to represent the worst-case spill from a response perspective, considering:

- + It represents the hydrocarbon type that could be spilled during Bayu-Undan to Darwin Gas Export Pipeline activities.
- + It represents the maximum credible release volume.
- + It represents the greatest spatial extent from a response perspective based on surface oil and shoreline accumulation as these are the key factors contributing to response.
- + The proximity to sensitive receptors, shorelines and Territory/Commonwealth boundaries, noting that a spill could occur at any location along the pipeline.

The worst-case credible spill risk selected to inform this OPEP is presented in **Table 6-1**. The Bayu-Undan to Darwin Gas Export Pipeline EP (Sections 7.5 to 7.6) details the derivation of this maximum credible spill.

For a description of the characteristics and behaviour associated with hydrocarbons that may unintentionally be released refer to **Appendix A**.

Table 6-1: Maximum credible spill scenarios for Bayu-Undan to Darwin Gas Export Pipeline activities

Worst-case credible spill scenario	Approx. depth of spill	Hydrocarbon type	Maximum credible volume released (m ³)	Release duration
Surface MGO/MDO release	0 m	MGO/MDO	187	6 hours

6.2 Response planning thresholds

Environmental impact assessment thresholds are addressed in Section 7.5.4 of the EP. In addition to the environmental impact assessment thresholds, response thresholds have been developed for response planning to determine the conditions that response strategies would be effective. These are shown in **Table 6-2**.

Table 6-2: Surface hydrocarbon thresholds for response planning

Hydrocarbon concentration (g/m ²)	Description
>1	Estimated minimum threshold for commencing some scientific monitoring components (refer to Appendix N)
>50	Estimated minimum floating hydrocarbon threshold for containment and recovery and surface dispersant application <i>Note: Containment and recovery and surface dispersant application are not applicable spill response strategies under this OPEP (Table 6-4).</i>

Hydrocarbon concentration (g/m ³)	Description
>100	<p>Estimated floating hydrocarbon threshold for effective containment and recovery and surface dispersant application</p> <p>Estimated minimum shoreline accumulation threshold for shoreline clean-up</p> <p><i>Note: Containment and recovery and surface dispersant application are not applicable spill response strategies under this OPEP (Table 6-4).</i></p>

6.3 Stochastic spill modelling results

Table 6-3 presents the spill modelling results at sensitive receptor locations. The scenario outlined in **Table 6-1** was modelled at location KP380 (**Figure 3-1**) using a stochastic approach running multiple simulations (300 simulations) across all seasons using a number of unique environmental conditions sampled from historical metocean data. KP380 was selected as the most credible location for a vessel collision to occur. The Environment that May Be Affected (EMBA) and Moderate Exposure Value Area (MEVA) for the activity is provided in Figure 7-1 of the EP.

Previous consultation with Darwin Port (performed by ConocoPhillips during the development of previous revisions of this OPEP), indicated port management do not consider a marine diesel release from a vessel collision during IMMR activities within Darwin Harbour to be credible. This is aligned with Santos' assessment of this risk. A vessel collision with the potential to result in the release of marine diesel is considered credible within the Operational Area beyond the limits of Darwin Harbour. Spill modelling of a potential vessel collision was therefore performed at a location closest to the sensitive shorelines of the Tiwi Islands. A marine diesel release from a vessel collision during IMR activities within Darwin Harbour is considered less credible, given the controls in place within the harbour, including speed restrictions and shipping lanes. Should a spill occur closer to the NT mainland, it is likely to result in quicker arrival times of oil reaching the locations listed in **Table 6-3**, greater contact probabilities and higher shoreline accumulation volumes.

For the purpose of spill response preparedness, outputs relating to floating oil and oil accumulated on the shoreline are most relevant (**Table 6-3**) (i.e. oil that can be diverted, contained, collected or dispersed through the use of spill response strategies) for the allocation and mobilisation of spill response resources. Therefore, these are the results presented in this OPEP for primary consideration.

Santos uses the modelling results for entrained oil from the worst-case scenario for the purposes of identifying scientific monitoring priority areas (). Refer to Section 7.5.4 of the EP for dissolved and entrained thresholds and Sections 7.5.5 and 7.6.5 for potential impacts to receptors.

Table 6-3: Worst-case spill modelling results – vessel collision (MGO) at KP380 (RPS, 2022)

Location	Total contact probability (%) floating oil >1 g/m ²	Minimum arrival time floating oil >1 g/m ² (days)	Total probability (%) shoreline oil accumulation >10 g/m ²	Minimum arrival time shoreline oil accumulation >10 g/m ² (days)	Total probability (%) shoreline oil accumulation >100 g/m ²	Minimum arrival time shoreline oil accumulation >100 g/m ² (days)	Total accumulated volume of oil ashore (tonnes)	Maximum length of shoreline oiled (km) >100 g/m ²
Tiwi Islands	1	2.5	6	3.17	NC	NC	9.7	NC
Vernon Islands	NC	NC	6	8.25	NC	NC	7.2	NC
Beagle Gulf-Darwin Coast	3	5.2	5	5.54	NC	NC	11.4	NC

6.4 Evaluation of applicable response strategies

Based on the nature and scale of the credible spill scenarios outlined in **Section 6.1** and spill modelling results (**Section 6.3**) the following spill response strategies have been assessed as potentially applicable for combatting a spill (**Table 6-4**).

Note: The information contained in **Table 6-4** has been developed by Santos for preparedness purposes. Santos may not be the Control Agency or Lead IMT for implementing a spill response. For example, for Level 2 spills contacting NT shorelines, NT IMT will ultimately determine the strategies and controls implemented for most shoreline activities with Santos providing resources and planning assistance.

Table 6-4: Evaluation of applicable response strategies

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy	Considerations
		MGO/MDO	
Source Control	Spill kits	✓ 1	Relevant for containing spills that may arise onboard a vessel.
	Secondary containment	✓ 1	Relevant for spills that may arise due to stored hydrocarbons, and from spills arising from machinery and equipment onboard a vessel. Bunded areas will contain hydrocarbons reducing the potential for a spill escaping to marine waters. Where applicable open deck drainage will be closed to prevent hydrocarbon draining into the marine environment.
	Shipboard Oil Pollution Emergency Plan (SOPEP)/SMPEP	✓ 1	MARPOL requirement for applicable vessels. In the event a vessel hydrocarbon storage tank is ruptured, applicable strategies for reducing the volume of hydrocarbon releases will be contained within the vessel SOPEP/SMPEP. This may include securing fuel via transfer to another storage area onboard the vessel, transfer to another vessel, or through pumping in water to affected tank to create a water cushion (tank water bottom). Trimming the vessel may also be used to avoid further damage to intact tanks. These actions will aim to minimise the volume of fuel spilled.
In-Situ Burning	Controlled burning of oil spill	X	Not applicable to MGO/MDO spills due to inability to contain MGO/MDO making it very difficult to maintain necessary slick thickness for ignition and sustained burning. In addition, in-situ burning is not normally considered as an acceptable response strategy due to the atmospheric emissions created.
Monitor and Evaluate Plan (Operational Monitoring)	Vessel surveillance	✓ 1	<p>Provides real-time information on spill trajectory and behaviour (e.g. weathering).</p> <p>Informs implementation of other response strategies.</p> <p>Vessel personnel may not be trained observers.</p> <p>Vessel observers on leaking vessel may not have capacity to observe oil during emergency response procedure implementation.</p> <p>Constrained to daylight.</p> <p>Limited to visual range from the vessel.</p> <p>Limited capacity to evaluate possible interactions with sensitive receptors.</p>

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy	Considerations
		MGO/MDO	
	Aerial surveillance	✓ 1	Provides real-time information on spill trajectory and behaviour (e.g. weathering). May identify environmental sensitivities impacted or at risk of impact (e.g. seabird aggregations, other users such as fishers). Informs implementation of other response strategies.
	Tracking buoys	✓ 1	Can be implemented rapidly. Can provide indication of near-surface entrained/dissolved hydrocarbons (most other monitor and evaluate techniques rely on the hydrocarbon being on the surface or shoreline).
	Trajectory Modelling	✓ 1	Can be implemented rapidly. Predictive – provides estimate of where the oil may go, which can be used to prepare and implement other responses. No additional field personnel required. Not constrained by weather conditions. Can predict floating, entrained, dissolved and stranded hydrocarbon fractions. May not be accurate. Requires in-field calibration.
	Satellite Imagery	✓ 1	Can work under large range of weather conditions (e.g. night-time, cloud cover, etc.). Mobilisation restricted to image availability. Requires processing. May return false positives.
	Operational Water Quality Monitoring	✓ 1	Used to determine the location and distribution of the entrained oil and dissolved aromatic hydrocarbon components and validate the spill fate modelling predictions.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy	Considerations
		MGO/MDO	
	Shoreline Clean-up Assessment	✓ 1	<p>Provides information on shoreline oiling (state of the oil, extent of pollution, etc).</p> <p>Can provide information on amenability of shoreline response options (e.g. clean-up, protect and deflect).</p> <p>Provides information on status of impacts to sensitive receptors.</p> <p>Considerable health & safety considerations.</p> <p>Requires trained observers.</p> <p>Constrained to daylight.</p> <p>Delayed response time.</p>
Chemical dispersion	Vessel Application	X	<p>Surface chemical dispersants are most effective on hydrocarbons that are at a thickness of 50–100 g/m² on the sea surface. EMSA (2010) recommends thin layers of spilled hydrocarbons should not be treated with dispersant. MGO/MDO is not considered a persistent hydrocarbon and has high natural dispersion rates in the marine environment, rapidly spreading to a thin sheen. Chemical dispersant application is not recommended as a beneficial option for MGO/MDO as it has a low additional benefit of increasing the dispersal rate of the spill while introducing the potential for more chemicals into the marine environment.</p>
	Aerial Application	X	
Offshore Containment and Recovery	Use of offshore booms/ skimmers or other collection techniques deployed from vessel/s to contain and collect oil	X	<p>Containment and recovery effectiveness drops significantly with reduced oil thickness (McKinney and Caplis 2017; NOAA 2013). McKinney and Caplis (2017) tested the effectiveness of various oil skimmers at different oil thicknesses. Their results showed that the oil recovery rate of skimmers dropped significantly when oil thickness was <50 g/m². Given the rapid weathering nature of MGO/MDO, and its ability to spread quickly to a thin film, containment and recovery would be ineffective.</p>
Mechanical Dispersion	Vessel prop-washing	✓ 2	<p>Safety is a key factor and slicks with potential for high volatile organic compound (VOC) emission are not suitable.</p>

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy	Considerations
		MGO/MDO	
			<p>Mechanical dispersion may be applicable for the localised entrainment of surface oil but is not considered to have a significant effect on removing oil from the surface.</p> <p>Mechanical dispersion will entrain surface oil into the top layer of the water column. The aim of mechanical dispersion is to reduce the concentration of oil floating at the surface which could potentially contact receptors at the sea surface (e.g. sea birds) or shoreline receptors (e.g. mangroves). Once dispersed in the water column the smaller droplet sizes enhance the biodegradation process.</p> <p>MGO/MDO is a light oil that can be easily dispersed in the water column by running vessels through the plume and using the turbulence developed by the propellers to break up the slick.</p> <p>Mechanical dispersion may be considered for targeted small breakaway patches of crude but may have limited effectiveness.</p> <p>The potential disadvantage of mechanical dispersion is that it could temporarily increase the concentration of entrained and dissolved oil in the vicinity of submerged shallow water receptors (e.g. corals, seagrass and macroalgae). This is most likely in shallow water of a few metres deep. The suitability of mechanical dispersion as a response measure would consider the prevailing environmental conditions (it mimics the action of wave induced entrainment so is most beneficial in calm conditions) and the type, proximity and depth (as applicable) of sensitivities in the area.</p> <p>Mechanical dispersion will be considered for petroleum activity sourced spills at the discretion of the OSC/IMT or by the relevant Control Agency. It is unlikely that vessels would be specifically allocated for mechanical dispersion but support vessels in the field may be used opportunistically.</p>
Protection and Deflection	Booming in nearshore waters and at shorelines	✓ 2	<p>Considered if operational monitoring shows or predicts contact with sensitive shorelines.</p> <p>Modelling shows very low probability of contact with shorelines and no shoreline accumulation >100 g/m². Shoreline protection and deflection activities can result in physical disturbance to intertidal and shoreline habitats. Given the relatively small volumes predicted to come ashore, and the high rates of natural biodegradation of MGO/MDO, it would be better to focus on the priority area for protection. This strategy is</p>

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy	Considerations
		MGO/MDO	
			considered to be a secondary response strategy where it is safe and practical to implement and where priority protection areas are at risk of impact from MGO/MDO.
Shoreline clean-up	Activities include physical removal, surf washing, flushing, bioremediation, natural dispersion	✓ 2	Considered if operational monitoring shows or predicts contact with sensitive shorelines. Modelling shows very low probability of contact with shorelines and no shoreline accumulation >100 g/m ² . Shoreline clean-up activities can result in physical disturbance to shoreline habitats. Given the relatively small volumes predicted to come ashore, and the high rates of natural biodegradation of MGO/MDO, it would be better to focus on high priority areas for clean-up. This strategy is considered to be a secondary response strategy where it is safe and practical to implement and where protection priority areas are at risk of impacts from MGO/MDO.
Oiled wildlife response	Activities include hazing, pre-emptive capture, oiled wildlife capture, cleaning and rehabilitation	✓ 1	Can be used to deter and protect wildlife from contact with oil. Mainly applicable for marine and coastal fauna (e.g. birds) where oil is present at the sea surface or accumulated at coastlines. Surveillance can be carried out as a part of the fauna specific operational monitoring. Wildlife may become desensitised to hazing method. Hazing may impact upon animals (e.g. stress, disturb important behaviours such as nesting or foraging). Permitting requirements for hazing and pre-emptive capture.
Scientific Monitoring	The monitoring of environmental receptors to determine the level of impact and recovery from the oil spill	✓ 1	Monitoring activities include: <ul style="list-style-type: none"> + water and sediment quality + biota of shorelines (sandy beaches, rocky shores and intertidal mudflats) + mangrove monitoring + benthic habitat monitoring (seagrass, algae, corals, non-coral benthic filter feeders) + seabirds and shorebirds

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy	Considerations
		MGO/MDO	
	and associated response activities		<ul style="list-style-type: none"> + marine megafauna (incl. whale sharks and mammals) + marine reptiles (incl. turtles) + seafood quality + fish, fisheries and aquaculture <p>The type and extent of scientific monitoring will depend upon the nature and scale of oil contact to sensitive receptor locations as determined through operational monitoring. Pre-defined initiation criteria exist for scientific monitoring plans associated with marine and coastal sensitivities.</p>

6.5 Identify priority protection areas and initial response priorities

When dealing with oil spills in remote environments, it is not always realistic or feasible to protect all receptors. Therefore, prioritising receptors helps identify where available resources (for response and/or monitoring) should be directed for the best effect. It enables the control agency to make informed decisions, and ultimately in the development and execution of an effective response strategy.

As described in Section 7.5.5.1 of the EP, moderate environmental impact areas (MEVAs) for surface and entrained oil have been created for the pipeline route, based on the greatest distances for hydrocarbons to travel at moderate thresholds, based on spill modelling performed at location KP380. No exposure was predicted for dissolved hydrocarbons above the moderate threshold. The MEVA has been estimated by extrapolating the modelling results at KP380 along the length of the Operational Area. Hydrocarbons above the moderate exposure values are expected to remain in the upper water column with probability of contact decreasing with water depth. Consequently, areas at greatest risk of impact along the pipeline route are the shallower offshore banks and shoals, while impacts are not predicted for benthic habitats in deeper waters in the EMBA.

For the purposes of response planning, results from available hydrocarbon spill modelling were compared against the location of key sensitive receptors with high conservation valued habitat or species or important socio-economic/heritage value.

Table 6-5 outlines the list of priority response and monitoring areas that may be impacted above moderate exposure values in the event of a spill.

It should be noted that the implementation of scientific monitoring is dependent upon the initiation criteria in **Appendix N** being met. In some cases, scientific monitoring will be triggered when aerial, visual or fluorescence observation reports submitted to the IMT show presence or likely presence of oil; or spill fate modelling predicts oil at sensitive receptors of $>1\text{g}/\text{m}^2$ for surface oil, and >10 ppb for entrained and dissolved oil. This then activates the relevant Scientific Monitoring Plan (SMP), which determines if any impact has occurred based upon applicable exposure values.

Table 6-5: Priority response and monitoring areas in the EMBA

Priority response and monitoring area	Description
Tiwi Islands	Contains a range of shoreline types that are vulnerable to oil pollution, including: <ul style="list-style-type: none"> + Mangroves; + Sandy beaches; + Exposed rocky shores; + Wavecut platforms; and + Tidal flats. Contains cultural heritage sites, including: <ul style="list-style-type: none"> + Culturally significant heritage sites for Tiwi Islanders. Contains nesting beaches for flatback and olive ridley turtles and crested terns.

Priority response and monitoring area	Description
Beagle Gulf – Darwin Coast	<p>Includes the Darwin Harbour and areas south west and north west of Darwin on the Northern Territory mainland. Contains a range of receptors vulnerable to oil pollution including;</p> <ul style="list-style-type: none"> + Mangroves; + Sandy beaches; + Delta river mouths; + Tidal flats; + Shorebirds and seabirds; and + Turtle nesting beaches. <p>Contains nationally recognised wetlands, particularly:</p> <ul style="list-style-type: none"> + Port Darwin + Shoal Bay – Micket Creek <p>Contains sites of socioeconomic and cultural importance, including:</p> <ul style="list-style-type: none"> + Recreational fishing, tourism, boating, scuba diving; + Shipwrecks; and + Culturally significant heritage sites.
Vernon Islands	<p>Located in the Clarence Strait in the Northern Territory, between the Australian mainland Melville Island. Contains a range of shoreline types and species that are vulnerable to oil pollution, including:</p> <ul style="list-style-type: none"> + Mangroves; + Coral reefs and extensive coralline algal terraces; + Sandy beaches; + Mudflats; + Dugong populations; and + Turtles. <p>Contains sites of socioeconomic and cultural importance, including:</p> <ul style="list-style-type: none"> + Culturally significant heritage sites for Tiwi, Larrakia and Wulna people (TLC, 2013); + Important diving sites ('Blue Holes') (TLC, 2013); and + Shipwrecks.
Offshore shoals and banks (<30 m depth)	<ul style="list-style-type: none"> + Newby Shoals + Shepparton Shoals + Flat Top Bank + The Boxers
Oceanic Shoals Marine Park	<p>The Oceanic Shoals Marine Park is protected under the EPBC Act. The Oceanic Shoals Marine Park is significant because it contains habitats, species and ecological communities associated with the Northwest Shelf Transition. It contains four key ecological features: carbonate bank and terrace systems of the Van Diemen Rise; carbonate bank and terrace systems of the Sahul Shelf; pinnacles of the Bonaparte Basin; and shelf</p>

Priority response and monitoring area	Description
	break and slope of the Arafura Shelf (all valued as unique seafloor features with ecological properties of regional significance).

6.6 Net environmental benefit analysis

The IMT uses a NEBA, also referred to as a spill impact mitigation assessment (SIMA), to inform the incident action planning process (**Section 8**), so the most effective response strategies with the least detrimental environmental impacts can be identified, documented and executed.

The Environment Unit Leader will use the information in **Section 6.5** to identify and prioritise initial response priorities and apply the NEBA to identify which response strategies are preferred for the situation, oil type and behaviour, environmental conditions, direction of plume and priorities for protection.

As a component of the incident action planning process, NEBA is conducted by the Control Agency with responsibility for the spill response activity. Where there are different activities controlled by different IMTs, as in a cross-jurisdictional response, consultation will be required during the NEBA process such that there is consistency in the sensitivities prioritised for response across the Control Agencies.

In the event of a spill, NEBA is applied with supporting information collected as part of the Operational Monitoring Plan (**Section 10**) to achieve the following:

- + Identify sensitivities within the area potentially affected by a spill at that time of the year (noting that the sensitivity of some key receptors, such as birdlife and turtles, varies seasonally).
- + Assist in prioritising and allocating resources to sensitivities with a higher protection and response priority.
- + Assist in determining appropriate response strategies with support of real-time metocean conditions, oil spill tracking and fate modelling.

When a spill occurs, NEBA is applied to the current situation, or operationalised. Operational NEBA Templates are filed within the Environment Unit Leader folder on the Santos ER Intranet site. To complete the Operational NEBA:

- + All ecological and socioeconomic sensitivities identified within the spill trajectory area are recorded.
- + Potential effects of response strategies on each sensitivity are assessed in terms of their benefit or otherwise to the socio-economic sensitivities.
- + All persons involved and data inputs have been considered for the analysis.

The Operational NEBA Form documents the decisions behind the recommendation to the Incident Commander on which resources at risk to prioritise, and the positives and negatives of response strategies to deploy. The Operational NEBA provides guidance to the IAPs and is revisited each Operational Period.

6.7 Oil spill response as-low-as-reasonably-practicable assessment

For each response strategy included within this OPEP an environmental performance outcome has been determined and key control measures and performance standards have been identified such that the response can meet the required performance outcome. For each response strategy, an ALARP assessment has been conducted to demonstrate that the control measures mitigate the risk of an oil spill to ALARP.

Appendix B details the ALARP assessment framework and the results of the ALARP assessment conducted to inform the control measures and performance standards contained within this OPEP.

7 External notifications and reporting requirements

For oil spill incidents, the OSC (or Company Site Representative) will notify the Perth-based IMT for delegation of further notifications to relevant regulatory authorities and for further spill response assistance for Level 2 spills.

7.1 Regulatory notification and reporting

The Incident Commander (IC) is to delegate the following regulatory reporting requirements. Typical delegated parties will be the Safety Officer and the Environment Unit Leader.

Contact details for the Regulatory agencies outlined in **Table 7-1** are provided within the Incident Response Telephone Directory (SO-00-ZF-00025.020).

Table 7-1 outlines the external regulatory reporting requirements specifically for oil spill incidents outlined within this OPEP in Commonwealth and Territory jurisdictions, noting that regulatory reporting may apply to smaller Level 1 spills that can be responded to using on-site resources as well as larger Level 2 spills. There are also additional requirements for Vessel Masters to report oil spills from their vessels under relevant marine oil pollution legislation (e.g. MARPOL). This includes, where relevant, reporting oil spills to AMSA (Rescue Coordination Centre) and the NT Regional Harbourmaster.

Territory water notifications to the NT Department of Environment, Parks and Water Security (DEPWS) will apply to spills in NT waters or spills originating in Commonwealth waters and moving to NT waters.

The Incident Response Telephone Directory (SO-00-ZF-00025.02) contains a more detailed list and contact details for incident response support and is updated every 6 months with up-to-date revisions available within the IMT room and online (intranet procedures and emergency response pages).

7.2 Activation of external oil spill response organisations and support agencies

Table 7-2 outlines notifications that should be made to supporting agencies to assist with spill response activities outlined within this plan. This list contains key OSROs that have pre-established roles in assisting Santos in an oil spill response. It is not an exhaustive list of all providers that Santos may use for assisting an oil spill response.

The Incident Response Telephone Directory (SO-00-ZF-00025.02) contains a more detailed list and contact details for incident response support and is updated every six months with up-to-date revisions available within the IMT room and online (intranet procedures and emergency response pages).

7.3 Environmental performance

Table 7-3 lists the environmental performance standards and measurement criteria for external notifications and reporting.

Table 7-1: External notification and reporting requirements (Commonwealth, state and international waters)

Agency or Authority	Type of notification/ timing	Legislation/guidance	Reporting requirements	Responsible person/group	Forms
NOPSEMA reporting requirements for Commonwealth water spills					
NOPSEMA (Incident Notification Office)	Verbal notification within two hours Written report as soon as practicable, but no later than three days	<i>Petroleum and Greenhouse Gas Storage Act 2006</i> Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations 2009 (as amended 2014)	A spill associated with the activity in <u>Commonwealth waters</u> that has the potential to cause moderate to significant environmental damage ¹	Notification by Environment Unit Leader (or delegate)	Incident reporting requirements: https://www.nopsema.gov.au/environmental-management/notification-and-reporting/
National Offshore Petroleum Titles Administrator (NOPTA) (Titles Administrator)	Written report to NOPTA within seven days of the initial report being submitted to NOPSEMA	Guidance Note (N-03000-GN0926) Notification and Reporting of Environmental Incidents	Spill in <u>Commonwealth waters</u> that is reportable to NOPSEMA	Notification by Environment Unit Leader (or delegate)	Provide same written report as provided to NOPSEMA
AMSA Rescue Coordination Centre (RCC)²	Verbal notification within two hours of incident Written POLREP form, within 24 hours on request from AMSA	MARPOL	Santos to notify AMSA of any marine pollution incident ¹	Notification by Environment Unit Leader (or delegate)	Not applicable
Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) (Director of monitoring and audit section)	Email notification as soon as practicable	<i>Environment Protection and Biodiversity Conservation Act 1999</i>	If Matters of National Environmental Significance (MNES) are considered at risk from a spill or response strategy, or where there is death or injury to a protected species	Notification by Environment Unit Leader (or delegate)	Not applicable

Agency or Authority	Type of notification/ timing	Legislation/guidance	Reporting requirements	Responsible person/group	Forms
Parks Australia (24-hour Marine Compliance Duty Officer)	Verbal notification as soon as practicable	<i>Environment Protection and Biodiversity Conservation Act 1999</i>	An oil spill which occurs within a marine park or are likely to impact on an Australian Marine Park	Notification by Environment Unit Leader (or delegate)	Not applicable, but the following information should be provided: <ul style="list-style-type: none"> + Titleholder's details + Time and location of the incident (including name of marine park likely to be affected) + Proposed response arrangements as per the OPEP + confirmation of providing access to relevant monitoring and evaluation reports when available + Details of the relevant contact person in the IMT
Australian Fisheries Management Authority (AFMA)	Verbal phone call notification within 24 hours of incident	For consistency with DPIRD Fisheries notification	Reporting of marine oil pollution ¹ Fisheries within the EMBA Consider a courtesy call if not in exposure zone	Notification by Environment Unit Leader (or delegate)	Not applicable

Agency or Authority	Type of notification/ timing	Legislation/guidance	Reporting requirements	Responsible person/group	Forms
If spill is heading towards NT waters					
NT Regional Harbourmaster	Verbal notification Follow up with POLREP as soon as practicable after verbal notification	Northern Territory Oil Spill Contingency Plan. As per Territory legislation (i.e., <i>Marine Pollution Act 1999</i>)	All actual or impending spills in NT waters, regardless of source or quantity Notify if spill has the potential to impact wildlife in Territory waters (to activate the Oiled Wildlife Coordinator)	Notification by IMT Environment Unit Leader (or delegate)	POLREPs to be emailed to rhm@nt.gov.au (Regional Harbourmaster) 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
NT Department of Environment, Parks and Water Security (DEPWS) (Pollution Response Hotline; Environmental Operations)	Verbal notification as soon as practicable Written report to be provided as soon as practicable after the incident, unless otherwise specified by the Minister	Northern Territory Oil Spill Contingency Plan. As per State legislation (i.e., <i>Marine Pollution Act 1999</i>)	All actual or impending spills in NT waters	Notification by IMT Environment Unit Leader (or delegate)	Marine Pollution Reports (POLREPs) are to be emailed to pollution@nt.gov.au (Environmental Operations) 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

Agency or Authority	Type of notification/ timing	Legislation/guidance	Reporting requirements	Responsible person/group	Forms
Department of Industry, Tourism and Trade (DITT)	Verbal notification, timing not specified	Not applicable	Fisheries within the EMBA Consider a courtesy call if not in exposure zone	Notification by IMT Environment Unit Leader (or delegate)	Not applicable

1: For clarity and consistency across Santos regulatory reporting requirements, Santos will meet the requirement of reporting a marine oil pollution incident by reporting oil spills assessed to have an environmental consequence of moderate or higher in accordance with Santos’ environmental impact and risk assessment process outlined in Section 5 of the EP.

2: Santos reporting requirements only listed. For oil spills from vessels, Vessel Masters also have obligations to report spills from their vessels to AMSA Rescue Coordination Centre (RCC) and, in Territory waters, NT Regional Harbourmaster.

Table 7-2: List of spill response support notifications

Organisation	Indicative timeframe	Type of communication	Resources available	Activation instructions	Santos person responsible for activating
AMOSC Duty Officer	As soon as possible but within two hours of incident having been identified	Verbal Service Contract	Santos is a Participating Company in AMOSC and can call upon AMOSC personnel and equipment (including oiled wildlife). Under the AMOSPlan, Santos can also call upon mutual aid from other trained industry company personnel and response equipment AMOSC's stockpiles of equipment include dispersant, containment, recovery, cleaning, absorbent, oiled wildlife and communications equipment. Equipment is located in Geelong, Fremantle, Exmouth and Broome	Step 1. Obtain approval from Incident Commander to mobilise AMOSC. Step 2. Notify AMOSC that a spill has occurred. Put on standby as required – activate if spill response escalates in order to mobilise spill response resources consistent with the AMOSPlan. Step 3. Email confirmation and a telephone call to AMOSC will be required for mobilisation of response personnel and equipment. Only a Santos call-out authority (registered with AMOSC) can activate AMOSC and will be required to supply their credentials to AMOSC. A signed service contract must also be completed by the Santos call-out authority and returned to AMOSC before mobilisation.	Environment Unit Leader (or delegate) will notify AMOSC (upon approval from Incident Commander)
Aviation Service Provider	Within two hours of incident having been identified	Verbal	Helicopters/pilots available for aerial surveillance. Contract in place	Phone call.	Logistics Section Chief (or delegate)

Organisation	Indicative timeframe	Type of communication	Resources available	Activation instructions	Santos person responsible for activating
Duty Officers/ Incident Commanders (Woodside, BHP, Chevron)	Within two hours of incident having been identified	Verbal	Mutual aid resources (through AMOSC mutual aid arrangement)	Phone call.	Incident Commander (or delegate)
Toll - Freight & Logistics	Within two hours of incident having been identified	Verbal	Assistance with mobilising equipment and loading vessels	Phone call.	Logistics Section Chief (or delegate)
Waste Service Provider/s	As required for offshore and shoreline clean-up activities	Verbal	Santos has contract arrangements in place to take overall responsibility to transport and dispose of waste material generated through clean-up activities	Phone call to the Primary Contact Person. In the event the Primary Contact Person is not available, the Secondary Contact Person will be contacted.	Logistics Section Chief (or delegate)
Astron (Monitoring Service Provider)	Scientific Monitoring Plan initiation criteria are met (Appendix N)	Verbal and written	Astron has been contracted by Santos to provide Standby Services for Scientific Monitoring Plans (SMPs) 1 to 11. This includes provision of personnel and equipment. Astron annually reviews the SMPs for continual improvement	<p>Step 1. Obtain approval from Incident Commander to activate Astron for Scientific Monitoring.</p> <p>Step 2. Verbally notify Astron followed by the submission of an Activation Form (Environment Unit Leader Folder) via email.</p> <p>Step 3. Provide additional details as requested by the Astron Monitoring Coordinator on call-back.</p>	Environment Unit Leader (or delegate)

Organisation	Indicative timeframe	Type of communication	Resources available	Activation instructions	Santos person responsible for activating
				Step 4. Astron initiates Scientific Monitoring Activation and Response Process.	
Intertek Geotech (WA) Environmental Services and Ecotoxicology	When characterisation of oil is activated (Section 10.7)	Verbal	Oil analysis including gas chromatography/mass spectrometry fingerprinting	Phone call.	Environment Unit Leader (or delegate)
Oil Spill Response Limited, OSRL Duty Manager	Within two hours of incident having been identified	Verbal OSRL Mobilisation Authorisation Form	Santos has a Service Level Agreement with OSRL, which includes the provision of support functions, equipment and personnel to meet a wide range of scenarios At minimum OSRL will provide technical support to the IMT and place resources on standby Further details available on the OSRL webpage.	Step 1. Contact OSRL Duty Manager in Singapore and request assistance from OSRL. Step 2. Send notification to OSRL as soon as possible after verbal notification. Step 3. Upon completion of the OSRL incident notification form, OSRL will plan and place resources on standby.	Designated call-out authorities (including Incident Commanders)
RPS Group	As soon as possible but within two hours of incident having been identified	Verbal and written	Santos has an agreement in place with RPS Group to allow rapid marine hydrocarbon spill modelling capability to be activated at any time during activities, which will be undertaken for any spill greater than Level 1. AMOSC can also run modelling on behalf of Santos, if	Contact RPS Group Duty Officer.	Environment Unit Leader (or delegate)

Organisation	Indicative timeframe	Type of communication	Resources available	Activation instructions	Santos person responsible for activating
			required, as part of contracting arrangements with RPS Group		

Table 7-3: Environmental performance – external notification and reporting

Environmental performance outcome	Make notifications and reports within regulatory and defined timeframes.		
Response strategy	Control measures	Performance standards	Measurement criteria
External notifications and reporting plan	Response preparedness		
	Santos Incident Response Telephone Directory (SO-00-ZF-00025.020)	Incident Response Telephone Directory is revised every six months	Document revision history
	OPEP communications test	OPEP contact details for regulatory and service provider notifications are checked annually	Test records
	Response implementation		
	External notifications and reporting tables	External notification and reporting undertaken as per Table 7-1 and Table 7-2	Incident log

8 Incident action planning

The incident action planning process is built on the following phases:

1. Understand the situation.
2. Establish incident priorities, objectives and tasks.
3. Develop a plan (IAP).
4. Prepare and disseminate the plan.
5. Execute, evaluate and revise the plan for the next operational period.

The Santos IMT will use the IAP process to determine and document the appropriate response priorities, objectives, strategies and tasks to guide the incident response which are reviewed and updated as more information becomes available. The IMT will use an IAP for each operational period following the initial first-strike assessments, notifications, and activations undertaken.

When acting as the support agency, Santos may be requested by the control agency to develop or support the development of an IAP to help guide the incident response.

The Santos IAP process is built on the phases described in **Figure 8-1**.

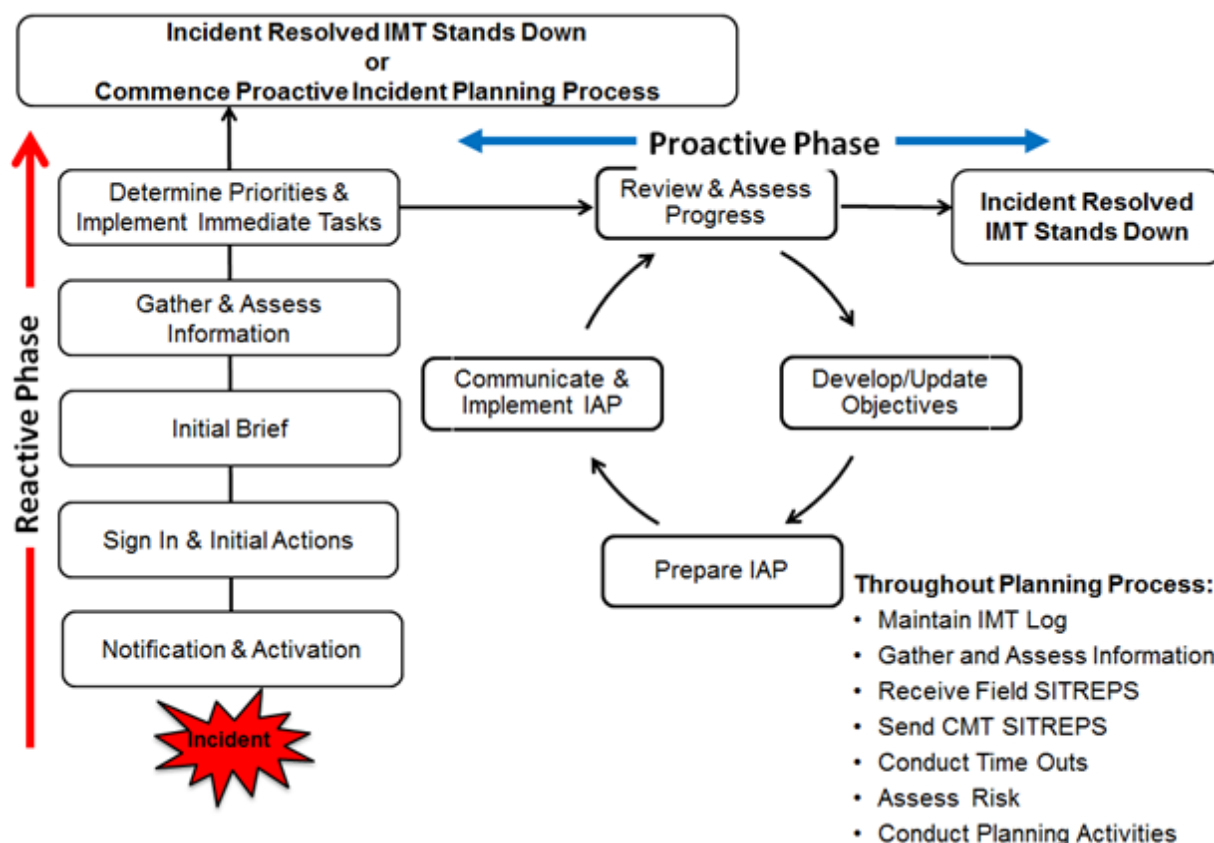


Figure 8-1: Incident action plan process

8.1.1 Reactive phase planning

The initial phase of the incident action planning process can be considered a reactive phase (indicatively lasting up to 48 hours) where information on the incident is being progressively established through reports

coming in from the field. During this phase there is no formal incident action plan to follow (given the incident has just begun and details are still being established) however the OPEP (this document) has been prepared to contain all first-strike oil spill response actions required to be followed during this phase in lieu of a formal IAP.

First-strike response actions are summarised in **Section 2** and provide links to relevant oil spill strategy sections within the OPEP which contain a more detailed list of implementation actions and considerations as well as statements of performance (performance standards) that must be followed to ensure the initial response meets regulatory requirements and environmental performance outcomes.

For the credible oil spill scenario covered by this OPEP, the first-strike response actions have been informed by a pre-assessment of applicable oil spill response strategies, priority response locations and a strategic NEBA also referred to as a SIMA. This pre-planning is included in **Section 6**. During the reactive phase the strategic NEBA is to be reviewed and, using the specific information gathered from the spill, operationalised into an operational NEBA. This assessment helps verify that the response strategies pre-selected for each spill scenario are providing the best environmental outcome for the incident response.

8.1.2 Developing an incident action plan

At the end of the reactive phase where the incident specifics have been determined, a more formal phase of spill response is entered whereby a documented IAP is developed to guide the incident response activities for the next operational period. An operational period is defined as the period scheduled for execution of actions specified in the IAP. The next operational period is nominally a daily period but for long running incidents may be extended further where the pace of the incident response has settled, and the level of new information has decreased.

As IAPs and response strategies are implemented their performance is monitored. The performance measurement results are fed back into the IMT to provide the IMT with greater situational awareness to enable the effective formulation of following IAPs. Those response strategies that are effective are continued or increased, while those strategies that are ineffective are scaled back or ceased.

The performance against the objectives of the IAP must be documented in the Incident log by the IMT. This provides the IMT with information required to assist in formulating the following IAP and provides evidence of Santos' response to the incident for regulatory and legal investigations that will follow the termination of the incident.

IAP performance is monitored through IMT communication with in-field response personnel both verbally and through logs/reports/photos sent throughout the response (e.g. surveillance personnel, team leaders, laboratory chemists) who report on the effectiveness of the response strategies.

IAP forms and processes are documented in the *Incident Command and Management Manual* (SO-00-ZF-00025) and in the 'Emergency Response' folder sets at *L:\Resource\Emergency Response\Incident-Exercise Number-Name*. Begin the response by copying and saving *Incident-Exercise Number-Name* folder set with a unique incident name and Id number on the lead folder; this is the Incident log. Access subfolders to display all forms required to conduct incident action planning. Each functional position within the IMT and CMT has subfolders carrying forms and processes unique to the functional position.

8.1.3 Environmental performance

Table 8-1 lists the environmental performance standards and measurement criteria for incident action planning.

Table 8-1: Environmental performance – incident action planning

Environmental performance outcome	Manage incident via a systematic planning process		
Response strategy	Control measures	Performance standards	Measurement criteria
Incident action planning	Response preparedness		
	IMT Exercise and Training Plan	Incident action planning and NEBA is practiced by the IMT during exercises	Exercise records
	Tactical Response Plans (TRP)	If operational monitoring shows that shoreline contact of Priority Protection Areas is likely, TRPs will be developed or sought from other titleholders/ regional industries prior to shoreline contact.	TRP
	Response implementation		
	Incident action plan	Incident action plan is completed for each operational period and approved by the Incident Commander	Incident log Incident action plan/s
		Monitor effectiveness of response strategies being implemented and use information in the development of IAPs	Incident log Incident action plan/s
	NEBA	An operational NEBA will be undertaken for each operational period of the incident	NEBA Incident action plan
	IMT activation and de-escalation	IMT will be activated Immediately once notified of a Level 2 spill (to Incident Commander).	Incident Action Plan
The decision to de-escalate the IMT will be made in consultation with the relevant Control Agency/s, Jurisdictional Authorities and other Statutory Authorities that play an advisory role.		NEBA Incident Action Plan	

9 Source control

The initial and highest priority response to an oil spill incident following the health and safety of on-site personnel is to prevent or limit further loss of hydrocarbons to the environment.

For vessels with a SOPEP, the SOPEP will provide the relevant initial actions to control the source of the spill.

The sections below provide an outline of source control activities noting that the Vessel SOPEP, where applicable, will provide a higher level of detail for specific incidents.

9.1 Vessel collision – fuel tank rupture

Table 9-1 provides the environmental performance outcome, initiation criteria and termination criteria for source control response to a fuel tank rupture. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 9-1: Vessel collision – source control environmental performance outcome, initiation criteria and termination criteria

Environmental performance outcome.	Implementation of source control methods to stop the release of hydrocarbons into the marine environment
Initiation criteria	Notification of a spill
Termination criteria	Release of oil to the marine environment has ceased and the workplace environment is deemed environmentally safe and free of hydrocarbons

9.1.1 Implementation guidance

Implementation guidance is summarised in **Table 9-2**. In the event MGO/MDO is released from a vessel due to a tank rupture, the relevant vessel-specific procedures will be applied. For vessel collisions, the vessel's SOPEP will be followed to control the source, reduce the loss of hydrocarbons and prevent escalation of the incident. **Table 9-3** lists the environmental performance standards and measurement criteria for this strategy.

Table 9-2: Implementation guidance – fuel tank rupture

	Action	Consideration	Responsibility	Complete
Initial actions	<p>The vessel’s SOPEP, as applicable under MARPOL, or procedure for responding to a ruptured tank will be followed, as applicable.</p>	<p>Notwithstanding vessel-specific procedures for source control, the following activities would be evaluated immediately for implementation, providing it is safe to do so:</p> <ul style="list-style-type: none"> + Reduce the head of fuel by dropping or pumping the tank contents into an empty or slack tank. + Consider pumping water into the leaking tank to create a water cushion to prevent further fuel inventory loss. + If the affected tank is not easily identified, reduce the level of the fuel in the tanks in the vicinity of the suspected area if stability of the vessel will not be compromised. + Evaluate the transfer of fuel to other vessels. + Trim or lighten the vessel to avoid further damage to intact tanks. + Attempt repair and plugging of hole or rupture. 	<p>Vessel Master</p>	<input type="checkbox"/>

9.2 Environmental performance

Table 9-3 indicates the environmental performance outcomes, controls and performance standards for the Source Control response strategy.

Table 9-3: Environmental performance – source control

Environmental Performance Outcome	Implementation of source control methods to stop the release of hydrocarbons into the marine/onshore environment.		
Response Strategy	Control Measures	Performance Standards	Measurement Criteria
Response Preparedness			
Source control – vessel collision	Vessel Spill Response Plan (SOPEP/SMPEP)	Vessels associated with the activity have a SOPEP or shipboard marine pollution emergency plan (SMPEP) that outlines steps taken to combat spills	Audit records Inspection records
		Spill exercises on vessels are conducted as per the vessels SOPEP or SMPEP	Spill exercise close out reports
Response Implementation			
Source control – vessel collision	As per the vessel SOPEP/SMPEP	Actions to control spill associated with a vessel incident followed in accordance with SOPEP/SMPEP	Vessel logs

10 Monitor and evaluate

Understanding the behaviour and likely trajectory of an oil spill is critical to evaluate the appropriate response strategy. There are a number of methods that can be used to monitor and evaluate, including:

- + vessel surveillance
- + aerial surveillance
- + tracking buoys
- + oil spill trajectory modelling
- + satellite imagery
- + initial oil characterisation
- + operational water quality monitoring
- + shoreline clean-up assessment.

10.1 Vessel surveillance

Table 10-1 lists the environmental performance outcome, initiation and termination criteria for this strategy.

Table 10-1: Vessel surveillance – environmental performance outcome, initiation and termination criteria

Environmental performance outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making
Initiation criteria	Notification of a Level 2 spill – may be deployed in a Level 1 incident (to be determined by OSC)
Termination criteria	<ul style="list-style-type: none"> + Vessel-based surveillance is undertaken at scheduled intervals during daylight hours and continues for 24 hours after the source is under control and a surface sheen is no longer observable, OR + NEBA is no longer being achieved, OR + Agreement is reached with Jurisdictional Authorities to terminate the response.

Direct observations from field support or other vessels can be used to assess the location and visible extent of the hydrocarbon incidents, and to verify modelling predictions and trajectories. Due to the proximity of observers to the water's surface, vessel surveillance is limited in its coverage in comparison to aerial surveillance and may also be compromised in rough sea-state conditions or where fresh hydrocarbons at surface pose safety risks.

10.1.1 Implementation guidance

Table 10-2 provides guidance to the IMT on the actions and responsibilities to be considered when selecting this strategy. **Table 10-3** has a list of resources that may be used to implement this strategy. Mobilisation times for the minimum resources that are required to start initial vessel surveillance operations are listed in **Table 10-4**. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 10-35 lists the environmental performance standards and measurement criteria for this strategy.

Table 10-2: Implementation guidance – vessel surveillance

	Action	Consideration	Responsibility	Complete
Initial actions	Notify nearest available Support Vessel to commence surveillance.	Current Santos on hire vessels or Vessels of Opportunity (VOO) can be used. Automatic Identification System (AIS) vessel tracking is available through Emergency Response (ER) intranet page.	On-Scene Commander Operations Section Chief	<input type="checkbox"/>
	Source additional contracted vessels if required for assistance.		Logistics Section Chief	<input type="checkbox"/>
	Record surface slick location and extent, weather conditions, and marine fauna. Complete vessel surveillance forms (Appendix E) and provide to On-Scene Commander (Level 1 spills) or IMT (Level 2 spills).	Photographic images are to be taken where possible and included with surveillance forms. Trained observers will not be available immediately – photos and locations will provide initial information that can be interpreted by IMT.	Vessel Observers	<input type="checkbox"/>
	Relay surveillance information (spill location, weather conditions, marine fauna sightings and visual appearance of the slick) to the IMT within 60 minutes of completing vessel surveillance.	Initial reports to the IMT may be verbal (followed by written transmission) if the vessel is out of range or has no facilities for transmitting forms.	Vessel Master and/or On-Scene Commander	<input type="checkbox"/>
Ongoing actions	Review surveillance information to validate spill fate and trajectory.		Planning Section Chief / GIS	<input type="checkbox"/>
	Use available data to conduct operational NEBA and confirm that pre-identified response options are appropriate.		Environment Unit Leader	<input type="checkbox"/>
	Use monitor and evaluate data to periodically reassess the spill and modify the response (through the IAP), as required	Surveillance data is useful in updating the Common Operating Picture	Planning Section Chief	<input type="checkbox"/>

Table 10-3: Vessel surveillance resource capability

Equipment type/ personnel required	Organisation	Quantity available	Location	Mobilisation timeframe
Contracted vessels and vessels of opportunity	Santos Contracted Vessel Providers Vessels of opportunity identified through AIS Vessel Tracking.	Availability dependent upon Santos and Vessel Contractor activities.	Vessels mobilised from Darwin. Locations verified through AIS Vessel Tracking Software.	Pending availability and location. Expected within 12 hours.

Table 10-4: Vessel surveillance – first-strike response timeline

Task		Time from IMT call-out
IMT begins sourcing Santos-contracted vessel or VOO for on-water surveillance		<90 minutes
VOO on site for surveillance		<24 hours (daylight dependent)
Minimum resource requirements		
One vessel. No specific vessel or crew requirements.		
Approximate steam time		
Deployment location	Approximate distance to operational area ¹² (nautical miles)	Approximate steam time ¹³ (hours)
Darwin	132	13.2
Broome	260	26

10.2 Aerial surveillance

Table 10-5 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-5: Aerial surveillance – environmental performance outcome, initiation criteria and termination criteria

Environmental performance outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making
Initiation criteria	Notification of a Level 2 spill
Termination criteria	<ul style="list-style-type: none"> + Aerial surveillance undertaken at scheduled intervals during daylight hours and continues for 24 hours after the source is under control and a surface sheen is no longer observable, OR + As directed by the relevant Control Agency

Aerial surveillance is used to record the presence and size of the hydrocarbon spill at surface as well as other environmental observations including weather conditions, marine fauna and sensitive receptors in the area. Aerial surveillance provides superior coverage over vessel surveillance for estimating the spatial extent of a spill but is generally required only for larger Level 2 spills.

10.2.1 Implementation guidance

Table 10-6 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy.

Table 10-7 provides a list of resources that may be used to implement this strategy. Mobilisation times for the minimum resources that are required to commence initial aerial surveillance operations are listed in

¹² As measured to geometric centre point of operational area

¹³ At average rate of 10 knots

Table 10-8. The On-Scene Commander and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 10-35 lists the environmental performance standards and measurement criteria for this strategy.

Table 10-6: Implementation guidance – aerial surveillance

Action	Consideration	Responsibility	Complete
<div style="background-color: red; color: white; padding: 5px; writing-mode: vertical-rl; transform: rotate(180deg);">Initial actions</div> <p>Contact contracted aviation provider – provide details of incident and request mobilisation to spill site for initial surveillance.</p>	<p>If aviation asset is available near spill location, use where possible to gather as much information about the spill. If aviation asset not available at spill location IMT is to seek available resources through existing contractual arrangements.</p> <p>It is possible that the initial surveillance flight will not include a trained aerial surveillance observer. Initial flights can be conducted using a standard crew and initial surveillance should not be delayed waiting for trained personnel. Ensure all safety requirements are met before deployment.</p> <p>There should be an attempt to obtain the following data during initial surveillance:</p> <ul style="list-style-type: none"> + name of observer, date, time, aircraft type, speed and altitude of aircraft + location of slick or plume (global positioning system [GPS] positions, if possible) + spill source + size of the spill, including approximate length and width of the slick or plume + visual appearance of the slick (e.g. colour) + edge description (clear or blurred) + general description (windrows, patches etc.) + wildlife, habitat or other sensitive receptors observed + basic metocean conditions (e.g. sea state, wind, current) + photographic/video images. 	<p>Operations Section Chief Logistics Section Chief</p>	<p style="text-align: center;"><input type="checkbox"/></p>

Action	Consideration	Responsibility	Complete
Source available Santos Aerial Observers, arrange accommodation/logistics and deploy to Forward Operations/Air base location.	Santos Aerial Observer list available from First-strike Resources on Santos Offshore ER Intranet page.	Operations Section Chief Logistics Section Chief	<input type="checkbox"/>
Develop flight plan (frequency and flight path) to meet IMT expectations and considering other aviation ops. Expected that two overpasses per day of the spill area are completed.	Flight plan to confirm with OSC that aircraft are permitted in the vicinity of the spill. Flights are only to occur during daylight and in weather conditions that do not pose significant safety risks.	Operations Section Chief / Aviation Superintendent	<input type="checkbox"/>
Pre-flight briefing.		Aerial Observers Contracted aircraft provider/ pilots	<input type="checkbox"/>
Aerial Observers to commence surveillance	Consider procedure for interacting with marine fauna.	Operations Section Chief	<input type="checkbox"/>
Determine spill extent by completing Aerial Surveillance Log (Appendix F) and Aerial Surveillance Surface Slick Monitoring Template. Calculate volume of oil (Appendix G). Take still and/or video images of the slick.	Thickness estimates are to be based on the Bonn Agreement Oil Appearance Code.	Aerial Observer	<input type="checkbox"/>
Record presence and type of fauna by completing the Aerial Surveillance Marine Fauna Sighting Record Sheet (Appendix H).		Aerial Observer	<input type="checkbox"/>
Relay all surveillance records: logs, forms, photographic images, video footage to the IMT	Where possible, a verbal report via radio/telephone en-route providing relevant information should be considered if the aircraft has long transits from the spill location to base.	Aerial Observer Planning Section Chief Operations Section Chief	<input type="checkbox"/>

	Action	Consideration	Responsibility	Complete
Ongoing actions	Update flight schedule for ongoing aerial surveillance as part of broader Aviation Subplan of IAP	Frequency of flights should consider information needs of IMT to help maintain the Common Operating Picture and determine ongoing response operations	Operations Section Chief / Aviation Superintendent Planning Section Chief	<input type="checkbox"/>
	Mobilise additional aircraft and trained observers to the spill location to undertake ongoing surveillance activities		Logistics Section Chief	<input type="checkbox"/>
	Update Common Operating Picture with surveillance information and provide updates to spill trajectory modelling provider		Planning Section Chief GIS Team Leader	<input type="checkbox"/>

Table 10-7: Aerial surveillance resource capability

Equipment type/personnel required	Organisation	Quantity available	Location	Mobilisation timeframe
Rotary-Wing Aircraft & flight Crew	Santos contracted provider/s (primary provider currently Babcock)	2 x contracted (1 x primary + 1 x backup) + additional as required	Darwin Karratha Learmonth Onslow	Wheels up within 1 hour for Emergency Response. Spill surveillance <10 hours (daylight dependent)
Aerial Surveillance Crew	Santos aerial observers AMOSC Industry Mutual aid	7 x Santos staff 9 x AMOSC staff 5 x AMOSC Core Group personnel available Additional trained industry mutual aid personnel	Perth and Varanus Island (VI) (Santos aerial observers) Australia wide	Santos trained personnel – next day mobilisation to airbase <24 hours
Drones and pilots ** secondary response to assist vessel-based surveillance	AMOSC OSRL – Third-Party UAV provider Local WA hire companies	2 x pilots 2 x qualified remote pilots, however response is on best endeavour 10+	Geelong Perth Perth and regional WA	<48 hours OSRL – depending on the port of departure, one to two days if within Australia

Table 10-8: Aerial surveillance – first-strike response timeline

Task		Time from IMT call-out
Aircraft activated for aerial surveillance		<3 hours
Aircraft on site for aerial surveillance		<6 hours (daylight dependent)
Trained Aerial Observers mobilised to airbase (Darwin)		<24 hours (daylight dependent)
Minimum resource requirements		
+ Santos contracted helicopter and pilots (based in Darwin)		
+ Santos trained Aerial Observers		
Approximate flight time		
Airport	Approximate distance ¹⁴ (nm)	Approximate flight time ¹⁵ (hours: minutes)
Darwin	131	1
Broome	245	2

10.3 Tracking buoys

Table 10-9 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-9: Tracking buoys – environmental performance outcome, initiation criteria and termination criteria

Environmental performance outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making
Initiation criteria	Notification of a Level 2 spill May be deployed for a Level 1 spill if deemed beneficial by the OSC
Termination criteria	+ Tracking buoy deployment will continue for 24 hours after the source is under control and a surface sheen is no longer observable, OR + As directed by the relevant Control Agency.

10.3.1 Implementation guidance

Table 10-10 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 10-11** provides a list of resources that may be used to implement this strategy. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned. **Table 10-35** lists the environmental performance standards and measurement criteria for this strategy.

¹⁴ As measured to geometric centre point of operational area

¹⁵ At average flight speed of 120 knots

Table 10-10: Implementation guidance – tracking buoys

	Action	Consideration	Responsibility	Complete
Initial actions	Organise vessel to mobilise 2 x tracking buoys to site from Darwin.	Personnel and vessel safety is priority. Current Santos on hire vessels or VOOs can be used. AIS vessel tracking is available through ER intranet page.	OSC/Operations Section Chief	<input type="checkbox"/>
	Deploy two tracking buoys at leading edge of slick.	Note deployment details and weather conditions in incident log.	Vessel Master	<input type="checkbox"/>
	Inform IMT that tracking buoys have been deployed and provide deployment details. Monitor movement of tracking buoys.	Refer login details of tracking buoy monitoring website on Santos ER intranet site.	OSC Planning Section Chief / GIS	<input type="checkbox"/>
	Use tracking buoy data to maintain Common Operating Picture.	Data tracked online.	Planning Section Chief / GIS	<input type="checkbox"/>
	Relay information to spill fate modelling supplier for calibration of trajectory modelling.		Planning Section Chief / GIS	<input type="checkbox"/>
Ongoing actions	Assess the need for additional tracking buoys in the spill scenario and identify/nominate preferred deployment locations.	Incident Action Plan to provide guidance regarding any additional deployments of tracking buoys.	Planning Section Chief	<input type="checkbox"/>
	Mobilise additional tracking buoys if required from other Santos operations (Santos presently has 12 Tracker Buoys located on the North West Shelf) or from AMOSC stockpiles.		Logistics Section Chief	<input type="checkbox"/>
	Deploy tracking buoys.		Vessel Master	<input type="checkbox"/>
	Monitor movement of tracking buoys.		Planning Section Chief /GIS	<input type="checkbox"/>

Action	Consideration	Responsibility	Complete
Relay information to spill trajectory modelling supplier for calibration of trajectory modelling.		Planning Section Chief /GIS	<input type="checkbox"/>

Table 10-11: Tracking buoy resource capability

Equipment type/personnel required	Organisation	Quantity available	Location	Mobilisation timeframe
Tracking buoys	Santos	2	Darwin	Darwin – 20 hours to site pending vessel availability
		8	VI, Dampier	VI/Dampier buoys – 48–72 hours to site pending vessel availability
AMOSC tracking buoys	AMOSC	4	Fremantle	Response via duty officer within 15 minutes of first call – AMOSC personnel available within 1 hour of initial activation call. Equipment logistics varies according to stockpile location (see Table 10-12)
		4	Geelong	

Table 10-12: Australian Marine Oil Spill Centre equipment mobilisation timeframes

	Perth	Darwin
Geelong	40 hours 3,395 km	44 hours 3,730 km
Perth	NA	48 hours 4,040 km
Exmouth	15 hours 1,250 km	38 hours 3,170 km
Broome	27 hours 2,240 km	22 hours 1,870 km

Table 10-13: Tracking buoy – first-strike response timeline

Task	Time from IMT call-out
Tracking buoys deployed from Darwin	20 hours to site pending vessel availability
Minimum Resource Requirements	
+ Two tracking buoys for initial deployment	

10.4 Oil spill trajectory modelling

Table 10-14 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-14: Oil spill trajectory modelling – environmental performance outcome, initiation criteria and termination criteria

Environmental performance outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision -making
Initiation criteria	Notification of a Level 2 spill
Termination criteria	<ul style="list-style-type: none"> + Spill fate modelling will continue for 24 hours after the source is under control and a surface sheen is no longer observable, or until no longer beneficial to predict spill trajectory and concentrations, OR + As directed by the relevant Control Agency.

Oil spill trajectory modelling uses computer modelling (e.g. OILMAP, SIMAP) to estimate the movement, fate and weathering potential of spills. Santos has engaged RPS Group to provide forecast spill fate modelling. RPS Group use SIMAP and OILMAP modelling systems that comply with Australian Standards (ASTM Standard F2067 'Standard Practice for Development and Use of Oil Spill Models'). RPS Group also provide the capacity for forecast air quality monitoring to enable an assessment of potential health and safety risks associated with VOCs released from a surface slick.

A particular advantage of spill trajectory modelling is that the transport and weathering of spilled hydrocarbons can be forecast, at all times of the day and night, at any location, and under any type of metocean conditions. By contrast, aerial surveillance and vessel-based monitoring will be constrained to day-time use, and have limits imposed by the operating environment. Aerial surveillance and vessel-based monitoring are, however, essential for model validation, verification and calibration of any modelling or first principal predictions.

10.4.1 Implementation guidance

Table 10-15 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy.

Table 10-16 provides a list of resources that may be used to implement this strategy. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Mobilisation times for the minimum resources that are required to oil spill trajectory modelling are listed in **Table 10-17**.

Table 10-35 lists the environmental performance standards and measurement criteria for this strategy.

Table 10-15: Implementation guidance – oil spill trajectory modelling

	Action	Consideration	Responsibility	Complete
Initial actions	Initiate oil spill trajectory modelling (OSTM) by submission of an oil spill trajectory modelling request form (Santos Procedure Index). Request for three-day forecast trajectory modelling.		Environment Unit Leader	<input type="checkbox"/>
	Determine requirement for gas/VOC modelling and request initiation.	Hydrocarbon releases have human health and safety considerations for responders (volatile gases and organic compounds). This to be considered for any tactics that monitor/recover oil – especially at close proximity to release site.	Safety Officer Environment Unit Leader	<input type="checkbox"/>
	Operational surveillance data (aerial, vessel, tracker buoys) to be given to modelling provider to verify and adjust fate predictions of the spill and improve predictive accuracy.		Planning Section Chief /GIS	<input type="checkbox"/>
	Login to the RPS Group data sharing website and maintain connection. Download modelling results.	Data should be stored digitally and backed up on to independent digital storage media. All datasets should be accompanied by a metadata summary and documented quality assurance and control procedures.	Planning Section Chief /GIS	<input type="checkbox"/>
	Place RPS Group modelling data into GIS/Common Operating Picture.	RPS Group to provide at least daily updates to the IMT of trajectory model outputs to inform response planning. More frequent updates can be provided if weather conditions are highly variable or change suddenly.	Planning Section Chief /GIS	<input type="checkbox"/>
	Identify location and sensitivities at risk based on the trajectory modelling and inform IMT. Conduct operational NEBA on proposed response strategies.		Environment Unit Leader	<input type="checkbox"/>

Action		Consideration	Responsibility	Complete
Ongoing actions	Request spill trajectory modelling be provided daily throughout the duration of the response and integrate data into Common Operating Picture.		Planning Section Chief / GIS	<input type="checkbox"/>
	Use results from other monitor and evaluate activities, and/or data derived from hydrocarbon assays of the source hydrocarbon or from other reservoirs in the region (that may be available) as input data (if or when available) to improve model accuracy.		Planning Section Chief / GIS	<input type="checkbox"/>

Table 10-16: Oil spill trajectory modelling resource capability

Equipment type/personnel required	Organisation	Quantity available	Location	Mobilisation timeframe
RPS OST modellers and software	RPS under direct contract to Santos, also available through AMOSC	Daily OSTM reports	Perth – digital	2–4 hours from activation

Table 10-17: Oil spill trajectory modelling – first-strike response timeline

Task	Time from IMT call-out
RPS OSTM activated by IMT	<2 hours
OSTM provided to IMT	<4 hours
Minimum Resource Requirements	
<ul style="list-style-type: none"> + Contracted OST modellers and software + OSTM Activation Form. 	

10.5 Satellite imagery

Table 10-18 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-18: Satellite imagery – environmental performance outcome, initiation criteria and termination criteria

Environmental performance outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision -making
Initiation criteria	Notification of a Level 2 spill
Termination criteria	+ Satellite monitoring will continue until no further benefit is achieved from continuing; or as advised by relevant Control Agency.

Satellite imagery is considered a supplementary source of information that can improve awareness but is not critical to the response and usage is at the discretion of the IMT.

Suitable imagery may be available via satellite imagery suppliers. This can be done through existing AMOSC and OSRL contracts. The most appropriate images for purchase will be based on the extent and location of the oil spill. Synthetic aperture radar and visible imagery may both be of value.

10.5.1 Implementation guidance

Table 10-19 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 10-20** provides a list of resources that may be used to implement this strategy. The Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 10-35 lists the environmental performance standards and measurement criteria for this strategy.

Table 10-19: Satellite imagery implementation guide

	Action	Consideration	Responsibility	Complete
Initial actions	Assess requirement for satellite imagery.		Planning Section Chief	<input type="checkbox"/>
	Notify AMOSC and OSRL Duty Officer to initiate request for available satellite imagery.	Formal written activation of resources from AMOSC and OSRL by designated call-out authorities (Santos Duty Managers/Incident Commanders) is required.	Planning Section Chief	<input type="checkbox"/>
	Assess suitability and order imagery.		Planning Section Chief	<input type="checkbox"/>
	Integrate satellite imagery into Common Operating Picture and provide to trajectory modelling provider for model validation.		GIS Team Leader Planning Section Chief	<input type="checkbox"/>
Ongoing actions	Review surveillance information to validate spill fate and trajectory.		Planning Section Chief	<input type="checkbox"/>
	Use monitor and evaluate data to periodically reassess the spill and modify the response (through the IAP), as required.	Use surveillance data when updating the Common Operating Picture.	Planning Section Chief	<input type="checkbox"/>

Table 10-20: Satellite imagery resource capability

Equipment type/ personnel required	Organisation	Quantity available	Location	Mobilisation timeframe
Satellite Imagery	KSAT – activated through AMOSC MDA – activated through OSRL	Dependent upon overpass frequency (TBC on activation)	Digital	AMOSC: 12-72 hrs from receipt of order submission OSRL: Within 4 hours of satellite image acquisition (i.e. latest pass with no cloud)

10.7 Initial oil characterisation

Table 10-21 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-21: Initial oil characterisation – environmental performance outcome, initiation criteria and termination criteria

Environmental performance outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision -making
Initiation criteria	Notification of a Level 2 spill
Termination criteria	<ul style="list-style-type: none"> + Oil sample and analysis to terminate once enough data has been collected to profile the oil characteristics throughout weathering and to provide oil for toxicity testing, OR + As directed by the relevant control agency.

10.7.1 Overview

Given MGO/MDO is a common fuel type with known properties, the general physical and chemical characteristics of this hydrocarbon are known and have been presented in **Appendix A**. Nevertheless, sampling and analysis of the released hydrocarbon will provide the most accurate information on the hydrocarbon properties at the time of release.

The composition and physical properties of the hydrocarbon will also evolve over time through weathering processes that change its composition and properties, such as the viscosity, density, water content and pour point. The rate of change of the hydrocarbon properties will affect the likely time-window of opportunities for particular responses and the associated logistical requirements of these responses.

10.7.2 Implementation guidance

Table 10-22 provides guidance to the IMT on the actions and responsibilities for this strategy. **Table 10-23** provides a list of resources that may be used to implement this tactic. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 10-35 lists the environmental performance standards and measurement criteria for this strategy.

10.7.3 Oil sampling and analysis

Oil sampling kits are provided by Santos for the purposes of taking spilled oil/ oily water samples, which include procedures for untrained personnel. Initial samples will be taken by the vessel crew using the sampling kits and included procedures. Trained personnel may be deployed to the field at a later time to continue sampling as required as part of ongoing monitoring.

Sampling kits are positioned at Santos strategic locations (refer to **Table 10-23**) and will be mobilized to the required locations when needed. The kits contain all necessary equipment and sampling containers for shipping to a laboratory for analysis.

The Santos Oil and Water Sampling Procedures (7710-650-PRO-0008) defines the sampling protocol and procedures.

Using on-site VOOs, oil samples are to be taken daily where possible from fresh oil, and from the weathered oil locations, nominally representing 24 hours old, 48 hours old and 72 hours old (as they occur) and dispatched to the laboratory for analysis.

Laboratory analysis

Laboratory analysis of the chemical and physical properties of the recovered oil, including gas chromatography/mass spectrometry for the purpose of fingerprinting the oil constituents, is to be undertaken. Fingerprinting of the released hydrocarbon potentially allows contamination to be traced back to the source where this is otherwise unclear or in dispute. The Santos Oil and Water Sampling Procedures (7710-650-PRO-0008) outlines the suite of available oil testing and fingerprinting analyses that can be performed by the preferred laboratories. Details of the testing laboratories can also be found within the document.

Ecotoxicology assessment of the oil is to be conducted at an ecotoxicology laboratory following the revised Australian and New Zealand Water Quality Guidelines. The quantity of sample required for analysis will be confirmed by the laboratory but is expected to be in the order of 6 to 10 L. Testing results will provide the concentrations at which toxicity endpoints consistent with revised Australian and New Zealand Water Quality Guidelines are met for each test. Overall species protection concentrations, including 90%, 95% and 99% species protection trigger levels are then to be generated using a species sensitivity distribution fitted to the data (e.g. by using the Burrlioz software program).

Table 10-22: Implementation guidance – initial oil characterisation

	Action	Consideration	Responsibility	Complete
Initial actions	Source available vessels (on hire or VOO) for oil sampling.	Can be multi-tasked – e.g. for vessel surveillance or tracking buoy deployment.	Operations Section Chief Logistics Section Chief	<input type="checkbox"/>
	Source sampling equipment. Confirm sampling methodology. Confirm laboratory for sample analysis. Develop health and safety requirements/controls.	Refer Table 10-23 for resource availability. The Santos Oil and Water Sampling Procedures (7110-650-PRO-0008) provide the procedures for sampling.	Environment Unit Leader Safety Officer	<input type="checkbox"/>
	Vessel directed to sampling location.	Sampling of oil at thickest part of slick – typically leading edge.	Operations Section Chief	<input type="checkbox"/>
	Vessel crew to undertake sampling and delivery of samples to Darwin for dispatch to laboratory. Environment Unit Leader to confirm analysis of oil with lab.	Logistics personnel to assist with logistics of sending oil samples to laboratory for analysis.	Operations Section Chief Environment Unit Leader Logistics Section Chief	<input type="checkbox"/>
Ongoing actions	Continue sample collection post release where oil is available.	Initial monitoring by crew of available vessels – Once mobilised to site Santos scientific monitoring provider to continue sampling of oil in conjunction with operational water quality monitoring.	Operations Section Chief Environment Unit Leader Logistics Section Chief	<input type="checkbox"/>

Table 10-23: Initial oil characterisation – resource capability

Equipment type/personnel required	Organisation	Quantity available	Location	Mobilisation timeframe
Oil sampling kits	Santos	1	Darwin	Within 48 hours
Bulk oil sampling bottles	Intertek/Santos	As required	Perth	Within 48 hours
Santos Contracted Vessel Providers Vessels of Opportunity identified through AIS vessel tracking system	Availability dependent upon Santos and Vessel Contractor activities.	Availability dependent upon Santos and Vessel Contractor activities. Locations verified through AIS vessel tracking system	Pending availability and location. Expected within 24 hours	Santos contracted vessel providers Vessels of Opportunity identified through AIS Vessel Tracking
National Association of Testing Authorities (NATA) accredited laboratory/ personnel for analysis	Intertek/ ALS/ ChemCentre / Leeder Analytical	NA	Perth	24+ hours

Table 10-24: Initial oil characterisation – first-strike response timeline

Task	Time from IMT call-out
Oil sample collection	<48 hours (daylight dependent)
Oil samples arrive at lab for analysis	<5 days
Minimum resource requirements	
<ul style="list-style-type: none"> + One vessel; no special requirements; oil sampling can be done concurrently with other tasks + One oil sampling kit + Sampling jars for bulk oil collection 	

10.8 Operational water quality monitoring

10.8.1 Operational water sampling and analysis

Table 10-25 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 10-25: Operational water quality sampling and analysis – environmental performance outcome, initiation criteria and termination criteria

Environmental performance outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision -making
Initiation criteria	Notification of a Level 2 spill
Termination criteria	<ul style="list-style-type: none"> + Operational water sampling and analysis will continue for 24 hours following control of the source provided oil is no longer detectable, OR + As directed by the relevant Control Agency, OR + Vessel surveillance will terminate if there are unacceptable safety risks associated with volatile hydrocarbons at the sea surface.

Operational sampling of oil and oil in water will be undertaken at discrete locations, providing visual observations, real-time fluorometry/ dissolved oxygen readings and providing oil and water samples for laboratory analysis. The intent of this sampling is to confirm the distribution and concentration of oil, validating spill trajectory modelling and providing and informing the selection and implementation of other response strategies, including scientific monitoring.

Table 10-26 presents the water quality sampling and analysis plan considerations.

This monitoring is complementary to scientific water quality monitoring (SMP1) delivered through the Oil Spill SMP in terms of methodology and required skillset and can be provided through Santos' Scientific Monitoring Provider (**Section 16**).

10.8.2 Implementation guidance

See **Table 10-27** for the operational water quality sampling and analysis implementation guide. The Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned. **Table 10-35** lists the environmental performance standards and measurement criteria for this strategy.

Table 10-26: Operational water quality sampling and analysis plan considerations

Considerations for operational water quality sampling and analysis	
Scope of work	The work scope for operational water quality monitoring will be driven by the IMT, confirming objectives for each operational period.
Survey design	<p>The operational water sampling activities will be conducted by experienced environmental scientists and managed through the IMT Incident Action Planning process. The exact nature of the sampling activities will depend upon the objectives for each operational period; however, the sampling design and methodology will consider the following points:</p> <ul style="list-style-type: none"> + Sampling locations will be moved with the slick and/or plume based on the observed or predicted location and movement of oil on water and subsea plumes. This will be informed by vessel/aerial surveillance, satellite tracking buoys and spill fate modelling. + At each discrete location, sampling will initially be conducted using a conductivity-temperature-depth (CTD) meter along a depth profile which captures the three-dimensional distribution of the oil. The CTD would require fluorometry and dissolved oxygen sensors as part of the sensor package to record the presence of oil (fluorometry) and the activity of hydrocarbon degrading bacteria (dissolved oxygen). Fluorometers appropriate to the hydrocarbon type will need to be selected. + The CTD would help inform the depth at which water samples would be taken. + Where surface oil is present in shallow water (<5 m) sampling should involve a depth profile from the seabed to surface waters. Profiles should ensure that the full gradient of oil in water concentration can be determined. + Oil and oil in water samples are to be collected using suitable pumping or sampling apparatus. For samples at depth a Niskin bottle(s) or similar device that allows remote closing and discrete sampling at depth is to be used. Alternatively, water samples can be pumped from defined depths using a hose suspended vertically using a suitable pump for water sampling (e.g. a peristaltic pump). + Samples are to be collected in clean, fully labelled glass jars, filled to the top and refrigerated/ kept cool and in darkness during storage and transport. Handling, storage and documentation requirements to be confirmed with laboratory but holding time <7 days is expected requirement. + Oil and oil in water samples will be replicated at each site to allow intra-site variability to be assessed and appropriate quality assurance and control samples incorporated into replicates. + Santos will coordinate transportation of samples from the sampling location to the laboratory. Samples will be accompanied with a completed Chain of Custody form. + Water samples also to be provided to an independent National Association of Testing Authorities-accredited laboratory in Perth for hydrocarbon suite analysis including polycyclic aromatic hydrocarbons.

Considerations for operational water quality sampling and analysis	
Analysis and reporting	<ul style="list-style-type: none"> + All data collected on oil properties provided in spreadsheets (including GPS location, depth of sampling, timing, on-water observations, in-situ readings and water sample label details) to IMT on an ongoing basis during spill response operations. + Daily field reports of results provided to the IMT. + Analysis of oil properties following laboratory evaluation. + Final report detailing all data collected on oil properties throughout the monitoring program including relevant interpretation.

Table 10-27: Implementation guidance – operational water quality sampling and analysis

	Action	Consideration	Responsibility	Complete
Initial actions	Activate Santos Monitoring Service Provider for Operational Water Quality Monitoring.		Environment Unit Leader	<input type="checkbox"/>
	Obtain spill trajectory modelling and provide to Monitoring Service Provider.		Environment Unit Leader Planning Section Chief GIS Support	<input type="checkbox"/>
	Develop Monitoring Action Plan (Including Sampling and Analysis Plan) for operational water quality monitoring. Plan to also consider oil characterisation sampling (Section 10.6)– Monitoring Service Provider to take over this sampling once mobilised.	Sites to be selected using oil spill trajectory modelling and distribution of oil from surveillance tactics. Refer Table 10-26 for considerations for Sampling and Analysis Plan.	Monitoring Service Provider Environment Unit Leader	<input type="checkbox"/>
	Develop health and safety plan including potential exposure to volatile gases/VOCs.	Refer Santos Oil Spill Response HSE Management Manual (SO-91-RF-10016).	Monitoring Service Provider Safety Officer	<input type="checkbox"/>

Action		Consideration	Responsibility	Complete
	Monitoring Service Provider to assemble team/s and water quality monitoring equipment.		Monitoring Service Provider	<input type="checkbox"/>
	Organise vessels, accommodation and transport requirements to mobilise monitoring team/s to site.	Monitoring Service provider to outline requirements in resource request form.	Logistics Section Chief	<input type="checkbox"/>
	Sampling and analysis undertaken. Daily communication and confirmation of sampling plan with OSC and IMT. Daily activity/data reports provided to IMT. Oil/water samples dispatched to nominated laboratories for analysis.		Monitoring Service Provider On-Scene Commander Operations Section Chief Environment Unit Leader Logistics Section Chief	<input type="checkbox"/>
Ongoing actions	Monitoring results to be conveyed to IMT through Common Operating Picture and provided to spill trajectory modeller to validate predictions.		Planning Section Chief GIS Support Environment Unit Leader	<input type="checkbox"/>

Table 10-28: Operational water quality sampling and analysis – resource capability

Equipment type/personnel required	Organisation	Quantity available	Location	Mobilisation timeframe
Water quality monitoring personnel	Monitoring Service Provider (currently Astron/BMT)	Approx. 6 (based on capability reports)	Perth-based	Personnel and equipment within 72 hours from approval of work scope – pending vessel availability
Water quality sampling equipment and water quality meters	Third-party suppliers via Monitoring Service Provider (currently Astron/BMT)	Multiple providers	Australia based	
Contracted water quality monitoring vessels	Santos Contracted Vessel Providers	Availability dependent upon Santos and Vessel Contractor activities; suitable vessels identified through AIS Vessel Tracking	Locations verified through AIS Vessel Tracking Software	<72 hours

Table 10-29: Operational water quality sampling and analysis – first-strike response timeline

Task	Time from IMT call-out
IMT activates monitoring service provider.	<4 hours
Operational water quality monitoring personnel, equipment and vessel deployed to spill site.	<72 hours
Minimum resource requirements	
<ul style="list-style-type: none"> + Water quality monitoring vessel/s – refer Santos Offshore ER Intranet and Santos Vessel Requirements for Oil Spill Response document (7710-650-ERP-0001) for vessel specification, if a vessel charter is needed. + Water quality monitoring team (through monitoring service provider). + Water quality monitoring equipment (through monitoring service provider). 	

10.9 Shoreline clean-up assessment

Table 10-30 provides the Environmental Performance Outcome, initiation criteria, termination criteria for this strategy.

Table 10-30: Shoreline clean-up assessment – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making
Initiation criteria	Level 2 – may be deployed in a Level 1 incident (to be determined by OSC)
Termination criteria	As directed by the relevant Control Agency

To assist in determining which response methods are most appropriate for shorelines, it is necessary to obtain information about shoreline character (topography, complexity, exposure, etc.), degree and distribution of oiling (if present), presence of sensitive receptors (habitats, fauna, etc.) and information on shoreline processes and access routes that could aid or hamper response efforts. This detailed information can be collected from shoreline clean-up assessments. A well-established systematic approach known as Shoreline Clean-up Assessment Technique (SCAT) will be used to document the status of oiled shorelines in the event of a worst-case release and their subsequent treatment recommendations.

Table 4-2 lists the designated Control Agency for shoreline clean-up assessment and response for the NT. Where Santos is not the Control Agency (e.g. Level 2 spills that contact the shoreline), the Control Agency will direct resources provided through Santos for the purposes of shoreline clean-up assessments and shoreline response activities. Santos will provide additional information on shoreline character and oiling collected as part of aerial surveillance activities carried out under its control (refer **Table 4-2**).

Existing information on shoreline character, distribution of habitats/fauna and access/safety constraints can be obtained from:

- + Santos Energy GIS, including habitat/fauna distribution layers and aerial imagery
- + Oil Spill Response Atlas Web Map Application

10.9.1 Implementation guidance

The information provided below is included for planning purposes and represents how Santos would approach shoreline clean-up assessments to support the Control Agency (where Santos is not the Control Agency). In the event of a spill with the potential for shoreline contact, the Control Agency is 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.

Table 10-31 presents considerations for planning and conducting the assessments. The implementation guide for Shoreline Clean-up and Assessment is found in **Table 10-32**. **Table 10-33** provides a list of resources that may be used to implement this strategy and **Table 10-34** details the minimum first-strike mobilisation requirements for Santos on activation. **Table 10-35** lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 10-31: Shoreline clean-up assessment considerations

Considerations for Shoreline Clean-up Assessment	
Survey design	<p>Shoreline Clean-up Assessment requires a systematic assessment of shorelines, which is typically undertaken in a number of stages (according to the extent of the spill):</p> <ul style="list-style-type: none"> + Reconnaissance surveys: designed as an initial phase (or further as required, such as inaccessible shorelines) to characterise the distribution, extent, and condition of shoreline habitats. + Continual monitoring surveys: monitors hydrocarbon spill extent at the shoreline to assess the potential impact, extent of actual impact, and the effectiveness of clean-up. <p>A shoreline clean-up assessment may include the following tasks:</p> <ul style="list-style-type: none"> + Assessment of shoreline character, habitats and fauna, including: <ul style="list-style-type: none"> – shoreline structured biotic habitats – distribution of fauna – shoreline and processes (e.g. wave, tidal flows) – shoreline substrate (e.g. mud, sand, pebble, rock) – shoreline form (e.g. width, shape and gradient) – access/safety constraints. + Assessment of shoreline oiling (if present): <ul style="list-style-type: none"> – surface distribution and cover – subsurface distribution – oil type, thickness, concentration and physical character – sampling of oil for laboratory analysis. + Recommendations for response: <ul style="list-style-type: none"> – applicable strategies based on oil type and habitat – potential access, safety and environmental constraints – likely resourcing (personnel and equipment) requirements. <p>Towards the end of a response, SCAT may be deployed for post-treatment shoreline survey and sign-off/completion, including:</p> <ul style="list-style-type: none"> – post-clean-up inspections to confirm if end points have been achieved or if they require further treatment

Considerations for Shoreline Clean-up Assessment

- approval of termination of response activities in each sector.

Ground surveys undertaken on foot, by vehicles or by small vessel will occur at prioritised areas (access permitting) to provide a close-range assessment of shoreline physical characteristics, coastal habitats/fauna, scale and character of oiling and safety/access constraints.

Shoreline clean-up assessment team leaders will likely include personnel from AMOSC Core Group, State and National Response Team and OSRL, or contracted staff who have completed SCAT training. Team members may include personnel who have completed a brief training course and are supervised on the job by team leaders, particularly for deployment to locations that are not contacted in the first few weeks of the spill.

The deployment of survey teams will be directed by the relevant Control Agency. The deployments will be informed by the observed and predicted contact of oil and from existing baseline information on shoreline character.

Shoreline surveys will be undertaken within segments that are recorded and/or mapped that share common traits based on coast geomorphology, habitat type, fauna presence, level of oiling or access.

Information on shoreline character and habitat/fauna distribution for each segment should be recorded through the use of:

- + still or video imagery collected with simultaneous GPS acquisition
- + field notes together with simultaneous GPS acquisition
- + mud maps outlining key natural features, oil distribution, imagery locations of quantitative data (transects, oil samples)
- + transects (cross-shore, longshore) and vertical sediment profiles
- + samples of oil and/or oiled sediments.

The parameters that should be assessed are:

- + physical characteristics: rocky, sandy beach, flat, dune, other wetland
- + major habitat types: mangrove, salt marsh, saltpan flats, fringing reef, rubble shore, seagrass verge
- + coastal fauna and key habitats (e.g. nests) including quantification/distribution of oiled fauna
- + state of erosion and deposition: deposition, erosion, stable
- + human modified coastline (access tracks, facilities, etc.)
- + oil character, if present, including appearance, surface thickness, depth (into sediments), distribution, area and percentage cover.

Analysis and reporting

Shoreline survey reports to be submitted to the Control Agency IMT at completion of assessments. All raw data collected will be included as appendices to the report and provided in a geospatial format for subsequent use in GIS mapping software.

Table 10-32: Shoreline clean-up assessment – implementation guidance

	Action	Consideration	Responsibility	Complete
Initial Actions	Ensure initial notifications to NT DEPWS have been made.	Refer to Section 7 for reporting requirements.	Environment Unit Leader	<input type="checkbox"/>
	Collect and provide spill trajectory modelling, other operational monitoring data and existing sensitivity information/mapping to Control Agency for assistance in identification of priority protection areas and Operational NEBA.	Existing shoreline sensitivity mapping information for potential oil contacted locations is available on the Santos ER intranet site.	Environment Unit Leader Planning Section Chief	<input type="checkbox"/>
	Actions below are indicative only and are at the final determination of the Control Agency.			
	Mobilise the AMOSC core group responders as required for industry support to Control Agency.	Refer to Table 10-33 . Unmanned Aerial Vehicles (UAVs) may be necessary for some sensitive environments and where personnel safety is at risk (dangerous fauna in remote locations).	Incident Commander Operations Section Chief Logistics Section Chief	<input type="checkbox"/>
	Conduct assessment of shoreline character, habitats and fauna.	Refer to Table 10-31 .	AMOSC Core group and Control Agency	<input type="checkbox"/>
	Conduct assessment of shoreline oiling (if present).	Refer to Table 10-31 .	AMOSC Core group and Control Agency	<input type="checkbox"/>
	Develop recommendations for clean-up activities and clean-up end points and communicate recommendations and SCAT forms back to IMT at the end of each operating period.	Refer to Table 10-31 .	AMOSC Core group and Control Agency	<input type="checkbox"/>

Table 10-33: Shoreline clean-up assessment – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Santos and industry AMOSC core group staff and responders (team leaders)	Santos Core Group Industry Core Group AMOSC staff	12 84 (minimum) 16	Perth, Geelong, Fremantle, Dampier, Varanus Island and other Australian locations	24-48 hours from time of shoreline contact prediction
Shoreline assessment team members	Santos contracted Work Force Hire company (e.g. Dare)	As per availability (up to 2,000)	Australia-wide	Subject to availability (indicatively 72+ hours)
Drones and pilots ** To assist shoreline and vessel-based surveillance	AMOSC OSRL – Third-Party UAV provider Local WA hire companies	2 x pilots 2 x qualified remote pilots, however response is on best endeavour 10+	Geelong Perth Perth and regional WA	<48 hours OSRL – depending on the port of departure, one to two days if within Australia

Table 10-34: Shoreline assessment – first-strike response timeline

Task	Time from shoreline contact (predicted or observed)
IMT confirms shoreline contact prediction and begins sourcing personnel for shoreline clean-up assessment team.	<4 hours
Shoreline clean-up assessment personnel mobilised to deployment location.	24 to 48 hours
Minimum Resource Requirements	
<ul style="list-style-type: none"> + 2 x AMOSC drone pilots trained in SCAT to undertake initial reconnaissance surveys + 2 x AMOSC drones + Minimum 2 x AMOSC core group personnel to undertake initial vessel or ground surveys. 	

10.10 Environmental performance

Table 10-35: Environmental performance – monitor and evaluate

Environmental performance outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making		
Response strategy	Control measures	Performance standards	Measurement criteria
Monitor and Evaluate – vessel and aerial surveillance	Response preparedness		
	Maintenance of Master Services Agreements (MSAs) with multiple vessel providers	Santos maintains MSAs with multiple vessel providers as specified in Table 10-3 .	MSAs with multiple vessel providers
	MSA with aircraft supplier	MSA in place with helicopter provider throughout activity	MSA with aircraft suppliers
	Santos trained Aerial Observers	Santos maintains a pool of trained aerial observers	Exercise Records Training Records
	AMOSC contract to facilitate mutual aid arrangements for access to Trained Aerial Observers	Maintenance of AMOSC contract to facilitate mutual aid arrangements for access to Trained Aerial Observers	AMOSC Participating Member Contract
	Access to certified UAV providers	Maintenance of contract for access to UAV providers	Maintenance of contract with service provider
	Aircraft charter companies for fauna observations	Maintain a list of aircraft charter companies that could potentially provide fauna observation services	List of providers

Environmental performance outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making		
Response strategy	Control measures	Performance standards	Measurement criteria
	Response implementation		
	Vessel surveillance	Minimum first-strike resource requirements mobilised in accordance with Table 10-4	Incident log
		Daily observation reports submitted to IMT until termination criteria is met	Incident log
	Vessels and aircraft compliant with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003)	Vessels comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003) which ensures compliance with Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000 which includes controls for minimising the risk of collision with marine fauna	Vessel contractor procedures align with Santos's Protected Marine Fauna Interaction and Sighting Procedure
		Aircraft comply with Santos' Protected Marine Fauna Interaction and Sighting Procedure (EA-91-11-00003) which ensures compliance with Part 8 of the Environment Protection and Biodiversity Conservation Regulations 2000 which includes controls for minimising interaction with marine fauna	Aircraft contractor procedures align with Santos' Protected Marine Fauna Interaction and Sighting Procedure
	Aerial surveillance	Minimum first-strike resource requirements mobilised in accordance with Table 10-8	Incident log
		Following initiation two passes per day of spill area by observation aircraft provided	Incident log; Incident Action Plan

Environmental performance outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making		
Response strategy	Control measures	Performance standards	Measurement criteria
		Trained Aerial Observers supplied from Day 2 of response	Incident log
		Flight schedules are maintained throughout response	Incident Action Plan
		Observers completed aerial surveillance observer log following completion of flight	Aerial Observer Logs
Monitor and Evaluate – tracking buoys	Response preparedness		
	Tracking buoys available	Maintenance of 10 tracker buoys throughout the activity	Computer tracking software Tracker buoy tests
	Response implementation		
	Tracking buoy mobilisation	Minimum requirements mobilised in accordance with Table 10-11	Incident log
Monitor and Evaluate – oil spill modelling	Response preparedness		
	Maintenance of contract for emergency response modelling	Maintenance of contract for forecast spill trajectory modelling services throughout activity	Modelling services contract
	Response implementation		
	Oil spill modelling	Oil Spill Modelling provider will be contacted immediately (within two hours) upon notification of a Level 2 or 3 spill	Incident log
		Modelling delivered to IMT within two hours of request to service provider	Incident log
Monitor and Evaluate – satellite imagery	Response preparedness		
	Satellite imagery	Maintain membership with AMOSC and OSRL to enable access and analysis of satellite imagery	Membership contracts with AMOSC and OSRL

Environmental performance outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making		
Response strategy	Control measures	Performance standards	Measurement criteria
Monitor and Evaluate – oil characterisation and operational water quality monitoring	Response implementation		
	Satellite imagery	Data incorporated into Common Operating Picture and provided to spill modelling provider	Incident log; Incident Action Plan
	Response preparedness		
	Maintenance of Monitoring Service Provider contract for water quality monitoring services	Maintain access to specialist monitoring personnel and equipment by maintaining contract with Monitoring Service Provider throughout activity as per Table 10-23	Contract with monitoring service provider
	Capability reports from Monitoring Service Provider	Obtain monthly capability reports from Monitoring Service Provider	Capability reports
	Water quality monitoring vessels	Maintenance of vessel specification for Water quality monitoring vessels	Vessel specification
	Oil and water quality monitoring equipment	Oil sampling kit pre-positioned at Darwin	Evidence of deployment to site
	Response implementation		
	Initial Oil Characterisation	Minimum requirements mobilised in accordance with Table 10-24	Incident log
		Oil samples sent to laboratory for initial fingerprinting	Incident log
		Oil samples to be sent immediately for laboratory ecotoxicity testing of oil	Incident log
		90, 95, and 99% Species protection triggers levels will be derived from ecotoxicity testing results (minimum five species' tests) within 24 hours of receiving all results	Ecotoxicity report from environmental contractor

Environmental performance outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making		
Response strategy	Control measures	Performance standards	Measurement criteria
	Operational oil and oil in water monitoring	IMT activates monitoring service provider within four hours	Incident log
		Operational water quality sampling and analysis surveys mobilised within 72 hours of approval	Incident log
Monitor and Evaluate – shoreline clean-up assessments	Response Preparedness		
	SCAT trained personnel are available	Access to SCAT trained personnel capability as outlined in Table 10-33 and Table 10-34 . Maintain capability throughout activity through AMOSC Core Group, State/Territory Response Team, AMSA National Response Team and OSRL	AMOSC Participating Member Contract, MoU for access to National Plan resources through AMSA, OSRL Associate Contract
	Response Implementation		
	Shoreline assessment	SCAT trained personnel are mobilised as per the numbers and deployment schedules provided in Table 10-34	Incident Log
		SCAT will be implemented under the direction of the Control Agency	Incident Log
		SCAT Team Leader positions will be filled with personnel trained in shoreline clean-up assessment techniques	Training records
		Santos will make available AMOSC Core Group Responders for SCAT Team Leader positions to the Control Agency	Incident Log
SCAT reports provided to the IMT daily detailing the assessed areas to maximise effective utilisation of resources		Incident Log	

Environmental performance outcome	Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making		
Response strategy	Control measures	Performance standards	Measurement criteria
	Use of shallow draft vessels for shoreline and nearshore operations	Shallow draft vessels are used for shoreline and nearshore operations unless directed otherwise by the designated Control Agency	Vessel specification documentation contained in IAP.
	SCAT Team Leader assessment/selection of vehicle appropriate to shoreline conditions	SCAT Team Leader assess/select vehicles appropriate to shoreline conditions	IAP demonstrates requirement is met
	Conduct shoreline/nearshore habitat/bathymetry assessment	Unless directed otherwise by the designated Control Agency, a shoreline/nearshore habitat/bathymetry assessment is conducted prior to nearshore activities	IAP records assessment records
	Establish demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/roosting areas and turtle nesting habitat	Unless directed otherwise by the designated Control Agency) demarcation zones are mapped out in sensitive habitat areas	IAP demonstrates requirement is met
	Operational restriction of vehicle and personnel movement to limit erosion and compaction	Unless directed otherwise by the designated Control Agency, action plans for shoreline operations include operational restrictions on vehicle and personnel movement	IAP demonstrates requirement is met

11 Mechanical dispersion

Table 11-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 11-1: Mechanical dispersion – environmental performance outcome, initiation criteria and termination criteria

Environmental performance outcome	To create mixing for oil and water to enhance natural dispersion
Initiation criteria	Operational monitoring identifies thin oil patches at sea surface that are not naturally dissipating in sea surface and is posing risks to wildlife and shorelines by remaining on the surface
Termination criteria	<ul style="list-style-type: none"> + There is no longer a noticeable reduction of surface oil resulting from the activity, OR + NEBA is no longer being achieved, OR + Unacceptable safety risks associated with gas and VOCs at the sea surface, OR + Agreement is reached with Jurisdictional Authorities to terminate the response.

11.1 Overview

This response strategy assists with the natural dispersion process; creating mixing through physical agitation by using a vessel's propellers and wake, which encourages the oil to break into smaller particle sizes that are more easily biodegraded. The two common activities associated with mechanical dispersion are:

- + manoeuvring a vessel through the slick, using propeller wash and vessel wake to create mixing in the water body
- + spraying water from the fire hose of a vessel and moving the vessel through the water body to create additional mixing and breakup of the slick.

11.2 Implementation guidance

Table 11-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 11-3** provides a list of resources that may be used to implement this strategy. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 11-2: Implementation guidance – mechanical dispersion

	Action	Consideration	Responsibility	Complete
Initial actions	The operational NEBA will confirm the suitability and environmental benefit of conducting mechanical dispersion at appropriate locations.	Water depth, sea state, possible impacts to sensitive shorelines and/or wildlife before spill naturally disperses. This activity is to be conducted during daylight hours only and once the safety plan has been developed.	Operations Section Chief Environment Unit Leader Planning Section Chief	<input type="checkbox"/>
	Safety Officer to develop a safety plan for the activity with respect to potentially dangerous gases and VOCs (including applicable controls).		Operations Section Chief Safety Officer	<input type="checkbox"/>
	Notify vessel-based responders to trial mechanical dispersion.		Operations Section Chief	<input type="checkbox"/>
	Response personnel on vessels to evaluate the effectiveness of the use of mechanical dispersion operations to reduce the volume of oil on the water surface. Communicate the information to the IMT Operations Section Chief for inclusion in operational NEBA.		Vessel Master/s Santos AMOSC Core Group Responders	<input type="checkbox"/>

Table 11-3: Mechanical dispersion resource capability

Equipment type/personnel required	Organisation	Quantity available	Location	Mobilisation timeframe
Vessels undertaking other activities Vessel(s) can be specifically contracted for the strategy if required (refer to Santos Vessel Requirements for Oil Spill Response Document [7710-650-ERP-0001])	Santos contracted vessel providers	Availability dependent upon Santos and Vessel Contractor activities.	Vessels mobilised from Darwin. Locations verified through AIS Vessel Tracking Software.	Pending availability and location.

11.3 Environmental performance

Table 11-4 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 11-4: Environmental performance – mechanical dispersion

Environmental performance outcome	To create mixing for oil and water to enhance natural dispersion		
Response strategy	Control measures	Performance standard	Measurement criteria
Mechanical dispersion	Response preparedness		
	Mechanical Dispersion Plan Safety Plan Operational NEBA	Mechanical dispersion is to be conducted during daylight only, once the safety plan has been developed and operational NEBA confirms suitability and environmental benefit	Incident log IAP

12 Shoreline protection and deflection plan

Table 12-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 12-1: Shoreline protection and deflection – objectives, initiation criteria and termination criteria

Environmental Performance Outcome	Implement shoreline protection and deflection tactics to reduce hydrocarbon contact with coastal protection priorities
Initiation criteria	<ul style="list-style-type: none"> + Level 2 spills where shorelines with identified or potential protection priorities will potentially be contacted. + Approval has been obtained from the relevant Control Agency to initiate the response strategy.
Termination criteria	<ul style="list-style-type: none"> + NEBA has determined that this strategy is unlikely to result in an overall benefit to the affected shoreline/s. + Agreement is reached with Jurisdictional Authorities to terminate the response strategy.

12.1 Overview

Protection and deflection tactics are used to divert hydrocarbons away from sensitive shoreline receptors and are more effective if they are deployed ahead of spill contact. They are typically used to protect smaller, high priority sections of shoreline.

The effectiveness of this response will be dependent on spill characteristics, hydrocarbon type, and the operating environment. Deployment is subject to safety constraints such as the potential grounding of vessels.

Protection and deflection is part of an integrated nearshore/shoreline response to be managed by the relevant Control Agency. Where Santos is not the Control Agency (refer to **Table 4-2**), it will undertake first-strike protection and deflection activities as required. In this circumstance, the relevant Control Agency will direct resources (equipment and personnel) provided by Santos for the purposes of shoreline protection. Santos will provide all relevant information on shoreline character and oiling collected as part of surveillance activities carried out under its control (refer **Section 4.2**).

In the event of a spill with the potential for shoreline contact where Santos is not the Control Agency, the ongoing response objectives, methodology, deployment locations and resource allocation will be controlled by the relevant Control Agency and therefore may differ from that included below.

Information gathered during operational monitoring including shoreline clean-up assessments and assessed through an Operational NEBA will guide the selection of protection and deflection locations and techniques.

Shoreline protection and deflection techniques include:

- + nearshore booming, which can involve different booming arrangements, including:
 - exclusion booming: boom acts as a barrier to exclude the spill from areas requiring protection
 - diversion booming: booms divert the spill to a specific location where it may be removed (e.g. sandy beach)
 - deflection booming: booms deflect the spill away from an area requiring protection.

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- + berms, dams and dykes – uses sandbags or embankments to exclude oil from sensitive areas
 - + shoreside recovery – uses nearshore skimmers to collect oil corralled by nearshore booms (also used during shoreline clean-up)
 - + passive recovery – uses sorbent booms or pads to collect oil and remove it from the environment. This can be used as a pre-impact tactic where sorbents are laid ahead of the spill making contact with the shoreline
 - + non-oiled debris removal – removes debris from the shoreline before it is impacted to reduce overall waste volumes from shoreline clean-up.

The effectiveness of these techniques will be dependent on local bathymetry, sea state, currents/tides and wind conditions and the available resources.

12.2 Implementation guidance

Table 12-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 12-3** provides a list of resources that may be used to implement this strategy. Mobilisation times for the minimum resources that are required to commence initial protection and deflection operations, unless directed otherwise by the relevant control agency, are listed in **Table 12-4**. The Incident Commander of the Control Agency's IMT (once they assume control) is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 12-2: Implementation guidance – shoreline protection and deflection

	Action	Consideration	Responsibility	Complete	
Initial Actions	Ensure initial notifications to the relevant Control Agency have been made.	Refer to Section 7 for reporting requirements.	Environment Unit Leader	<input type="checkbox"/>	
	Collect and provide spill trajectory modelling, other operational monitoring data and existing sensitivity information/mapping to Control Agency for confirmation of priority protection areas and NEBA.		Environment Unit Leader Planning Section Chief	<input type="checkbox"/>	
	Actions below are indicative only and are at the final determination of the relevant Control Agency.				
	Conduct Operational NEBA to determine if protection and deflection is likely to result in a net environmental benefit using information from shoreline clean-up assessments (Section 10.)		Environment Unit Leader	<input type="checkbox"/>	
	If NEBA indicates that there is an overall environmental benefit, develop a Shoreline Protection Plan (IAP Sub-Plan) for each deployment area.	Shoreline Protection Plan may include: <ul style="list-style-type: none"> + priority nearshore and shoreline areas for protection (liaise with Control Agency for direction on locations) + locations to deploy protection and deflection equipment + permits required (if applicable) + protection and deflection tactics to be employed for each location + list of resources (personnel and equipment) required + logistical arrangements (e.g. staging areas, accommodation, transport of personnel) 	Operations Section Chief Planning Section Chief Environment Unit Leader	<input type="checkbox"/>	

	Action	Consideration	Responsibility	Complete
		<ul style="list-style-type: none"> + timeframes to undertake deployment + access locations from land or sea + frequency of equipment inspections and maintenance (noting tidal cycles) + waste management information, including logistical information on temporary storage areas, segregation, decontamination zones and disposal routes + no access and demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/roosting areas and turtle nesting habitat (use existing roads and tracks first) + shift rotation requirements. 		
	If required identify vessels with relevant capabilities (e.g. shallow draft) for equipment deployment in consultation with Control Agency.	Ensure vessels have shallow draft and/or a suitable tender (with adequate towing capacity and tie-points) if they are required to access shorelines.	Operations Section Chief Logistics Section Chief	<input type="checkbox"/>
	Deploy shoreline protection response teams to each shoreline location selected and implement response.	If passive recovery and/or non-oiled debris removal has been selected as a tactic, ensure deployment activities prioritise their implementation prior to hydrocarbon contact.	Operations Section Chief On-Scene Commander	<input type="checkbox"/>
Ongoing Actions	Conduct daily re-evaluation of NEBA to assess varying net benefits and impacts of continuing to conduct shoreline protection and deflection activities.		Environment Unit Leader	<input type="checkbox"/>
	Report to the Operations Section Chief on the effectiveness of the tactics employed.		Shoreline Response Programme Manager – AMOSC core group responder	<input type="checkbox"/>

	Action	Consideration	Responsibility	Complete
	Response teams to conduct daily inspections and maintenance of equipment.	<p>Shoreline protection efforts will be maintained through the forward operation(s) facilities set-up at mainland locations under direction of the Control Agency.</p> <p>Response crews will be rotated on a roster basis, with new personnel procured on an as needs basis from existing human resource suppliers.</p>	Shoreline Response Programme Manager	<input type="checkbox"/>

Table 12-3: Shoreline protection and deflection – resource capability

Equipment Type/ Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
AMSA nearshore boom/skimmer equipment	AMSA	Structurflex (9 x 20 m) Canadyne Inflatable (5 x 20 m) Versatech Zoom Inflatable (10 x 25 m) Skimmers: Nearshore oleophilic skimmers (x2) and towable waste storage bladders	Darwin	Access to National Plan equipment through AMOSC For mobilisation timeframes refer to Table 10-12
AMOSC nearshore boom and skimming equipment'	AMOSC	Beach Guardian (98 x 25 m lengths) Zoom Boom (199 x 25 m lengths) HDB Boom (two 200 m lengths) Curtain Boom (58 x 30 m lengths) Skimmers: Passive Weir GT 185 Desmi 250 Weir Ro-skim Weir boom	Broome – 4; Exmouth – 20; Fremantle – 23; Geelong – 51 Broome – 8; Exmouth – 20; Fremantle – 30; Geelong – 141 Broome – 2 Fremantle – 18; Geelong – 40 Exmouth – 1; Fremantle – 1; Geelong – 1 Exmouth – 1; Geelong – 1 Geelong – 1 Geelong – 2	Response via duty officer within 15 minutes of first call; AMOSC personnel available within one hour of initial activation call. Equipment logistics varies according to stockpile location For mobilisation timeframes refer to Table 10-12
Personnel (field responders) for OSR strategies	AMOSC Staff	16	Fremantle – 5 Geelong – 11	Response via duty officer within 15 minutes of first call. Timeframe for availability of AMOSC personnel dependent on location of spill and transport to site

Equipment Type/ Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
	AMOSC Core Group (Santos)	12	Perth/NW Australia facilities – 10 Port Bonython (South Australia) – 2	From 24 hours
	AMOSC Core Group (Industry)	As per monthly availability (minimum 84)	Office and facility location across Australia	Location dependent. Confirmed at time of activation

Table 12-4: Shoreline protection and deflection – first-strike response timeline

Task	Time from shoreline contact (predicted or observed)
IMT confirms shoreline contact prediction, confirm if protection of shoreline sensitivity/s is required and begins sourcing resources	<4 hours
Santos Core Group mobilised to deployment port location	<24 hours
Protection booming equipment mobilised to deployment port location	<24 hours
Waste storage equipment mobilised to deployment port location	<24 hours
Boom deployment vessel mobilised to deployment port location	<24 hours
AMOSC Staff and Industry Core Group mobilised to deployment port location	<24–48 hours
Protection/deflection operation deployed to protection location	<48-72 hours (weather/daylight dependent)
Minimum Resource Requirements	
<p>NB: Resource requirements for protection and deflection will be situation/receptor specific. Indicative first strike resources for a single site protection area are:</p> <ul style="list-style-type: none"> + One small vessel suitable for boom deployment + Shoreline (e.g. Beach Guardian) and nearshore booms (e.g. Zoom Boom) plus ancillary equipment (e.g. anchors, stakes) sufficient for protection of shoreline resource + One skimmer appropriate for oil type + Waste storage equipment + One Protection and Deflection Team + Personal protective equipment 	

12.3 Environmental performance

Table 12-5 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 12-5: Environmental performance – shoreline protection and deflection

Environmental Performance Outcome	Implement shoreline protection and deflection tactics to reduce hydrocarbon contact with coastal protection priorities		
Response Strategy	Control Measures	Performance Standards	Measurement Criteria
Shoreline Protection and Deflection	Response Preparedness		
	Access to protection and deflection equipment and personnel through AMOSC, AMSA National Plan and OSRL	Maintenance of access to protection and deflection equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity as per Table 12-3 .	MoU for access to National Plan resources through AMSA
			AMOSC Participating Member Contract
			OSRL Associate Member Contract
	Small vessel providers for nearshore booming operations	Maintenance of a list of small vessel providers for North West Region	List of small vessel providers
	Response Implementation		
	Mobilisation of minimum requirements for initial response operations	Minimum requirements mobilised in accordance with Table 12-4 unless directed otherwise by Control Agency	Incident log
	Shoreline Protection and Deflection Plan	Santos IMT to confirm protection priorities in consultation with Control Agency	IAP/Incident Log
		Prepare operational NEBA to determine if shoreline protection and deflection activities are likely to result in a net environmental benefit	Records indicate operational NEBA completed prior to shoreline protection and deflection activities commencing
IAP Shoreline Protection and Deflection Sub-plan developed to provide oversight and management of shoreline protection and deflection operation		Records indicate IAP Shoreline Protection and Deflection Sub-plan prepared prior to shoreline protection and deflection operations commencing	

Environmental Performance Outcome	Implement shoreline protection and deflection tactics to reduce hydrocarbon contact with coastal protection priorities		
Response Strategy	Control Measures	Performance Standards	Measurement Criteria
		NEBA undertaken each operational period by the relevant Control Agency to determine if response strategy is continuing to have a net environmental benefit. NEBA included in development of following period Incident Action Plan	IAP/Incident Log
		Ensure operational NEBA considers waste management, to ensure environmental benefit outweighs the environmental impact of strategy implementation which may include secondary contamination	Incident Log IAP
	Spill response activities selected on basis of a Net Environmental Benefit Analysis	A NEBA is undertaken for every operational period	Incident Log contains NEBA
	Use of shallow draft vessels for shoreline and nearshore operations	Shallow draft vessels are used for shoreline and nearshore operations, unless directed otherwise by the designated Control Agency	Vessel specification documentation contained in IAP.
	Conduct rapid shoreline/nearshore habitat/bathymetry assessment	Unless directed otherwise by the designated Control Agency, a rapid shoreline/nearshore habitat/bathymetry assessment is conducted prior to nearshore activities	IAP records assessment records

13 Shoreline clean-up plan

Table 13-1: Shoreline clean-up – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement shoreline clean-up tactics to remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery
Initiation criteria	<ul style="list-style-type: none"> + Level 2 spills where shorelines with identified or potential protection priorities that will be, or have been, contacted + NEBA indicates shoreline clean-up will benefit receptors + Approval has been obtained from the Control Agency to initiate response strategy
Termination criteria	<ul style="list-style-type: none"> + As directed by Control Agency

13.1 Overview

Shoreline clean-up aims to remove hydrocarbons from shorelines and intertidal habitat to achieve a net environmental benefit. Removal of these hydrocarbons helps reduce remobilisation of hydrocarbons and contamination of wildlife, habitat and other sensitive receptors. Shoreline clean-up is often a lengthy and cyclical process, requiring regular shoreline clean-up assessments (**Section 10.**) to monitor the effectiveness of clean-up activities and assess if they are resulting in any adverse impacts.

Shoreline clean-up is part of an integrated nearshore/ shoreline response to be managed by the relevant Control Agency. Where Santos is not the Control Agency (refer to **Table 4-2**), it will undertake first-strike activations as required. In this circumstance, the relevant Control Agency will direct resources (equipment and personnel) provided by Santos for the purposes of shoreline clean-up. The information obtained from Operational Monitoring (refer **Section 10**), will be used by the IMT in the development of the operational NEBA to inform the most effective clean-up tactics (if any) to apply to individual sites. Intrusive shoreline clean-up techniques have the potential to damage sensitive shorelines. The appropriateness of clean-up tactics will be assessed against natural attenuation for sensitive sites. Selection of shoreline clean-up methods and controls to prevent further damage from the clean-up activities are to be undertaken in consultation with the Control Agency and selected based on NEBA.

Both types of hydrocarbon are light and volatile with a low proportion of residue following weathering. These hydrocarbons are difficult to handle for removal given their light nature but are readily washed from sediments by wave and tidal flushing; contaminated sand and debris the likely waste products from a shoreline response.

Shoreline clean-up techniques include:

- + Shoreline Clean-up Assessment – uses assessment processes (refer to **Section 10.**) to assess shoreline character, assess shoreline oiling and develop recommendations for response. Typically, this should be the first step in any shoreline clean-up response.
- + Natural Recovery – oiled shorelines are left untreated and the oil naturally degrades over time.
- + Manual and Mechanical Removal – removes oil and contaminated materials using machinery, hand tools, or a combination of both.

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- + Washing, Flooding and Flushing – uses water, steam, or sand to flush oil from impacted shoreline areas.
 - + Sediment Reworking and Surf Washing – uses various methods to accelerate natural degradation of oil by manipulating the sediment.

13.2 Implementation guidance

Table 13-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy. **Table 13-2** provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 13-3** provides a list of resources that may be used to implement this strategy. Mobilisation times for the minimum resources that are required to commence initial shoreline clean-up operations, unless directed otherwise by the relevant Control Agency, are listed in **Table 13-4**. The OSC and/or Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 13-2: Implementation guidance – shoreline clean-up

	Action	Consideration	Responsibility	Complete
Initial Actions	Actions below are indicative only and are at the final determination of the Control Agency.			
	Initiate Shoreline Clean-up Assessment (if not already activated).	Refer to Section 10. for additional information. Unmanned Aerial Vehicles (UAVs) may be necessary for some sensitive environments and where personnel safety is at risk (e.g. dangerous fauna in remote locations).	Environment Unit Leader	<input type="checkbox"/>
	Using results from Shoreline Clean-up Assessment, conduct Operational NEBA to assess shoreline clean-up suitability and recommended tactics for each shoreline location.	Shoreline Clean-up Assessment Teams are responsible for preparing field maps and forms detailing the area surveyed and make specific clean-up recommendations. The condition of affected shorelines will be constantly changing. Results of shoreline surveys should be reported as quickly as possible to the IMT to help inform real-time decision-making. Engage a Heritage Adviser if spill response activities overlap with potential areas of cultural significance.	Environment Unit Leader	<input type="checkbox"/>

Action	Consideration	Responsibility	Complete
<p>If operational NEBA supports shoreline clean-up, prepare a Shoreline Clean-up Plan for inclusion in the IAP.</p>	<p>Shoreline Clean-up Plan may include:</p> <ul style="list-style-type: none"> + clean-up objectives + clean-up end points (may be derived from Shoreline Clean-up Assessment) + clean-up priorities (may be derived from Shoreline Clean-up Assessment) + assessment and location of staging areas and worksites (including health and safety constraints, zoning) + utility resource assessment and support (to be conducted if activity is of significant size in comparison to the size of the coastal community) + permits required (if applicable) + chain of command for on-site personnel + list of resources (personnel, equipment, personal protective equipment) required for selected clean-up tactics at each site + details of accommodation and transport management + security management + waste management information, including logistical information on temporary storage areas, segregation, decontamination zones and disposal routes + establish no access and demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/roosting areas and turtle nesting habitat (use existing roads and tracks first) + shift rotation requirements. <p>Refer to IPIECA-IOGP (2015) for additional guidance on shoreline clean-up planning and implementation.</p>	<p>Environment Unit Leader Planning Section Chief Operations Section Chief</p>	<p><input type="checkbox"/></p>

	Action	Consideration	Responsibility	Complete
	In consultation with the Control Agency, procure and mobilise resources to a designated port location for deployment, or directly to location via road transport.		Logistics Section Chief Supply Unit Leader	<input type="checkbox"/>
	Deploy shoreline clean-up response teams to each shoreline location to begin operations under direction of the Control Agency.	Each clean-up team to be led by a Shoreline Response Team Leader, who could be an AMOSC Core Group Member or trained member of the AMSA administered National Response Team (as per the MoU agreement between Santos and AMSA). Clean-up teams and equipment will be deployed and positioned as per those observations by the Shoreline Clean-up Assessment Teams in consultation with the Control Agency. Team members will verify the effectiveness of clean-up, modifying guidelines as needed if conditions change.	Operations Section Chief Logistics Section Chief	<input type="checkbox"/>
Ongoing Actions	Shoreline Response Team Leader shall communicate daily reports to the IMT Operations Section Chief to inform of effectiveness of existing tactics and any proposed tactics and required resources.	Where possible, maintain some consistency in personnel within Shoreline Response Teams. If the same personnel are involved in Shoreline Clean-up Assessment and clean-up, they will be better placed to adapt their recommendations as the clean-up progresses and judge when the agreed end points have been met.	Shoreline Response Programme Manager Operations Section Chief	<input type="checkbox"/>
	The IMT Operations Section Chief shall work with the Planning Section Chief to incorporate recommendations into the Incident Action Plans for the following operational period, and ensure all required resources are released and activated through the Supply Unit Leader and Logistics Section Chief.		Operations Section Chief Planning Section Chief	<input type="checkbox"/>
	Monitor progress of clean-up efforts and report to the Control Agency.		Operations Section Chief On-Scene Commander	<input type="checkbox"/>

Table 13-3: Shoreline clean-up – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Manual clean-up tools (shovels, rakes, wheelbarrows, bags, etc.)	AMOSC shoreline kits	Shoreline support kits first-strike	Fremantle – 1 Geelong – 1	Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call; equipment logistics varies according to stockpile location (Table 10-12)
	Hardware suppliers	As available	Darwin, Broome, Perth	
Shoreline flushing (pumps/hoses)	AMOSC	Shoreline flushing kit Shoreline impact lance kit	Fremantle –1; Geelong – 1 Geelong – 1	Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call For mobilisation timeframes see Table 10-12
Nearshore skimmers/hoses	AMOSC AMSA	Refer to Protection and Deflection (Table 12-3)		
Decontamination/staging site equipment	AMOSC	Decontamination station – 3	Fremantle –1; Exmouth –1; Geelong – 1	Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call For mobilisation timeframes see Table 10-12

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
	AMSA	Decontamination station – 4	Karratha –2; Fremantle – 2	Access to National Plan equipment through AMOSC
	Oil spill equipment provider (e.g. Global Spill., PPS)	As available	Perth	Subject to availability
Waste storage (including temporary storage and waste skips and tanks for transport)	AMOSC temporary storage	Fast tanks – (9,000 L and 3,000 L) Vikotank (13,000 L) Lamor (11,400 L) IBCs (1 m ³)	Broome –1; Geelong –4; Fremantle –2; Exmouth – 2 Broome – 1; Geelong – 1; Fremantle – 4; Geelong – 13	Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call For mobilisation timeframes see Table 10-12
	AMSA temporary storage	Fast tanks – (10 m ³) Structureflex – (10 m ³) Vikoma – (10 m ³)	Darwin –2; Karratha –2; Fremantle – 4; Adelaide – 1; Brisbane – 2; Devonport – 2; Melbourne – 1; Sydney – 4; Townsville – 4 Brisbane – 1; Adelaide – 2; Darwin – 1; Adelaide – 1; Brisbane – 1; Devonport – 2; Fremantle – 4; Fremantle – 3; Melbourne – 2; Sydney – 2; Townsville – 4	Access to National Plan equipment through AMOSC
	Santos Waste Management Service Provider	Refer to Waste management (Section 15)	Darwin	24+ hours

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Personnel (field responders) for OSR strategies	AMOSC Staff	16	Fremantle – 5 Geelong – 11	Response via duty officer within 15 minutes of first call. Timeframe for availability of AMOSC personnel dependent on location of spill and transport to site
	AMOSC Core Group (Santos)	12	Perth/NW Australia facilities – 10 Port Bonython (South Australia) – 2	12+ hours
	AMOSC Core Group (Industry)	As per monthly availability (minimum 84)	Office and facility location across Australia	Location dependent. Confirmed at time of activation
	Santos contracted Work Force Hire company (e.g. Dare)	As per availability (up to 2,000)	Australia-wide	Subject to availability (indicatively 72+ hours)

Table 13-4: Shoreline clean-up – first-strike response timeline

Task	Time from shoreline contact (predicted or observed)
IMT confirms shoreline contact prediction, confirms applicability of strategy and begins sourcing resources.	<4 hours
Santos Offshore Core Group mobilised to deployment port location.	<24 hours
Clean-up equipment mobilised to deployment port location.	<24–48 hours
Waste storage equipment mobilised to deployment port location.	<24 hours
Remote island transfer vessel (if required) mobilised to deployment port location.	<24 hours
AMOSC Staff, Industry Core Group and Labour Hire mobilised to site/deployment port location.	<48 hours
Clean-up operation deployed to clean-up area under advice from Shoreline Assessment Team.	<48-72 hours (weather/daylight dependent)
Minimum Resource Requirements	
<p>NB: Resource requirements for shoreline clean-up will be situation/receptor specific. Indicative minimum requirements for one Santos-activated shoreline clean-up team are:</p> <ul style="list-style-type: none"> + manual clean-up/shoreline flushing equipment kit + waste storage (bags, temporary storage tanks, skips as appropriate) + decontamination/staging equipment kit + personal protective equipment. <p>One clean-up team comprises:</p> <ul style="list-style-type: none"> + one Team Leader (AMOSC staff, Industry Core Group or Santos Core Group) + 10–25 shoreline clean-up responders (AMOSC Core Group, Santos contracted labour hire personnel). 	

13.3 Shoreline clean-up decision guides

To assist with planning purposes, guidance for the selection of appropriate shoreline response strategies based on shoreline sensitivities is provided within **Appendix K**.

Operational guidelines for shoreline response activities including worksite preparation, manual and mechanical oil removal and vessel access for remote shorelines are included in **Appendix L**.

13.4 Environmental performance

Table 13-5 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 13-5: Environmental performance – shoreline clean-up

Environmental Performance Outcome	Implement shoreline clean-up tactics to remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery		
Response Strategy	Control Measures	Performance Standards	Measurement Criteria
Shoreline Clean-Up	Response Preparedness		
	Access to shoreline clean-up equipment and personnel through AMOSC, AMSA National Plan and OSRL	Maintenance of access to shoreline clean-up equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity. Maintain capability throughout activity through AMOSC Core Group, NT State Response Team, AMSA National Response Team and OSRL	MoU for access to National Plan resources through AMSA
			AMOSC Participating Member Contract
			OSRL Associate Member Contract
			Labour hire contract
	Maintenance of MSAs with multiple vessel providers	Santos maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers
	Vessels for offshore island response	Maintenance of vessel specification for resource transfer for offshore island response	Vessel Specification
	Labour hire contract	Maintenance of contract with labour hire provider	Contract
	Response Implementation		
	Mobilisation of minimum requirements for initial response operations	Minimum requirements mobilised in accordance with Table 13-4 unless directed otherwise by the Control Agency	Incident Log
	Shoreline Clean-Up Plan	Santos IMT to confirm protection priorities in consultation with the Control Agency	IAP Incident Log
		Prepare operational NEBA to determine if shoreline clean-up activities are likely to result in a net environmental benefit	Records indicate operational NEBA completed prior to shoreline clean-up activities commencing
Ensure operational NEBA considers waste management, to ensure environmental benefit outweighs the environmental impact of strategy implementation which may include secondary contamination		Incident Log IAP	

Environmental Performance Outcome	Implement shoreline clean-up tactics to remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery		
Response Strategy	Control Measures	Performance Standards	Measurement Criteria
		IAP Shoreline Clean-up Sub-plan developed to provide oversight and management of shoreline clean-up operation	Records indicate IAP Shoreline Clean-up Sub-plan prepared prior to shoreline clean-up operations commencing
		Clean-up strategies will be implemented under the direction of the Control Agency	Incident Log
		Santos will make available to the Control Agency Shoreline Supervisor/Specialist personnel from AMOSC/OSRL for shoreline clean-up team positions.	Incident Log
		Santos will make available to the Control Agency equipment from AMOSC and OSRL stockpiles	Incident Log
		NEBA undertaken every operational period by the relevant Control Agency to determine if response strategy is having a net environmental benefit. NEBA included in development of following period Incident Action Plan	IAP/Incident Log
	Prioritise use of existing roads and tracks	Unless directed otherwise by the designated Control Agency, access plans for shoreline operations will prioritise use of existing roads and tracks	IAP demonstrates requirement is met
	Soil profile assessment prior to earthworks	Unless directed otherwise by the designated Control Agency, a soil profile assessment is conducted prior to earthworks	Documented in IAP and Incident Log
	Pre-cleaning and inspection of equipment (quarantine)	Vehicles and equipment provided by Santos are verified as clean and invasive species free prior to deployment to offshore islands	Documented in IAP and Incident Log

Environmental Performance Outcome	Implement shoreline clean-up tactics to remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery		
Response Strategy	Control Measures	Performance Standards	Measurement Criteria
	Use of Heritage Adviser if spill response activities overlap with potential areas of cultural significance	Unless directed otherwise by the designated Control Agency, a Heritage Adviser is consulted if shoreline operations overlap with areas of cultural significance	Documented in IAP and Incident Log
	Select temporary base camps in consultation with NT IMT	Any establishment of forward staging areas at shoreline areas done under direction or in consultation with the Control Agency	Documented in IAP and Incident Log
	OSR Team Leader assessment/selection of vehicle appropriate to shoreline conditions	OSR Team Leader assess/select vehicles appropriate to shoreline conditions	IAP demonstrates requirement is met
	Establish demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/roosting areas and turtle nesting habitat	Unless directed otherwise by the Control Agency, demarcation zones are mapped out in sensitive habitat areas	IAP demonstrates requirement is met
	Operational restriction of vehicle and personnel movement to limit erosion and compaction	Unless directed otherwise by the Control Agency, action plans for shoreline operations include operational restrictions on vehicle and personnel movement	IAP demonstrates requirement is met
	Stakeholder consultation	Consultation is undertaken with relevant stakeholders prior to deployment of resources to townships and marine/coastal areas	Consultation records

14 Oiled wildlife

Note: the NT IMT is the Control Agency, and the Department of Environment, Parks and Water Security (DEPWS) is the Jurisdictional Authority for oiled wildlife response within NT waters. Santos and AMSA are the Control Agencies for oiled wildlife response within Commonwealth waters from facility and vessel spills respectively.

Table 14-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 14-1: Oiled wildlife response – environmental performance outcome, initiation criteria and termination criteria

Environmental performance outcome	Implement tactics in accordance with relevant Santos/ Territory Oiled Wildlife Response Plans (OWRP) to prevent or reduce impacts, and to humanely treat, house, and release or euthanise wildlife
Initiation criteria	Operational monitoring shows that wildlife are contacted or are predicted to be contacted by a spill
Termination criteria	<ul style="list-style-type: none"> + Oiling of wildlife have not been observed over a 48-hour period, and + Oiled wildlife have been successfully rehabilitated, and + Agreement is reached with Jurisdictional Authorities and stakeholders to terminate the incident response

14.1 Overview

The short-term effects of hydrocarbons on wildlife may be direct such as the external impacts from coating or internal effects from ingestion and inhalation. Oiled wildlife response (OWR) includes wildlife surveillance/reconnaissance, wildlife hazing, pre-emptive capture and the capture, cleaning, treatment, and rehabilitation of animals that have been oiled. In addition, it includes the collection, post-mortem examination, and disposal of deceased animals that have succumbed to the effects of oiling.

Long-term effects of a spill on wildlife may be associated with loss/degradation of habitat, impacts to food sources, and impacts to reproduction. An assessment of such impacts is covered under scientific monitoring (**Section 16**).

Table 14-2 provides guidance on the designated Control Agency and Jurisdictional Authority for Commonwealth and State waters for OWR. For a petroleum activity spill in Commonwealth waters, Santos act as the Control Agency and will be responsible for the wildlife response. The Santos Oiled Wildlife Response Framework Plan (SO-91-BI-20014) will be referred to for guidance for coordinating an OWR when Santos is the Control Agency, otherwise the relevant State OWR Plan will be referred to, as described below.

For Level 2 spills that contact NT shorelines the NT IC will assume the role of Control Agency with support from Santos. AMOSC on behalf of AMOSC Titleholder Members ConocoPhillips, INPEX and Shell Australia have developed a Northern Territory Oiled Wildlife Response Plan (NTOWRP) (AMOSC, 2019), this plan also has application for other titleholders as it provides operational guidance to respond to injured and oiled wildlife along the NT coastline and island groups.

Table 14-2: Jurisdictional and control agencies for oiled wildlife response

Jurisdictional boundary	Spill source	Jurisdictional authority for OWR	Control agency		Relevant documentation
			Level 1	Level 2/3	
Commonwealth waters (three to 200 nautical miles from territorial/state sea baseline)	Vessel	Department of Climate Change, Energy, the Environment and Water (DCCEEW)	AMSA		Northern Territory Oiled Wildlife Response Plan (NTOWRP) developed by AMOSC on behalf of AMOSC Titleholder Members ConocoPhillips, Inpex and Shell Australia to support their OWR operations in the NT.
	Petroleum activities		Titleholder		
Northern Territory (NT) waters (territorial sea baseline to three nautical miles and some areas around offshore atolls and islands)	Vessel	Department of Environment, Parks and Water Security (DEPWS)	NT IMT ¹⁶		
	Petroleum activities		Titleholder ¹⁷		

14.2 Wildlife response levels

To guide OWR resourcing requirements, **Table 14-3** has been adapted from the incident classification outlined in the National Plan (AMSA, 2020) in terms of wildlife at risk, incident duration and resourcing requirements.

Modelling results from the credible spill scenario for the Bayu-Undan to Darwin Gas Export Pipeline activities show no shoreline accumulation >100 g/m², and large aggregations of wildlife are not expected or known to occur within the moderate exposure zone of a potential spill. Consequently, it is not anticipated that there will be large numbers of oiled wildlife in the event of a spill.

¹⁶ For Level 2 spills that contact NT shorelines the NT IC will assume the role of Control Agency.

¹⁷ The Northern Territory Government have the following interim arrangements in place for OWR management:

- The NT Emergency Management Council will delegate responsibilities associated with wildlife and relevant activities in National Parks, Reserves and Marine Parks.
- Direct coordination shall be managed through the designated NT Government Functional Group.

Table 14-3: Wildlife incident level guidance

Characteristic	Level 1	Level 2	Level 3
Wildlife	Individual fauna	Groups of fauna or threatened fauna	Large numbers of fauna
Duration	0-3 days	Days to weeks	Weeks to months
Establishment of a wildlife facility	Not required	Likely required	Required

14.3 Implementation guidance

Table 14-4 provides guidance to the IMT on the actions and responsibilities that should be considered when implementing an oiled wildlife first-strike plan. This will enable an initial assessment of the OWR response level and initiation of a Wildlife Division for wildlife Level 2 spills (Table 14-3) where Santos is the Control Agency and as outlined in the Santos Oiled Wildlife Response Framework Plan (SO-91-BI-20014). Mobilisation times for the minimum resources that are required to commence initial oiled wildlife operations are listed in **Table 14-5**. Information on resource capability for this strategy is shown in **Appendix M**.

Wildlife surveillance/reconnaissance will likely form the main component of an OWR associated with a Bayu-Undan to Darwin Gas Export Pipeline activity spill. Refer to Section 7.3 in the Santos Wildlife Framework Plan for a list of the wildlife reconnaissance aims and objectives, tactics, species and life-cycle stages to consider when developing a wildlife reconnaissance plan. Wildlife reconnaissance should be undertaken in close consultation with personnel undertaking relevant monitor and evaluate activities.

Table 14-4: Implementation guidance – oiled wildlife response

Action	Consideration	Responsibility	Complete	
Initial wildlife assessment and notifications				
Initial actions	Personnel conducting monitor and evaluate activities shall report wildlife sightings in or near the spill trajectory (including those contacted with hydrocarbons or at risk of contact) and report them to the IMT within two hours of detection.	Record all reports of wildlife potentially impacted and impacted by spill. Record reports on: <ul style="list-style-type: none"> + location + access + number + species + condition of impacted animals (if available). 	Surveillance personnel	<input type="checkbox"/>
	<ul style="list-style-type: none"> + If wildlife are sighted and are at risk of contact (or have been contacted), initiate wildlife response by notifying AMOSC Duty Officer; and + if in Territory waters also notify DEPWS (Pollution Response Hotline; Environmental Operations); 	Obtain approval from IC before activating AMOSC Oiled Wildlife Adviser. If a Level 2 facility spill reaches the Northern Territory shoreline, the NT IMT will be the control agency for the shoreline.	Environment Unit Leader	<input type="checkbox"/>
	Notify Department of Climate Change, Energy, the Environment and Water (DCCEE) if there is a risk of death or injury to a protected species (including Matters of National Environmental Significance [MNES]).	Refer to Table 7-1 for reporting requirements. A list of MNES is provided in the Existing Environment Section of the EP (Section 3).	Environment Unit Leader	<input type="checkbox"/>
	Review all wildlife reports from surveillance or opportunistic activities and contact personnel who made the reports (if possible) to confirm information collected.		Environment Unit Leader Wildlife Response Branch Director	<input type="checkbox"/>

	Action	Consideration	Responsibility	Complete
	Use information from initial assessments to prepare an operational NEBA. Use this information to help determine: <ul style="list-style-type: none"> + initial OWR Response Level (1 to 3), see Table 14-3 + For Level 2 wildlife incidents where Santos is the control Agency, a Wildlife Division should be established (see the Santos Oiled Wildlife Framework Plan [SO-91-BI-20014]) + if OWR activities are likely to result in a net environmental benefit + prepare a Wildlife Plan for inclusion in the IAP. 	Oiled wildlife response activities such as hazing and pre-emptive capture can cause additional stress and mortality on individuals than oil pollution alone. The Environment Unit Leader and Wildlife Division Coordinator will determine via an operational NEBA whether strategies such as hazing/pre-emptive capture will result in a net environmental benefit. This may be done in consultation with the designated NT Government Functional Group and AMOSC Oiled Wildlife Advisers and any Subject Matter Experts as relevant (if available, but an operational NEBA should not be delayed if they are not immediately available).	Environment Unit Leader If Wildlife Response Branch activated: <ul style="list-style-type: none"> + Wildlife Response Branch Director 	<input type="checkbox"/>
	Prepare a Wildlife Plan for inclusion in the IAP	Refer to the Santos Oiled Wildlife Framework Plan (SO-91-BI-20014), Section 7.1	Environment Unit Leader If Wildlife Response Branch activated: <ul style="list-style-type: none"> + Wildlife Response Branch Director 	<input type="checkbox"/>
Mobilisation of wildlife resources				
	Determine resources required to undertake wildlife reconnaissance and provide list to Logistics Section.	Confirm best reconnaissance platform (e.g. vessel, aerial, shoreline). Consider ability to share resources (e.g. Monitor and Evaluate activities, Scientific Monitoring).	AMOSC OWA If Wildlife Response Branch activated: <ul style="list-style-type: none"> + Wildlife Response Branch Director + Wildlife Reconnaissance Officer 	<input type="checkbox"/>

Action	Consideration	Responsibility	Complete
Determine number of Oiled Wildlife Responders and IMT Wildlife related positions required based on the likely number of oiled wildlife and arrange access to resources via AMOSC and/or DEPWS.	Consider need for veterinary care.	AMOSC OWA Logistics Section Chief If Wildlife Response Branch activated: + Wildlife Response Branch Director NT shoreline: + Designated NT Government Functional Group	<input type="checkbox"/>
Commence mobilisation of equipment (including adequate PPE) and personnel to required location/s.		Logistics Section Chief	<input type="checkbox"/>
Contact OSRL to activate Sea Alarm if additional support is likely to be required to sustain an ongoing OWR.		Environment Unit Leader	<input type="checkbox"/>

Table 14-5: Oiled wildlife response – first-strike response timeline

Task	Time from oiled wildlife contact (predicted or observed)
IMT notifies regulatory authorities and AMOSC of oiled wildlife / potential for contact	<2 hours
Mobilise Santos personnel for oiled wildlife reconnaissance **this will be already occurring through Aerial Observer mobilisation**	<24 hours
Mobilisation of AMOSC oiled wildlife equipment and industry OWR team to forward staging area	<48 hours
Minimum resource requirements	
<p>The requirements for oiled wildlife response will be situation specific and dependent upon reconnaissance reports. Indicative minimum resource requirements below align with personnel requirements for a scenario with low wildlife impact:</p> <ul style="list-style-type: none"> + Six trained industry oiled wildlife response team personnel (AMOSC staff & contractors/ AMOSC Industry OWR group) + One AMOSC OWR treatment container + One AMOSC Oiled Wildlife Deterrence Kit. 	

14.4 Environmental performance standards

Table 14-6 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 14-6: Environmental performance – oiled wildlife response

Environmental performance outcome	Implement tactics in accordance with relevant Oiled Wildlife Response Plans (OWRP) to prevent or reduce impacts, and to humanely treat, house, and release or euthanise wildlife		
Response strategy	Control measures	Performance standards	Measurement criteria
Oiled wildlife response	Response preparedness		
	Maintenance of access to oiled wildlife response equipment and personnel	Maintenance of access to oiled wildlife response equipment and personnel through Santos, AMOSC, AMSA National Plan and OSRL throughout activity	MoU for access to National Plan resources through AMSA
			AMOSC Participating Member Contract. OSRL Associate Member Contract.
	Santos Oiled Wildlife Response Framework Plan (SO-91-BI-20014)	Santos Oiled Wildlife Response Framework Plan provides guidance for coordinating an OWR when Santos is the control	Santos Oiled Wildlife Response Framework Plan

Environmental performance outcome	Implement tactics in accordance with relevant Oiled Wildlife Response Plans (OWRP) to prevent or reduce impacts, and to humanely treat, house, and release or euthanise wildlife			
Response strategy	Control measures	Performance standards	Measurement criteria	
		agency and outlines Santos's response arrangements		
	Labour hire contract	Maintenance of contract with labour hire provider	Contract	
	Labour hire onboarding procedure (for low skilled shoreline clean-up- personnel)	Development of onboarding procedure for oil spill response labour hire	Onboarding procedure	
	Maintain Santos personnel trained in OWR and positioned at Perth and VI	Santos personnel trained in OWR	Training records	
	Response implementation			
	Mobilisation of minimum requirements for initial response operations	Minimum requirements mobilised in accordance with Table 14-5 unless directed otherwise by relevant control agency	Incident log	
	OWR managed in accordance with the Santos Oiled Wildlife Framework Plan (SO-91-BI-20014), and NT OWRP in Territory waters	Prepare operational NEBA to help classify OWR level and determine if OWR activities are likely to result in a net environmental benefit (particularly in relation to hazing/pre-emptive capture)	Records indicate operational NEBA completed prior to OWR operations commencing	
		Wildlife Plan developed and included in the IAP to provide oversight and management of OWR operation	Records indicate IAP Wildlife Plan prepared before OWR operations commencing	

15 Waste management

Table 15-1 lists the environmental performance outcome, initiation and termination criteria for this strategy.

Table 15-1: Waste management – environmental performance outcome, initiation criteria and termination criteria

Environmental performance outcome	Comply with waste treatment, transport and disposal regulations and prevent secondary contamination while reducing, re-using and recycling waste where possible
Initiation criteria	Response activities that will be generating waste have been initiated
Termination criteria	<ul style="list-style-type: none"> + All waste generated from the oil spill response has been stored, transported and disposed as per the regulatory requirements, and + Agreement is reached with Jurisdictional Authorities to terminate the response.

15.1 Overview

The implementation of some spill response strategies will generate waste solid and liquid waste that will require rapid management, storage, transport and disposal. It is important that waste is collected and removed efficiently to ensure waste management does not create a bottleneck in response operations.

The type and amount of waste generated during a spill response will vary depending on the spill type/characteristics, volume released, and response strategies implemented. To account for this potential variability, waste management (including handling and capacity) needs to be scalable to allow a continuous response to be maintained.

The worst-case oil spill modelling conducted for Bayu-Undan to Darwin Gas Export Pipeline activities predict no shoreline accumulation $>100 \text{ g/m}^2$ for MGO. Potential waste management requirements are therefore likely to be limited to oiled wildlife response and water quality monitoring activities. Significant volumes of waste from the applicable response activities for this OPEP are not anticipated due to the propensity of MGO/MDO to disperse naturally, although there may be some limited volumes of oiled sediment and/or PPE waste if a shoreline clean-up response is implemented.

Where Santos is the Control Agency, or at the request of the designated Control Agency, Santos will engage its contracted Waste Service Provider (WSP) to provide sufficient waste receptacles to store collected waste and manage oily waste collection, transport and disposal associated with spill response activities. The WSP will arrange for all personnel, equipment and vehicles to carry out these activities from nominated collection points to licensed waste management facilities. All transport will be undertaken via controlled-waste-licensed vehicles and in accordance with the *Waste Management and Pollution Control Act* (NT). Santos' Oil Pollution Waste Management Plan (QE-91-IF-10053) provides detailed guidance to the WSP in the event of a spill.

15.2 Implementation guidance

Table 15-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. The Incident Commander is ultimately responsible for implementing the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 15-2: Implementation guidance – waste management

	Action	Consideration	Responsibility	Complete
Initial actions	Contact WSP (Primary or Secondary Contact Person) and activate Waste Project Manager.	Refer to Incident Response Contacts Directory (SO-00-ZF-00025.020) for contact details.	Logistics Section Chief	<input type="checkbox"/>
	Based on operational modelling and applicable response strategies communicate the type and quantity of empty liquid and solid waste receptacles required to support planned operations.	It is better to overestimate volumes and scale back resources than to underestimate waste volumes.	Logistics Section Chief Planning Section Chief	<input type="checkbox"/>
	Using most recent monitor and evaluate data and any existing and future response activities, determine most suitable locations for waste receptacles to be positioned and for temporary storage locations to be established.	Shoreline waste collection points (temporary storage site) will be determined by the NT IMT and will depend upon the location of shoreline clean-up activities and staging areas and the availability of vehicle access routes.	Logistics Section Chief Planning Section Chief Environmental Unit Leader	<input type="checkbox"/>
	For each receipt location indicate the anticipated: <ul style="list-style-type: none"> + material types + material generation rates + material generation quantities + commencement date/time + anticipated clean-up duration + receptacle types required + logistical support requirements + any approvals required from Ports, Local Governments, Landowners, State Government Agencies (Refer to Oil Pollution Waste Management Plan (QE-91-IF-10053)). 	Consider facilities for waste segregation at source.	Logistics Section Chief Planning Section Chief	<input type="checkbox"/>
	Once the above information is obtained, ensure all necessary waste management information is included in the IAP.	Waste management should be done in accordance with Santos' Oil Pollution Waste Management Plan (QE-91-IF-	Logistics Section Chief (or delegate) Planning Section Chief	<input type="checkbox"/>

	Action	Consideration	Responsibility	Complete
		10053); and where relevant, the respective Port, Port Operator and/or Ship Owner’s waste management plan.	WSP location Responsible Person or Operations Supervisor	
	Mobilise waste management resources and services to agreed priority locations.		WSP location Responsible Person or Operations Supervisor Logistics Section Chief	<input type="checkbox"/>
Ongoing actions	Provide ongoing point of contact between IMT & WSP.		Logistics Section Chief	<input type="checkbox"/>
	Ensure all waste handling, transport and disposal practices comply with legislative requirements.	Alert Logistics Section Chief (or delegate) if any non-compliance is anticipated or detected. Site clean-up, removal and disposal of response waste should be conducted in accordance with Santos’ Oil Pollution Waste Management Plan (QE-91-IF-10053); and where relevant, the <i>Waste Management and Pollution Control Act</i> (NT), the respective Port, Port Operator and/or Ship Owner’s waste management plan.	WSP location Responsible Person or Operations Supervisor	<input type="checkbox"/>
	Ensure records are maintained for all waste management activities, including but not limited to: <ul style="list-style-type: none"> + waste movements (e.g. types of receptacles, receipt points, temporary storage points, final disposal locations) + volumes generated at each site (including total volume and generation rates) + types of waste generated at each site + approvals obtained (as required). 		WSP location Responsible Person or Operations Supervisor	<input type="checkbox"/>

15.3 Waste approvals

Site clean-up, removal and disposal of response waste should be conducted in accordance with Santos' Oil Pollution Waste Management Plan (QE-91-IF-10053); and where relevant, the *Waste Management and Pollution Control Act* (NT), and the respective Port, Port Operator and/or Ship Owner's waste management plan. In addition, regulatory approval may be required for the temporary storage, transport, disposal and treatment of waste, through the NT Environmental Protection Authority (EPA).

The DEPWS administers the *Waste Management and Pollution Control Act* (NT) and the NT EPA is the relevant regulatory Authority for waste management approvals in the NT. The Santos Oil Pollution Waste Management Plan (QE-91-IF-10053) provides detail on the regulatory requirements for each port/location likely to be used for waste management during any spill response operation associated with Santos' activities.

15.4 Resource requirements

Based on the credible spill scenarios for the Bayu-Undan to Darwin Gas Export Pipeline activities, Santos do not anticipate that large volumes of waste will be generated. The potential types and total volumes of waste anticipated for each response option are provided in **Table 15-3**.

Table 15-4 summarises the waste storage, treatment and disposal options available to manage waste associated with the spill response options.

Given that large volumes of a waste are not anticipated, storage space on the spill response vessels is anticipated to be adequate. However, as soon as the details of an actual spill are available, waste management arrangements to allow a continuous response to be maintained should be reviewed.

The waste products are likely to be transported by vessel from the response location to Darwin Port. Waste will be transported from Darwin Port to licensed waste disposal facilities by a dedicated waste contractor. Santos has existing service agreements with a WSP which include the provision of waste management services during a spill response. Transport to the licensed waste management facilities would be undertaken via controlled-waste-licensed vehicles and in accordance with the NT *Waste Management and Pollution Control Act, 2015*.

Table 15-3: Waste types and volumes anticipated during a spill response

Spill response option	Oily liquid waste	Solid oily waste	PPE and consumables
Monitor and evaluate	None	None	<1 m ³ /day
Mechanical dispersion	None	None	<1 m ³ /day
Shoreline clean-up ¹⁸	<1 m ³ /day	<3 m ³ /day	<2-4 m ³ /day
Wildlife response	<1 m ³ /day	<2 m ³ /day	<4-6 m ³ /day

¹⁸ Based on one small clean-up team of 4-6 people removing approximately 1 m³/person/day.

Table 15-4: Spill response waste storage, treatment and disposal options

Waste category	On-site storage	Treatment/disposal option
Liquid waste (e.g. recovered oil/water mixture)	Holding on vessels, oil drums, tanks, oil barges and flexible bladders	Wastewater treatment process and discharge (e.g. dust suppression) Incineration
Solid waste – oiled organic matter/sediment, PPE and consumables (e.g. oily gloves)	Lined skips, oil drums, industrial waste bags, plastic rubbish bags	Recovery (e.g. thermal desorption or fixation process) and recycling Incineration Landfill
Oiled wildlife response	Industrial waste bags, plastic rubbish bags	Incineration Landfill

15.5 Waste service provider capability

Detailed guidance on Santos' WSP responsibilities for spill response waste management is provided in the Santos Oil Pollution Waste Management Plan (QE-91-IF-10053).

Key responsibilities of the WSP include:

- + Maintain emergency response standby preparedness arrangements, including:
 - have access to personnel, equipment and vehicles required for a first-strike and ongoing response commensurate to Santos worst case spill and waste requirements
 - provide primary and secondary contact details for activation of spill response waste management services
 - have suitably trained personnel for completing critical tasks in spill response waste management
 - participate in exercises undertaken by Santos.
- + Maintain ability to assist in the Control Agency's IAP and Waste Management Sub-plan process as required.
- + Mobilise resources to waste collection points identified by the control agency.
- + Ensure waste handling, transport and disposal practices meet legislative requirements.
- + Keep auditable records of waste streams from collection points to final disposal points.
- + Provide regular progress reporting to the control agency IMT and a final report relating to quantities and destinations of collected waste.
- + Provide a project manager responsible for the rollout of spill response resources to meet spill response waste management objectives.
- + Provide location-specific Operations Supervisor/s to handle on-site operational aspects (management of personnel and equipment, reporting, liaison with relevant field-based spill responders).

15.6 Environmental performance

Table 15-5 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 15-5: Environmental performance – waste management

Environmental performance outcome	Comply with waste treatment, transport and disposal regulations and prevent secondary contamination while reducing, reusing and recycling waste where possible		
Response strategy	Control measures	Performance standards	Measurement criteria
Waste management	Response preparedness		
	Maintain access to waste management equipment, personnel, transport and disposal facilities	Maintain access to waste management equipment, personnel, transport and disposal facilities throughout activity	Contract with WSP for emergency response services
	Response implementation		
	Implement Oil Pollution Waste Management Plan (QE-91-IF-10053)	WSP to appoint a Project Manager within 24 hours of activation	Incident log
		WSP shall track all wastes from point of generation to final destination	Waste tracking records
WSP to provide monthly waste management reports and more regular situation reports during the response until termination criteria are met		Waste reports	

16 Scientific monitoring

Table 16-1: Scientific monitoring – environmental performance outcome, initiation criteria and termination criteria

Environmental performance outcome	Implement monitoring programs to assess and report on the impact, extent, severity, persistence and recovery of sensitive receptors contacted by a spill or affected by spill response
Initiation criteria	Refer to individual Receptor SMPs – Appendix N
Termination criteria	Refer to individual SMPs – Appendix N

Oil spill scientific monitoring is the principal tool for detecting and quantifying environmental impact and recovery to sensitive receptors from an oil spill. Santos is required to have an oil spill SMP in place for Petroleum activities in Territory and Commonwealth waters.

Santos will activate and implement scientific monitoring in Territory and Commonwealth waters for hydrocarbon spills in line with its SMPs unless directed otherwise by the relevant Control Agency/s.

16.1 Objectives

The overarching objective of Santos' SMPs is to provide guidance to staff, consultants and contractors in developing monitoring a monitoring program for detecting impacts and recovery to environmentally sensitive receptors contacted by a spill.

Receptor-specific SMPs have different objectives as outlined in **Appendix N**.

16.2 Scope

Santos will implement its SMPs, as applicable, for Bayu-Undan to Darwin Gas Export Pipeline activities spills across both Territory and Commonwealth waters. For oil spills that contact NT shorelines, Santos will liaise directly with the NT IMT and provide all of the required support to implement scientific monitoring on NT shorelines.

16.3 Relationship to operational monitoring

Operational monitoring (**Section 10**) is monitoring undertaken to obtain information which will provide situational awareness and assist in the planning and execution of the oil spill response.

Scientific monitoring activities have different objectives to operational monitoring, which influences the monitoring methods likely to be used, the degree of scientific rigour required to meet the monitoring objectives, and the scope of studies. Scientific monitoring may occur in parallel to operational monitoring and is typically conducted over a wider study area, extending beyond the spill footprint. It is also typically conducted over a longer time period, extending beyond the spill response.

Scientific monitoring is designed to provide data for short-term and longer-term environmental effects assessment. This is typically required to be quantitative in nature and appropriate for statistical analyses. However, these two types of monitoring are related, and Operational Monitoring outputs typically inform the final design of the related SMP.

16.4 Scientific monitoring plans

Owing to the diverse nature of sensitive receptors that could be contacted by an oil spill and the different techniques and skillsets required to monitor impact and recovery to these receptors, there are a number of Oil Spill Scientific Monitoring Plans relevant to Bayu-Undan to Darwin Gas Export Pipeline activities (**Table 16-2**). These are detailed further in **Appendix N**; each SMP has corresponding objectives, initiation/termination criteria, methodologies, baseline data sources and analysis and reporting requirements, noting that in a response controlled by the NT IMT, the methodology, termination criteria and analysis/reporting requirements may differ.

Table 16-2: Oil spill scientific monitoring plans relevant to Bayu-Undan to Darwin Gas Export Pipeline activities

Study	Title
SMP1	Marine water quality
SMP2	Marine sediment quality
SMP3	Shorelines and coastal habitats – sandy beaches and rocky shores
SMP4	Shorelines and coastal habitats – mangroves
SMP5	Shorelines and coastal habitats – intertidal mudflats
SMP6	Benthic habitats
SMP7	Seabirds and shorebirds
SMP8	Marine megafauna (incl. Whale sharks and mammals)
SMP9	Marine reptiles
SMP10	Seafood quality
SMP11	Fish, fisheries and aquaculture
SMP12	Whale sharks

16.5 Baseline monitoring

Baseline monitoring provides information on the condition of ecological receptors before, or spatially independent of (e.g. if used in control chart analyses), a spill event and is used for comparison with the post-impact scientific monitoring where required. This is particularly important for scientific monitoring where the ability to detect changes between pre-impact and post-impact conditions is necessary.

In the event of a spill to marine or coastal waters, reactive pre-impact monitoring should, where practicable, be implemented to gather additional data on the current state of the environment.

Santos periodically reviews the status, availability and suitability of existing baseline data sources related to key environmental sensitivities in its areas of operations. **Appendix P: Scientific monitoring capability** provides further information on Santos baseline data reviews and outlines a baseline data assessment conducted on high priority areas for scientific monitoring in the event of a spill.

16.6 Monitoring service providers

Oil Spill Scientific Monitoring will be conducted on behalf of Santos by contracted monitoring service providers (MSPs) and applies to the implementation of SMPs 1 to 12 (**Table 16-2**). These services are provided by Astron Environmental Services (Astron) and primary sub-contractor (BMT). **Appendix P: Scientific monitoring capability** provides further information regarding Astron's capability and assurance arrangements.

For whale sharks, in addition to the monitoring that will be undertaken as part of SMP8 Marine Megafauna, additional scientific monitoring of whale sharks within the foraging BIA will be undertaken (SMP12). Santos has historically and currently supports research on the behaviour, demography and migration patterns of whale sharks at Ningaloo Reef conducted by Australian Institute of Marine Science (AIMS). In the event of a spill that could impact whale sharks, Santos will leverage off this long-term research program to assess potential impacts to whale sharks within the foraging BIA. SMP12 is regarded as complementary to SMP8 which will detect potential impacts to whale sharks from visual surveys of whale sharks wherever they may occur in relation to a spill.

As per the Santos Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162), Santos' MSP provides the following scientific monitoring services to Santos:

- + 24/7 monitoring support accessed through 24-hour call-out number
- + provision of a suitably trained Monitoring Coordination Team including a Monitoring Coordinator, Monitoring Operations Officer, Planning and Logistics Officer and Safety Officer
- + provision of Technical Advisers and Field Teams (staff and contractors) for first-strike deployments
- + maintenance of standby monitoring equipment
- + monthly personnel capability reports
- + provision and review of Scientific Monitoring Sub-plans
- + provision and review of Standby Service Manual (EA-00-RI-10162) and associated response activation forms
- + participation in audits, workshops, drills and exercise to facilitate readiness.

Appendix N provides an overview of Santos' processes in place to provide assurance that its oil spill scientific monitoring arrangements for SMPs 1–11 are fit-for-purpose to meet the worst-case first-strike monitoring requirements associated with the Bayu-Undan to Darwin Gas Export Pipeline activities.

16.7 Activation

The SMP Activation Process is outlined in **Appendix O**. SMPs are activated as per the initiation criteria for each as outlined in **Appendix N**. The SMP Activation Form is available on the Santos Procedures Index and Environment Unit Leader folder.

The Santos IMT Environment Unit Leader with support from IMT Environment Unit members is responsible for activating the primary MSP. The Santos Environment Unit will assist the MSP Monitoring Coordination personnel and relevant Technical Advisers in defining the monitoring study design, monitoring locations and field methodologies based on Operational Monitoring information (e.g. spill modelling and aerial surveillance

information), relative location of sensitive receptors to the spill and the timing of the spill with respect to seasonality of sensitive receptors.

This process will identify monitoring operational objectives and resourcing/ mobilisation requirements which the Environment Unit Leader will feed back to the IMT for approval. Mobilisation times for the minimum resources that are required to commence initial scientific monitoring operations are listed in **Table 16-3**.

In the event that a designated Control Agency takes command of scientific monitoring, Santos will follow the direction of the Control Agency providing planning and resourcing support through its MSPs as required.

Table 16-3: Scientific monitoring – first-strike response timeline

Task	Time from activation
Monitoring Service Provider commences activation process once initial notification form is received from Santos	30 mins
Santos IMT approve initial monitoring plan	<24 hours
Santos to mobilise sampling platforms to deployment location	<120 hours (72 hours from monitoring plan approval)
SMP teams and monitoring equipment mobilised to deployment locations	<120 hours (72 hours from monitoring plan approval)
Minimum resource requirements	
Initial resourcing requirements will be dependent upon the number of SMPs activated and the requirement for post-spill baseline data to be collected. First-strike personnel requirements for scientific monitoring field teams at Protection Priority areas are presented in Appendix P .	
<ul style="list-style-type: none"> + suitable vessels for on-water monitoring or transfer of personnel to remotes areas/islands + vehicle/s as required + helicopter for aerial surveys as required + scientific monitoring personnel for first-strike teams (refer Appendix P) + scientific monitoring equipment as detailed in the relevant SMP. 	

16.8 Environmental performance

Table 16-4 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 16-4: Environmental performance – scientific monitoring

Environmental performance outcome	Implement monitoring programs to assess and report on the impact, extent, severity, persistence and recovery of sensitive receptors contacted by a spill		
Response strategy	Control measures	Performance standards	Measurement criteria
Scientific monitoring	Response preparedness		
	Maintenance of Monitoring Service Provider contract for scientific monitoring services	Maintain access to specialist monitoring personnel and equipment by maintaining contract with Monitoring	Contract with monitoring service provider

Environmental performance outcome	Implement monitoring programs to assess and report on the impact, extent, severity, persistence and recovery of sensitive receptors contacted by a spill		
Response strategy	Control measures	Performance standards	Measurement criteria
		Service Provider throughout activity	
	Capability reports from Monitoring Service Provider	Obtain monthly capability reports from Monitoring Service Provider	Capability reports
	Conduct periodical review of existing baseline data sources across the Santos combined EMBA	Regular review of baseline data	Baseline data review report
	Water quality monitoring vessels	Maintenance of vessel specification for water quality monitoring vessels	Vessel specification
	Response implementation		
	Activate Scientific Monitoring Plans	Initiation criteria of SMPs will be reviewed during the preparation of the initial IAP and subsequent IAPs; and if any criteria are met, relevant SMPs will be activated	Incident Action Plan and Incident log
		If any SMPs are activated, the subsequent activation of MSP is to follow the process outlined in the Santos Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162)	Incident log
		MSP shall commence activation process within 30 mins of initial notification form being received from Santos	Monitoring Service Provider records
		Santos personnel to support MSP through the provision of operational monitoring information and relative location of sensitive receptors to the spill	Incident log and Monitoring Service Provider records

Environmental performance outcome	Implement monitoring programs to assess and report on the impact, extent, severity, persistence and recovery of sensitive receptors contacted by a spill		
Response strategy	Control measures	Performance standards	Measurement criteria
	Mobilisation of minimum requirements for initial scientific monitoring operations	Minimum requirements mobilised in accordance with Table 16-3	Incident log

17 Response termination

The decision to terminate the spill response is made in consultation with the relevant Control Agency/s, Jurisdictional Authorities and other Statutory Authorities that play an advisory role. This decision will be made with consideration of:

- + the efficacy and benefit of current response options
- + any potential for additional pollution
- + any potential for additional environmental damage caused by further clean-up efforts
- + an assessment of prevailing weather conditions that can increase risk to response teams or increase the efficacy in weathering hydrocarbon.

An operational NEBA will be conducted to inform the decision-making process. Termination criteria are defined within each section of contingency response activities defined within the OPEP.

Upon conclusion of the spill response activity, Santos will:

- + prepare detailed reports and collate all documents
- + report on the performance objectives of each individual spill response that was mobilised
- + undertake an inventory of consumables and prepare accounts
- + arrange for the return of equipment
- + arrange for the refurbishment of consumed equipment
- + investigate the cause of the incident and report to relevant authorities
- + assess long-term environmental monitoring requirements.

18 References

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Appendix A: Hydrocarbon characteristics and behaviour

Marine gas oil (MGO)

IOPF (2021) and AMSA (2015) categorises MGO as a light group 2 hydrocarbon. The physical characteristics of MGO are summarised in **Table A-1**. In the marine environment, a 2.7% residual of the total quantity of MGO spilt will remain after the volatilisation and solubilisation processes associated with weathering. For full details on the properties of MGO, refer to Section 7.5.4 of the Bayu-Undan to Darwin Gas Export Pipeline EP (7710-057-EIS-0001).

In summary, in the marine environment MGO will behave as follows:

- + MGO will spread rapidly in the direction of the prevailing wind and waves;
- + Evaporation is the dominant process contributing to the fate of spilled MGO from the sea surface and will account for ~97% reduction of the net hydrocarbon balance;
- + Has a strong tendency to entrain into the upper water column (0 m–10 m) (and consequently reduce evaporative loss) in the presence of moderate winds (>10 knots) and breaking waves. However, it re-surfaces when the conditions calm; and
- + The evaporation rate of MGO will increase in warmer air and sea temperatures such as those present around the operational area.

Figure A-1 provides the predicted weathering and fates of surface MGO (RPS, 2022). The graph shows that >150 m³, or more than 80% of the original volume of the spill (187 m³) would evaporate within 2 days.

Table A-1: Properties of MGO (RPS, 2022)

Hydrocarbon type	Density (kg/m ³) @ 15°C	Dynamic viscosity (cP @ 25°C)	API	Pour point °C	Residual (%)
MGO	830	4	36.4	-36	2.7

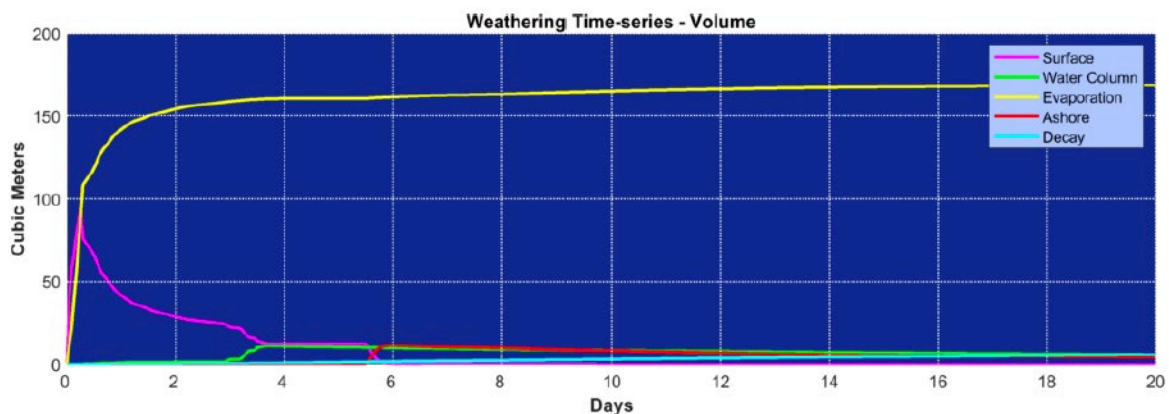


Figure A-1: Predicted weathering and fates of MGO for a 187 m³ spill (RPS, 2022)

Marine diesel oil (MDO)

ITOPF (2021) and AMSA (2015) categorises MDO as a light group 2 hydrocarbon. The physical characteristics of MDO are summarised in **Table A-2**. In the marine environment, a 5% residual of the total quantity of MDO spilt will remain after the volatilisation and solubilisation processes associated with weathering.

In summary, in the marine environment MDO will behave as follows:

- + MDO will spread rapidly in the direction of the prevailing wind and waves;
- + In calm conditions, evaporation is the dominant process contributing to the fate of spilled MDO from the sea surface and will account for 60 to 80% reduction of the net hydrocarbon balance;
- + Has a strong tendency to entrain into the upper water column (0 m–10 m) (and consequently reduce evaporative loss) in the presence of moderate winds (>10 knots) and breaking waves. However, it re-surfaces when the conditions calm.
- + The evaporation rate of MDO will increase in warmer air and sea temperatures such as those present around the area; and
- + MDO residues usually consist of heavy compounds that may persist longer and will tend to disperse as oil droplets into the upper layers of the water column.

Figure A-2 provides the predicted weathering and fates of a surface spill of MDO. The graphs show that under low winds (1 m/s), 60% of the surface slick is predicted to remain as surface oil after 120 hours (5 days), while 40% has evaporated. Under moderate winds (5 m/s), 40% of the initial surface slick is predicted to remain as surface oil after 24 hours, decreasing further to ~10% after 48 hours and ~1% after 72 hours while the remainder has evaporated or dispersed into the water column. With high winds (10 m/s), the surface slick is predicted to almost entirely evaporate (~20–25%) or disperse (~75–80%) after 12 hours.

Table A-2: Properties of MDO (GHD, 2021)

Hydrocarbon type	Specific gravity	Viscosity at 20 °C (cSt)	API	Wax content (%)	Pour point °C	Asphaltene (%)
MDO	0.843	3.9	36.4	0.05	-36	0.05

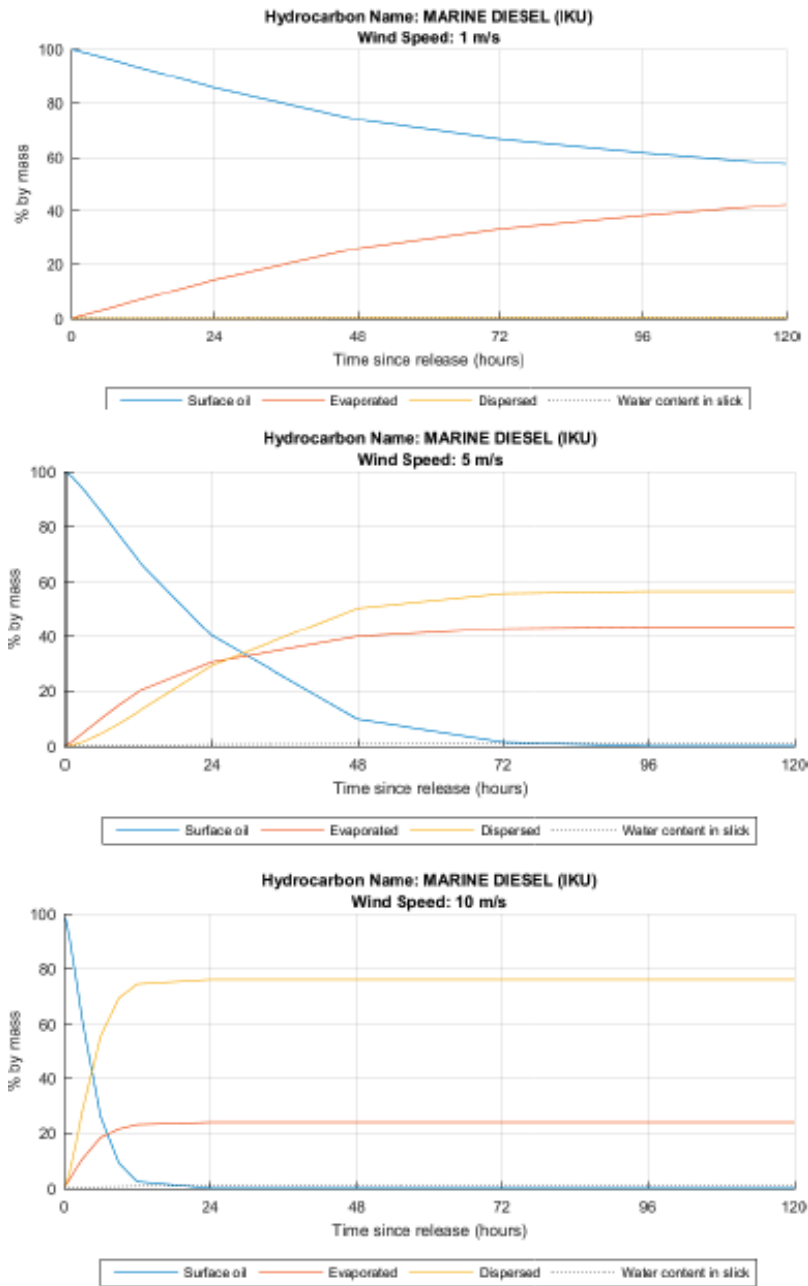


Figure A-2: Predicted weathering and fates of MDO spill (GHD, 2021)

Appendix B: ALARP Assessment Framework

1. Rationale

As part regulatory approval requirements for petroleum activities, the Environment Plan (EP) and/or Oil Pollution Emergency Plan (OPEP) must demonstrate that through the implementation of all reasonable control measures, environmental risks have been reduced to a level that is As Low As Reasonably Practicable (ALARP).

With respect to hydrocarbon spill risk and response planning, this includes an assessment to demonstrate that the oil spill response control measures are reducing risk to a level that is ALARP.

This ALARP Assessment Framework provides a process to facilitate the identification of all existing and potential spill response control measures, the selection or rejection of which are supported by reasoned arguments.

2. Guidance documents

Guidance documents used in the preparation of this framework include:

- + Oil Spill Risk Assessment and Response Planning Procedure QE-91-II-20003
- + NOPSEMA Guidance Note ALARP N-04300-GN0166 Revision 6 June 2015
- + NOPSEMA Guidance Note Control Measures and Performance Standards N04300-GN0271 Revision No 4 Last Reviewed 2020
- + NOPSEMA Guideline Environment Plan Decision Making N-04750-GL1721 Revision 6 – November 2019
- + NOPSEMA Guidance Note Risk Assessment GN0165 Revision 5 May 2017
- + NOPSEMA Oil Pollution Risk Management GN1488 Rev 2 February 2018.

3. Overview

The ALARP Assessment Framework uses activity-specific information to systematically assess existing and potential control measures and ensure that all practicable control measures are identified and documented.

When selecting controls to reduce risk is it good practice to apply a preferential order; elimination, substitution, prevention, reduction and mitigation. In the context of this ALARP Assessment Framework for oil spill response, all control measures are response strategies to reduce the impacts of an unplanned event that has already occurred. All source control response measures may be classed as 'reduction' in the hierarchy of controls with all other response measures classed as 'mitigation'.

The ALARP Assessment Framework is shown in **Figure B-1**.



Figure B-1: ALARP Assessment Framework

In **Figure B-1**, Steps 1 to 5 (in GREEN) denote input information into the ALARP Assessment Framework. This information comprises:

1. Spill Scenarios: This step will involve assessing all possible spill scenarios from the activity and identifying the worst-case credible scenarios as a basis for pollution response planning.
2. Spill Modelling: A quantitative spill modelling assessment is conducted for the worst-case credible scenarios identified in Step 1.
3. Protection Priority Areas: The Environment that may be Affected (EMBA) is the largest area within which impacts from hydrocarbon spills associated with the activity could extend. The EMBA is predicted using spill modelling results from Step 2. Protection Priority Areas are locations of high ecological value within the EMBA that would be targeted in response. Selection of Protection Priority Areas is detailed in the Oil Spill Risk Assessment and Response Planning Procedure QE-91-II-20003
4. NEBA: Net Environmental Benefit Analysis (NEBA) is used to select the most effective response strategies to protect the Protection Priority Areas identified in Step 3.
5. Resource Needs Analysis: For the response strategies identified through NEBA, the worst-case resource, timing, and location requirements are determined, using quantitative spill modelling information where applicable. An Implementation Guidance is then developed to detail what arrangements and actions are required to be initiated by the Incident Management Team (IMT) to meet the incident requirements up to a worst-case incident.

Through the development of the Implementation Guidance, it may be possible to identify resource, timing and location requirements that could be improved. These areas of improvement should be noted in the ALARP so that additional, alternative or improved control measures can be considered in this context.

A detailed ALARP Assessment Framework for the evaluation of control measures is shown in **Figure B-1**, Step 6 (in BLUE). Criteria and definitions used to evaluate control measures are shown in **Table B-1**.

- 6a) Record Control Measures In Effect: The spill response control measures currently in place for Santos Offshore are listed here. The environmental outcomes and effectiveness of the in-effect control measures are noted, using the Resource Needs Analysis to assess whether there are any areas of improvement. Environmental outcomes include potential harmful effects of control measures.
- 6b) Identify Potential Additional Control Measures: Potential control measures are identified, with a focus on any control measures that address areas of improvement identified in Step 6a.
- 6c) Investigate Control Measure Categories: In-effect and potential control measures from Steps 6a and 6b are classified as either additional, alternative or improved, and as either people, system, equipment or procedures. This step serves as a prompt to ensure that potential control measures from all categories are explored.
- 6d) Evaluate Environmental Outcomes, Effectiveness: The environmental outcomes and effectiveness are assessed for all control measures identified and described through Steps 6a, b, and c.
- 6e) Evaluate Feasibility: Time, cost and effort required for implementation are assessed for all control measures identified and described through Steps 6a, b, and c.
- 6f) Accept or Reject: The potential control measure will be accepted or rejected on the basis of environmental outcomes and effectiveness described in Step 6d and whether cost is grossly disproportionate, as described in Step 6e.

When evaluating potential control measures, implementation plans of in-effect control measures are carefully considered to ensure that any accepted control measures will equal or improve Santos capacity to meet resource needs. Potential control measures are also considered within the context of current Santos response arrangements to determine if synergies or resource conflicts might occur.

As control measures are evaluated for selection or rejection, they can be compared with industry good practice to ensure that all practicable control measures were implemented. Where unique circumstances exist and further analysis is required, a different evaluation technique may be used, such as technical analysis, detailed cost benefit analysis or combination of approaches.

New information on risks, impacts and response strategies obtained through analysis of operations, exercises and scheduled documentation reviews can be incorporated into the ALARP Assessment Framework cycle in a process of continual improvement.

In **Figure B-1**, Steps 7 and 8 show the conclusion of the ALARP Assessment Framework:

7. Finalised Control Measure Selection: Outputs from the ALARP Assessment shown in Step 6 comprise finalised control measures (in BLUE).
8. Develop Performance Standards and Measurement Criteria: For each control measure finalised in Step 7, performance standards and measurement criteria are then developed and documented in the OPEP (in GREEN).

Performance standards for all accepted control measures should be written to enable the operator to measure, monitor and test effectiveness. Only the key aspects of any given control will require performance standards and these may include the various measures of effectiveness; functionality, availability, reliability, survivability, dependency and compatibility. Parameters set in the performance standard should be ‘SMART’; specific, measurable, appropriate, realistic and timely.

Corrective action based on deviations or trends in performance should be taken by amending either the performance standard or the control measure, as appropriate.

4. Criteria and definitions

Standardised criteria and definitions are used to bring consistency to the ALARP assessment across diverse activities and response strategies. Criteria and definitions are shown in **Table B-1**.

Table B-1: Criteria and definitions of ALARP Assessment Framework

Column	Description
Strategy	Response Strategy
Control Measure	Aspect of Response Strategy being evaluated Description of the control measure that is In Effect or description of the potential control measure
In Effect, Alternative, Additional, Improved	In Effect control measures are already in place. Alternative control measures are evaluated as replacements for the control already in effect. Additional control measures are evaluated in terms of their ability to reduce an impact or risk when added to the existing suite of control measures. Improved control measures are evaluated for improvements they could bring to the effectiveness of adopted control measures. Adapted from NOPSEMA Guideline Environment Plan Decision Making N-04750-GL1721 Revision 6 – November 2019
Control Measure Category	A range of different types of controls generally provide effective protection as they provide independence and multiple layers of protection. The OPGGS(S) Regulations refer to technical and ‘other’ controls where technical control measures involve hardware like shutdown valves and alarms. ‘Other’ control measures include administrative and procedural control measures such as inductions, a drug and alcohol policy or an inspection regime. Industry practice has further developed this concept of a range of different types of controls based on a POiSTED framework to assess organisational capability: People – personnel System – organisation, information/communications, support facilities, training/ competency Equipment – equipment Procedures – doctrine Santos aims to implement a range of different types of controls where possible.

Column	Description
Environmental Outcomes	<p>Assessment of environmental benefits, particularly those over and above those environmental benefits documented in the Control Measure that is in effect.</p> <p>Environmental impacts of the Control Measure are also considered here.</p>
Effectiveness	<p>The effectiveness of a Control Measure in reducing the risk to ALARP is evaluated using the following six criteria.</p> <p><u>Functionality</u> The functional performance of a control measure is what it is required to do. How does the control perform in order to achieve the required risk reduction?</p> <p><u>Availability</u> Probability that the control measure will be available when required and has not failed or is undergoing a maintenance or repair.</p> <p><u>Reliability</u> The reliability of a control measure is the probability that at any point in time it will operate correctly for a further specified length of time. Reliability is all to do with the probability that the system will function correctly and is usually measured by the mean time between failure.</p> <p><u>Survivability</u> Whether or not a control measure is able to survive a potentially damaging event such as fire or explosion is relevant for all control measures that are required to function after an incident has occurred. To achieve their purpose, oil spill response control measures should have high survivability. However, some control measures, such as those involving equipment deployment from an FPSO would have low survivability in an incident that involves an FPSO explosion or fire.</p> <p><u>Dependency</u> The dependency of the control measure is its degree of reliance on other systems in order for it to be able to perform its intended function. If several control measures can be disabled by one failure mechanism (common mode failure), or the failure of one control measure is likely to cause the failure of others, then the control measures are not independent and it may not be appropriate to count such measures as separate. <u>Several control measures are reliant on equipment, people and vessels, hence have high dependence.</u></p> <p><u>Compatibility</u> Whether or not a control measure is compatible takes into account how alternative control measures may interact with other controls and the rest of the facility, if introduced. Consideration should be given to whether new control measures are compatible with the facility and any other control measures already in use. Adapted from NOPSEMA Guidance Note Control Measures and Performance Standards N04300-GN0271 Revision No 4 Last Reviewed 2020</p>
Feasibility	Feasibility describes the time, cost and/or effort required to implement the Control Measure.
Accept/ Reject	Outcome of assessment and key reasons for the decision

5. ALARP Assessment Summaries

ALARP assessment summary – source control
<p>Source control is limited to minimising potential volumes of MGO/MDO lost to the marine environment and no areas of improvement were identified.</p> <p>No additional Control Measures were identified and assessed.</p> <p>Performance Standards and Measurement Criteria that have been developed for the in-effect Control Measures are shown in Table 9-3. The key performance requirements are to follow the response actions listed in the respective ships SOPEP and conduct spill exercises in line with the ships SOPEP.</p>
ALARP assessment summary – monitor and evaluate
<p>Various, independent inputs from multiple service providers are used to build a detailed Common Operating Picture in the incident.</p> <p>Seven additional potential Control Measures were identified and assessed.</p> <p>Three additional Control Measures were accepted as reasonably practicable. The accepted measures were:</p> <ul style="list-style-type: none">+ 2 tracking buoys available in Darwin, 8 available at Varanus Island during the activity+ required vessel specifications included in Vessel Tracking System+ maintain a list of providers that could assist with fauna aerial observations. <p>Four Control Measures were rejected as grossly disproportionate. Rejected Control Measures were:</p> <ul style="list-style-type: none">+ purchase of oil spill modelling system and internal personnel trained to use system+ trained aerial observers based in strategic locations such as Darwin+ ensure trained marine mammal/fauna observers based in Darwin+ trained water monitoring specialists available in Darwin. <p>Performance Standards and Measurement Criteria that have been developed for the in-effect and accepted Control Measures are shown in Table 10-. The key areas of effectiveness for the identified Control Measures, during times of preparedness, focus on maintaining access to equipment and personnel through contractual arrangements with vessel providers, aircraft providers, aerial observers, UAV providers, tracking buoys, oil spill trajectory modelling providers, satellite imagery providers, water quality monitoring providers, and spill responders. Additional key areas for effectiveness during preparedness are following relevant procedures such as the Protected Marine Fauna Interaction and Sighting Procedure, and limiting environmental impacts from response activity through personnel and vehicle management. During response, a key area for ensuring effectiveness is the mobilisation of requirements in order to commence monitor and evaluate operations. These key areas of effectiveness have been represented in Performance Standards for monitor and evaluate operations.</p>
ALARP assessment summary – mechanical dispersion
<p>Mechanical dispersion is a secondary strategy that could be undertaken by vessels undertaking primary response strategies without the requirement for additional equipment, and no areas of improvement</p>

were identified. The use of mechanical dispersion in a response would be assessed as part of an operational NEBA.

No potential additional Control Measures were identified and assessed.

Performance standards and measurement criteria that have been developed for the in-effect control measures are shown in **Table 11-4**. The key areas of effectiveness for the identified control measures during a response are around the development of an operational NEBA to confirm suitability and environmental benefit, and the mobilisation of vessels. These key areas of effectiveness are reflected in the performance standards.

ALARP assessment summary – shoreline protection and deflection

Various types of nearshore booms available from Darwin ensures that equipment is in place to implement this response strategy within 24-48 hrs in a wide range of metocean conditions. Trained regional Santos personnel can be quickly mobilised to appropriate locations using helo services, followed by AMOSC staff and AMOSC Core Group from Perth. These regional and state resources ensure that equipment and personnel are not a limiting factor in this response strategy. An area of improvement is availability of shallow draft vessels. A review of Control Measures associated with vessels identified that improvement could be made by adding a provision for shallow draft boom tow vessels in existing Master Service Agreements with vessel providers.

Four additional potential Control Measures were identified and assessed.

One Control Measure was accepted as reasonably practicable. The accepted control measure was:

- + provision for shallow draft boom tow vessels added to Master Service Agreement.

Three Control Measures were rejected as grossly disproportionate. Rejected response strategies were:

- + Santos to purchase additional shoreline and nearshore booms and ancillary equipment
- + access to additional shallow draft boom tow vessels owned by Santos
- + ensure trained personnel are based at strategic locations such as Darwin.

Performance Standards and Measurement Criteria that have been developed for the in-effect and accepted Control Measures are shown in **Table 12-5**. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to equipment and personnel through contractual arrangements. During response, a key area for ensuring effectiveness is the mobilisation of requirements in order to commence protection and deflection operations and the preparation of an operational NEBA for each operational period that takes into account protection priorities and the ongoing effectiveness of the response strategy. These key areas of effectiveness have been represented in Performance Standards for protection and deflection operations.

ALARP assessment summary – shoreline clean-up

Darwin and regional stockpiles and locally available supplies provide a range of shoreline clean-up equipment can be accessed to suit most beach types/ required clean-up operations. Trained regional Santos personnel can be quickly mobilised to appropriate locations using helo services, followed by AMOSC staff and AMOSC Core Group from Perth. Equipment and trained personnel are not expected to be limiting factors for this response strategy. Shoreline accumulation volumes above low thresholds exceed 3 days and clean-up activities would be able to be mobilised in this timeframe by resources obtained via AMOSC Core Group personnel and mutual aid (if required). The availability of shallow draft

vessels was identified as an area of improvement. A review of control measures associated with vessels identified that improvements could be made by adding a provision for shallow draft vessels in existing Master Service Agreements with vessel providers.

Nine additional potential Control Measures were identified and assessed.

One Control Measure was accepted as reasonably practicable. The accepted control measure was:

- + provision for shallow draft vessels added to Master Service Agreement.

Eight Control Measures were rejected as grossly disproportionate. Rejected response strategies were:

- + mechanical mobile plant equipment for clean-up pre purchased and positioned in Darwin
- + pre-purchase and storage of equipment (decontamination/ staging equipment, clean-up and flushing, PPE) at Darwin
- + access to additional shallow draft vessels owned by Santos to transport personnel to key sensitive areas on offshore islands
- + access to additional team leaders that are locally based in Darwin or can be mobilised within short time frames
- + faster access to clean-up personnel via Perth based labour hire contractor
- + faster access to clean-up personnel via locally based (Darwin) labour hire companies or emergency response organisations
- + faster access to clean-up personnel via Santos employment of local personnel
- + review of shoreline sensitivity mapping.

Performance Standards and Measurement Criteria that have been developed for the in effect and accepted Control Measures are shown in **Table 13-5**. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to suitable equipment and personnel through contractual arrangements. During response, a key area of effectiveness is the rapid mobilisation of equipment and personnel, and the preparation of a Shoreline Clean-up Subplan and NEBA to ensure that impacts from response activities are minimised and operations are conducted in accordance with protection priorities as confirmed by the Control Agency.

ALARP assessment summary – oiled wildlife

The worst-case scenario associated with this OPEP results in no shoreline accumulation $>100 \text{ g/m}^2$ and consequently only low numbers of oiled wildlife are anticipated in the event of a worst-case release. Santos has developed a Santos Oiled Wildlife Response Framework Plan as a Control Measure to ensure that a procedure is in place for OWR, where they are the Control Agency or Support Organisation, in order to provide an effective and coordinated OWR. Santos has access to the indicative resource requirements for the worst-case scenario in this OPEP, including mobilisation of AMOSC oiled wildlife equipment and industry OWR team to a forward staging area within 48 hours. Oiled wildlife equipment including first strike kits and containers can be mobilised from various locations around Australia (noting there is an AMSA OWR washing container in both Darwin and Broome). The availability of trained personnel in the initial stages of an incident is a limiting factor for this response strategy. Potential Control Measures around additional responders through pre-hiring or contracts with additional service providers were investigated but were found to be not beneficial and/or the cost was grossly disproportionate to risk reduction.

Three potential Control Measures were identified and assessed. All were rejected as grossly disproportionate. Rejected response strategies were:

- + additional Santos OWR trained personnel positioned in Darwin
- + pre-hire and/or repositioning of staging areas and responders
- + direct contracts with service providers.

Performance Standards and Measurement Criteria that have been developed for the in-effect Control Measures are shown in **Table 14-6**. The key areas of effectiveness for the identified control measures, during times of preparedness, are around maintaining access to equipment and personnel through contractual arrangements. During response, the mobilisation of requirements for initial oiled wildlife response operations and the management of the oiled wildlife response in accordance with the Santos/NT Oiled Wildlife Response Plan are both key elements for achieving this strategy and they are represented as Performance Standards.

ALARP assessment summary – waste

The worst-case scenario associated with this OPEP results in no shoreline accumulation $> 100 \text{ g/m}^2$ and consequently low waste volumes are anticipated in the event of a worst-case release. The Santos contract with the waste service provider has provisions for waste management operations for the worst-case scenario detailed in **Table 6-3**. Further detail is captured in the Waste Management Plan – Oil Spill Response Support (QE-91-IF-10053). The waste service provider can mobilise waste receptacles to Darwin within 12–24 hrs. Given the waste service provider arrangements and preplanning already undertaken, waste storage facilities, road transport and logistics are not expected to be limiting factors in the response. For these components, potential Control Measures were identified and evaluated but were found to either make no improvement in capability or cost was grossly disproportionate.

Three potential Control Measures were rejected as grossly disproportionate. Rejected Control Measures were:

- + maintain contracts with multiple service providers
- + procure temporary waste storage for Santos stockpile
- + contract additional vessels on standby for waste transport.

Performance Standards and Measurement Criteria that have been developed for the in-effect Control Measures are shown in **Table 15-5**. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to waste management equipment and services through contractual arrangements. During response, a key area for increasing effectiveness is the timely mobilisation of requirements for initial response operations and defining critical management and reporting services to be provided by the waste service provider. These key areas of effectiveness are captured in the Performance Standards.

ALARP assessment summary – scientific monitoring

Oil spill scientific monitoring will be conducted on behalf of Santos by a contracted monitoring service provider as detailed in the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162) and the relevant Scientific Monitoring Programs. An area of improvement is the availability of vessels in the initial stages of response. To address this area of improvement, a potential Control Measure around more detailed vessel tracking was assessed and accepted. One Control Measure, having trained scientific

monitoring personnel and equipment on standby in Darwin was considered disproportionate. Another potential Control Measure relating to maintaining equipment and lists of monitoring providers was adopted.

Three additional potential Control Measures were identified and assessed.

Two additional Control Measures were accepted as reasonably practicable. The accepted Control Measures were:

- + maintain equipment list and list of suppliers for implementation of Scientific Monitoring Plans
- + determine required vessel specifications required for scientific monitoring implementation and improve accuracy of Vessel Tracking System.

One Control Measure was rejected as grossly disproportionate. The rejected Control Measure was:

- + scientific monitoring personnel and equipment on standby in Darwin

Performance Standards and Measurement criteria that have been developed for the in effect and accepted Control Measures are shown in **Table 16-4**. The key areas of effectiveness for the identified Control Measures, during times of preparedness, are around maintaining access to equipment and personnel through contractual arrangements, regular reviews of monitoring service provider capability and reviews of existing baseline data. During response, a key area for effectiveness is the mobilisation of requirements to commence scientific monitoring, and ensuring that relevant approved manuals and plans are followed. These key areas of effectiveness are reflected in the Performance Standards.

Appendix C: Pollution report



When blank, this form is classed as OFFICIAL, when filled out, this form is classed as OFFICIAL-SENSITIVE.

BEFORE completing this form please contact the MEER duty officer on (08) 9480 9924 (24hrs). Immediate reporting will enable a rapid response.

Marine Pollution Report (POLREP)

Return completed form to: Maritime Environmental Emergency Response Department of Transport Email: marine.pollution@transport.wa.gov.au and rccaus@amsa.gov.au Phone (08) 9480 9924 Fax: 1300 905 866

INCIDENT DETAILS

Date of Incident: Time of Incident (24 hr format):

Location name/description:

Incident Coordinates Latitude of spill Longitude of spill

Format of coordinates used (select one) Degrees & decimal degrees Degrees, minutes & decimal minutes Degrees, minutes & seconds

Description of Incident:

POLLUTION SOURCE

Vessel Land (Specify) Other (Specify) Unknown

Vessel type (if known) Tanker Container Bulk Cargo Fishing Defence Recreational Other (Specify)

Vessel name: Flag State / Callsign: Australian vessel? Yes No

POLLUTANT

Oil (type) Bilge Diesel HFO bunker Crude Unknown Other (Specify)

Chemical Name: MARPOL cat / UN Nos:

Garbage Details/description:

Packaged Details/description:

Sewage Details/description:

Other Details/description:

EXTENT

Size of spill (length & width in metres):

Amount of pollutant, if known (litres):

Has the discharge stopped? Yes No Unknown

Weather conditions at site:

Photos taken Details: held by:

Video taken Details: held by:

Samples taken Description: held by:

Items retrieved Description: held by:

Appendix D: Situation report



When blank, this form is classed as **OFFICIAL**, when filled out, this form is classed as **OFFICIAL-SENSITIVE**.

Marine Pollution Situation Report (SITREP)

Send completed form to:

Maritime Environmental Emergency Response

Department of Transport

GPO Box C102 PERTH, WA 6839

Email: marine.pollution@transport.wa.gov.au

and rccaus@amsa.gov.au

Fax: 1300 905 866

MARINE POLLUTION SITUATION REPORT (SITREP)

This is advice from the Control Agency of the current status of the incident and the response.

This form is transmitted to all relevant agencies including:

- Jurisdictional Authority
- Support Agencies

Incident Name: _____ Ref. No. _____

Priority Urgent Immediate Standard

Final SITREP? Yes No Next SITREP on: _____

Date: _____ Time: _____

POLREP Reference: _____

Incident location Latitude _____ Longitude _____

Brief description of incident and impact: _____

Overall weather conditions: _____

Summary of response actions to date: _____

Current Strategies:

Summary of resources available/deployed:

Expected developments:

Other Information:

SITREP Prepared By	Name:	
	Agency:	
	Role:	
	Contact	Telephone
		Fax
		Mobile
No of Pages Attached:		

Appendix E: Vessel surveillance observer log

Vessel Surveillance Observer Log – Oil Spill

Survey Details			
Date	Start time:	End Time:	Observers:
Incident:			Area of Survey:
Vessel:			Master:
Weather Conditions			
Wind speed (knots):		Wind direction:	
Time high water and height (LAT):		Current direction:	
Time low water and height (LAT):		Current speed (nM):	
Tide during observations:		Sea state:	
Stage of tide during observations (incoming/falling):		Other weather observations:	

Slick Details										
Slick grid parameters by lat/long:					Slick grid parameters (vessel speed)		Slick grid dimensions: N/A			
Length Axis:		Width Axis:			Length Axis: N/A		Width Axis	Length	nm	
Start Latitude		Start Latitude			Time (seconds)		Time (seconds)	Width	nm	
Start Longitude		Start Longitude						Length	nm	
End Latitude		End Latitude			Speed (knots)		Speed (knots)	Width	nm	
End Longitude		End Longitude						Grid area	km ²	
Code	Colour	%age cover observed	Total grid area		Area per oil code		Factor	Oil volume		
1	Silver			km ²		km ²	40-300 L/ km ²		L	
2	Iridescent (rainbow)			km ²		km ²	300-5,000 L/ km ²		L	
3	Discontinuous true oil colour (Brown to black)			km ²		km ²	5,000-50,000L/ km ²		L	
4	Continuous true oil colour (Brown to black)			km ²		km ²	50,000 – 200,000 L/ km ²		L	
5	Brown / orange			km ²		km ²	>200,000 L/ km ²		L	

Timeline of observations:

Time	Description

Appendix F: Aerial surveillance observer log

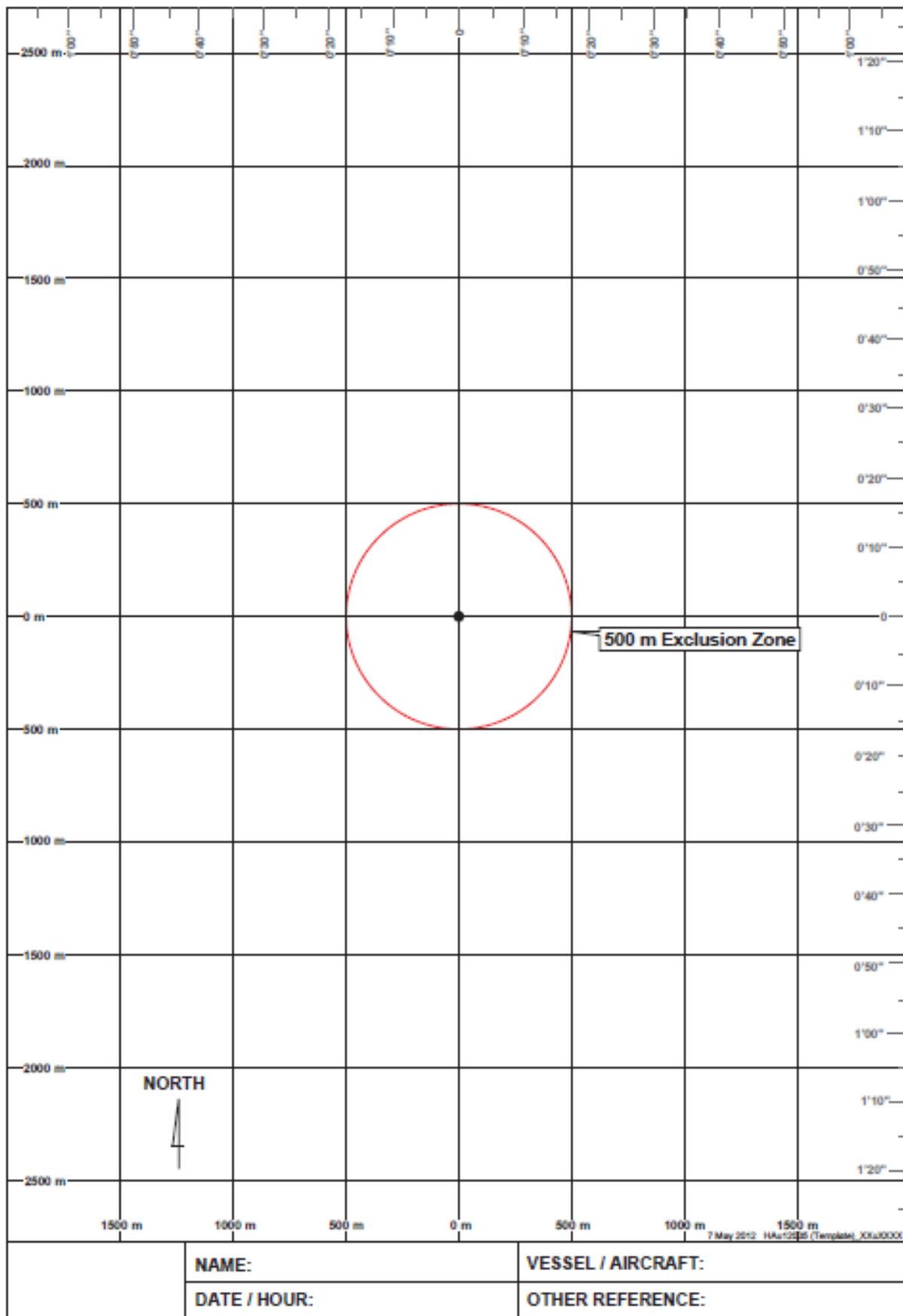
Aerial Surveillance Observer Log – Oil Spill

Survey Details			
Date:	Start time:	End Time:	Observer/s:
Incident:		Area of Survey:	
Aircraft type:	Call sign:	Average Altitude:	Remote sensing used:
Weather Conditions			
Wind speed (knots)	Wind direction		
Cloud base (feet)	Visibility		
Time high water	Current direction		
Time low water	Current speed (nM)		

Slick Details									
Slick grid parameters (lat/long)				Slick grid parameters (air speed)		Slick grid dimensions			
Length Axis		Width Axis		Length Axis		Width Axis	Length	nm	
Start Latitude		Start Latitude		Time (seconds)		Time (seconds)	Width	nm	
Start Longitude		Start Longitude					Length	nm	
End Latitude		End Latitude		Air Speed (knots)		Air Speed (knots)	Width	nm	
End Longitude		End Longitude					Grid area	km ²	
Code	Colour	% cover observed	Total grid area	Area per oil code		Factor	Oil volume		
1	Silver		km ²		km ²	40-300 L/ km ²		L	
2	Iridescent (rainbow)		km ²		km ²	300-5,000 L/ km ²		L	
3	Discontinuous true oil colour (Brown to black)		km ²		km ²	5,000-50,000L/ km ²		L	
4	Continuous true oil colour (Brown to black)		km ²		km ²	50,000 – 200,000 L/ km ²		L	
5	Brown / orange		km ²		km ²	>200,000 L/ km ²		L	

Appendix G: Aerial surveillance surface slick monitoring template

AERIAL SURVEILLANCE SURFACE SLICK MONITORING TEMPLATE



Appendix H: Aerial surveillance marine fauna sighting record

OIL SPILL SURVILLANCE - MARINE FAUNA SIGHTING RECORD SHEET

Date:		Time:	
Latitude:		Longitude:	

MARINE FAUNA ID GUIDE



Humpback whale



Blue whale



Whale shark



Dugong



Minke whale



Sperm whale



Hawksbill turtle



Loggerhead turtle



Killer whale



Bryde's whale



Green turtle



Flatback turtle

Whale species unknown



Bottlenose dolphin



Spinner dolphin

Dolphin species unknown



Leatherback turtle

Turtle species unknown

FAUNA DETAILS					
Category	Type/species? Adult/juvenile? ID confidence?	Number	Date/Time	Photo/ video taken? Reference No.	<u>Behaviour / Comments.</u> Proximity to oil? Oiled? Milling? Feeding? Transiting?
Cetaceans (Whales/ Dolphins)					
Turtles					
Birds					
Dugongs					
Sharks					
Other					

Other details for each observation location

WEATHER DETAILS

- Sea State** Mirror calm Small waves Slight ripples
 Large waves some whitecaps Large waves, many whitecaps
- Visibility** Excellent Good Moderate Poor Very Poor

OBSERVER DETAILS

Observer Name

Observer signature

Observer Inexperienced Experienced

Appendix I: Aerial Surveillance Shoreline Observation Log

Aerial Surveillance Reconnaissance Log – Oil Spill

Survey Details					
Incident:	Date:	Start time:	End Time:	Observer/s:	
Area of Survey					
<u>Start GPS</u> LATITUDE: LONGITUDE:			<u>End GPS</u> LATITUDE: LONGITUDE:		
Aircraft type	Call sign	Average Altitude	Remote sensing used (if any)		
Weather Conditions					
Sun/Cloud/Rain/Windy	Visibility	Tide Height L/M/H			
Time high water	Time low water	Other			
Shoreline Type - Select only ONE primary (P) and ANY secondary (S) types present					
<input type="checkbox"/>	Rocky Cliffs	<input type="checkbox"/>	Boulder and cobble beaches	<input type="checkbox"/>	Sheltered tidal flats
<input type="checkbox"/>	Exposed artificial structures	<input type="checkbox"/>	Riprap	<input type="checkbox"/>	Mixed sand and gravel beaches
<input type="checkbox"/>	Inter-tidal platforms	<input type="checkbox"/>	Exposed tidal flats	<input type="checkbox"/>	Fine-Medium sand grained beaches
<input type="checkbox"/>	Mangroves	<input type="checkbox"/>	Sheltered rocky shores	<input type="checkbox"/>	Other
<input type="checkbox"/>	Wetlands	<input type="checkbox"/>	Sheltered artificial structures		
Operational Features (tick appropriate box)					
<input type="checkbox"/>	Direct backshore access	<input type="checkbox"/>	Alongshore access	<input type="checkbox"/>	Suitable backshore staging
Other					

Appendix J: Shoreline Clean-up Equipment

Equipment List for an Initial deployment of a 6 person Manual Clean Up Team

On Shore Clean-up Tools		Quantity
	Disposal Bag Labelled, 140 cm x50cm x 100um	1000
	Disposal Bag large fit 205ltr drum, 100cm x 150cm x 100um	50
	Polyethylene Safety Shovel 247mm z 978mm	2
	Steel Shovel	4
	Steel Rake	2
	Landscapers Rake	2
	Barrier Tape – “Caution Spill Area”	10
	Pool scoop with extendable handle – flat solid	2
	Poly Mop Handle	2
	Safety Retractable Blade Knife	2
	Poly Rope 20m	6
	Star Pickets	24
	Star Picket driver	1
	Hand Cleaner	1
	Cable ties – general use	1000
	Wheel Barrow	2
	Galvanised Bucket	4
	Pruning secateurs	2
	Hedge Shears	1
Personal Protection Equipment (PPE) Team of 6		
	Spill Crew Hazguard water resistant coveralls (assort sizes)	36
	Respirator dust/mist/fume and valve	40
	Disposable box light nitrile gloves (100bx)	2
	Alpha Tec gloves (assort size)	24
	Ear Plugs (200bx)	1
	Safety Glasses	18
	Safety Goggles non vented	6
	Gum Boots (assort size)	18
	Rigger Gloves (assort size)	18
	Day/Night Vest	6
Storage Equipment		
	Collapsible Bund 1.6m x 1.2m	2
	Collapsible bund 4m x 2.4m	1
	Misc sizes of ground sheets/tarps	6
Absorbents		
	Absorbent Roll ‘oil and fuel only’ 40m x 9m	6
	Absorbent Pad “oil and fuel only” 45cm x 45cm	400
	Poly Mops (snags)	150
	Poly Absorbent Wipes	10
Additional Items		
	Folding Deck Chair	6
	Folding Table	1
	Shelter open side	1
	6 Person first aid kit	1
	Wide Brim Hat with cord	6
	Sunburn Cream 1 litre pump bottle	1
	Personal Eyewash bottle 500mls	6
	Personal Drink bottle 750mls	6
	Boxes, Bin and Lid Storage/transport assorted	
Optional Items		

Inflatable Tent 9 square metres	1
---------------------------------	---

Equipment list for a decontamination unit for Beach Clean Up Team

Shore Clean-up Tools		Quantity
Inflatable Decon Tent		1
Inflatable Tent 9 square metres – Modesty or Control tent		1
Misc sizes of ground sheets/tarps		4
Collapsible Bund 1.6m x 1.2m (two stages)		2
2 stools in each bund		
Collapsible Bund 4m x 2.4m (for used PPE and clothing into DB's)		1
Long Handled Scrub brush		2
Scrub Brush		2
Simple Green 20 ltr		2
Poly Absorbent Wipes		10
Wet Wipe Canister		6
Disposal Bag for Clothing, 140cm x 50cm x 100um		100
Bath towel		6
Liquid soap in push dispenser (citrus based)		1
Track mat – Absorbent for Corridor/walkway		1
Star pickets		16
Star picket driver		1
Barrier tape to create corridors		4
Safety Goggles non vented (used during decon)		6
Optional Items		
Folding Deck Chair		6
Folding Table		1
Shelter open side		1
6 Person first aid kit		1
Wide Brim Hat with cord		6
Sunburn Cream 1 litre pump bottle		1
Personal Eyewash bottle 500mls		6
Personal Drink bottle 750mls		6
Boxes, Bin and Lid Storage/transport assorted		

Equipment list for deployment of a 6-person team for flushing or recovery

Flushing Equipment		Quantity
	Diesel self prime semi trash pump, 25-35 psi, 4.8hp	1
	Perforated 2" lay flat hose, 20 mtr sections	2
	Section Hose 2", 20m sections	5
	Hose End Strainer	1
Recovery Equipment		
	Tidal Boom (shoreline boom) 25m lengths	2 (50m)
	Tidal Boom Accessories pack	1
	Versatech Zoom Curtin Boom 300mm chamber, 450mm skirt 25m section	2 (50m)
	Towing Bridle	2
	Danforth Sand Anchor Kit, 30m lines, 15m trip lines	3
	Diesel Powered pump with hose	1
	Manta Ray skimmer	1
Personal Protection Equipment (PPE) Team of 6		
	Spill Crew Hazguard water resistant coveralls (assort sizes)	36
	Respirator dust/mist/fume and valve	40
	Disposable box light nitrile gloves (100bx)	2
	Ear Plugs (200bx)	1
	Safety Glasses	18
	Gum Boots (assort size)	18
	Hyflex Oil Restraint Gloves (assort size)	18
	Day/Night Vest	6
Storage Equipment		
	Collapsible Bund 1.6m x1.2m	1
	Misc sizes of ground sheets/tarps	6
	Collapsible Tank 5000 litres	2
Absorbents		
	Absorbent Boom 'oil and fuel only' 3 or 6m x 180mm	200mtrs
	Absorbent Roll 'oil and fuel only' 40m x 9m	10
	Absorbent Pad "oil and fuel only" 45cm x 45cm	1000
	Poly Absorbent Wipes	10
Additional Items		
	Folding Deck Chair	6
	Folding Table	1
	Shelter open side	1
	6 Person first aid kit	1
	Wide Brim Hat with cord	6
	Sunburn Cream 1 litre pump bottle	1
	Personal Eyewash bottle 500mls	6
	Personal Drink bottle 750mls	6
	Boxes, Bin and Lid Storage/transport assorted	
	Inflatable Tent 9 square metres	1

Equipment list for a 6 person team for near shore clean up

Absorbents		
	Absorbent Roll 'oil and fuel only' 40m x 9m	20
	Absorbent Pad "oil and fuel only" 45cm x 45cm	2000
	Absorbent Boom "oil and fuel only" 3or6m z 180mm	200mtrs
	Poly Mops (snags)	150
	Poly Absorbent Wipes	20
Recovery Equipment		
	Tidal Boom (shoreline boom) 25m lengths	4 (100m)
	Tidal Boom Accessories pack	2
	Versatech Zoom Curtin Boom 300mm chamber, 450mm skirt 25m section	8 (200m)
	Towing Bridle	2
	Danforth Sand Anchor Kit 15kg 30m lines, 15m trip lines	10
	Weir Skimmer 30T hr	1
	Trash Screen for above	1
	Diesel Powered pump with hose	1
	Manta Ray skimmer	1
Shore Clean-up Tools		Quantity
	Disposal Bag large fit 205ltr drum, 100cm x 150cm x 100um	200
	Pool scoop with extendable handle – flat solid	2
	Poly Mop Handle	2
	Poly Rope 20m	10
	Star Pickets	24
	Star Picket driver	1
	Intrinsic Safe Torch	6
	Hand Cleaner	1
	Cable ties (to add extra join to absorbent booms)	150
Personal Protection Equipment (PPE) Team of 6		
	Spill Crew Hazguard water resistant coveralls (assort sizes)	36
	Disposable box light nitrile gloves (100bx)	2
	Alpha Tec gloves (assort size)	24
	Ear Plugs (200bx)	1
	Safety Glasses – with head strap	18
	Gum Boots (worn extra large or as advised by skipper)	18
	Steel cap waders	2
	Personal Flotation Device	6
	Rigger Gloves (assort size)	18
Storage Equipment		
	Collapsible Bund 1.6m x 1.2m	2
	Collapsible bund 4m x 2.4m	1
	Collapsible Tank 5000 litres	2
	Alum box, Bin & lid Storage/transport cases	10
	Misc sizes of ground sheets/tarps	6
Optional Items		
	6 Person first aid kit	1
	Wide Brim Hat with cord	6
	Sunburn Cream 1 litre pump bottle	1
	Personal Eyewash bottle 500mls	6
	Personal Drink bottle 750mls	6

Appendix K: Shoreline Response Strategy Guidance

Shoreline Response Strategy Guidelines

Guidance on response methods for sensitive coastal habitats is provided in **Table K-1**.

Guidance on applicable shoreline clean-up techniques based on shoreline substrate and degree of oiling are presented in **Figure K-1** to **Figure K-4**.

Table K-1: Strategy Guidance for shoreline response at coastal sensitivities

Sensitive Receptors	Strategy Guidance
Mangroves	<ul style="list-style-type: none"> - All efforts should be mounted to prevent any oil from moving towards this area by using booms to divert the oil away from this area. - However, if oil is expected to move into this area, multiple rows of booms, or earthen booms can be deployed at the entrance of creeks or along the mangrove fringe to prevent/minimise oiling. - Sorbents can be used to wipe heavy oil coating from roots in areas of firm substrate. Close supervision of clean-up is required. - Where thick oil accumulations are not being naturally removed, low-pressure flushing may be attempted at the outer fringe – sorbent pads and sorbent sweeps can be used to recover the sheen. - No attempt should be made to clean interior mangroves, except where access to the oil is possible from terrestrial areas. - Oily debris should be removed; it is extremely important to prevent disturbance of the substrate by foot traffic; thus most activities should be conducted from boats. - Live vegetation should not be cut or otherwise removed.
Mudflats	<ul style="list-style-type: none"> - All efforts should be mounted to prevent any oil from moving towards this area by using booms to divert the oil away from this area. - However, if oil is expected to move into this area, multiple rows of booms, or earthen booms can be deployed at the entrance of channels filling/ draining mudflats. - Efforts to manually clean mudflats may result in further damage due to trampling of the oil into sediments which typically rich in biota and provide a food source for fish and birds. - Therefore, natural remediation may be the preferred approach and if removal is required, the flushing of oil into open water, if feasible, may be preferred to manual collection - The presence of wildlife (e.g. shorebirds) and sensitive flora (e.g. mangroves) which are often associated with mudflats needs to be considered in determining the best approach.

Sensitive Receptors	Strategy Guidance
Sandy beaches	<ul style="list-style-type: none"> - Clean-up techniques will depend upon the degree of infiltration into sand or and degree of burial which will require surveying/mapping - Clean-up will also depend upon sensitivity of environment (existing ecological features), access to the beach and potential for additional erosion. - Oil and oiled sediments can be physically removed offsite, moved to surf zone for surf washing of sediment or assisted to move to water edge by ploughing of channels or flushing. - Recovery of oil can be by manual means (hand tools) or mechanical means (earth moving, pumping equipment). - The sensitivity of the environment is a key factor, with manual removal creating less waste and disturbance but more consuming in time and resources.
Seabirds, shorebirds and migratory waders	<ul style="list-style-type: none"> - All efforts should focus on deflecting oil away from this area or dispersing the oil offshore or using booms offshore to divert the oil away from this area. - If oil is expected to move into the coastal colonies and roosting areas, multiple booms can be deployed along the reserve to prevent/minimise oiling.
Turtle nesting beaches during or near nesting season	<ul style="list-style-type: none"> - All efforts should be mounted to prevent any oil from moving towards this area by using booms to divert the oil away from this area. - However, if oil is expected to move into this area, booms can be deployed along the reserve to prevent/minimise oiling.
Fringing coral reef communities (Note: submerged coral reef communities are less susceptible to oiling)	<ul style="list-style-type: none"> - Little can be done to protect coral reef beds along exposed sections of shoreline. - Floating oil would potentially coat living reef communities, which are usually slightly elevated and are consequently exposed at low tide. - Natural recovery with a close monitoring program is the preferred clean-up technique. Clean-up of the reef itself by natural processes is expected to be rapid. - As much as practicable, oil should be removed from adjacent intertidal areas to prevent chronic exposure of the corals to oil leaching from these sites. - Use of sorbents should be limited to those that can be contained and recovered.
Macroalgal and seagrass beds	<ul style="list-style-type: none"> - All efforts should focus on deflecting oil away from this area, dispersing the oil offshore, or using booms to divert the oil away from this area. - Extreme care should be taken not to disturb the sediments during clean-up operations in the vicinity of macroalgal and seagrass beds, which could result in total loss of the macroalgal and seagrass beds. - Removal of oiled parts of the macroalgal and seagrass beds should only be considered when it can be demonstrated that special species are at significant risk of injury from contact or grazing on the macroalgal and seagrass beds. - Otherwise, the best strategy for oiled seaweed is to allow natural recovery.
Rocky coast	<ul style="list-style-type: none"> - Where practicable, booms can be deployed parallel to the rocky coasts to prevent/minimise oiling. - Flushing rocky shoreline is considered the most effective method of cleaning. Care must be taken to assess the fate and transport of the flushed oil and sorbent snares can be used to recover if deemed necessary to reduce impacts to ALARP. - For small areas of contamination, rocky structure can be manually wiped with sorbent pads or scraped to remove oil.

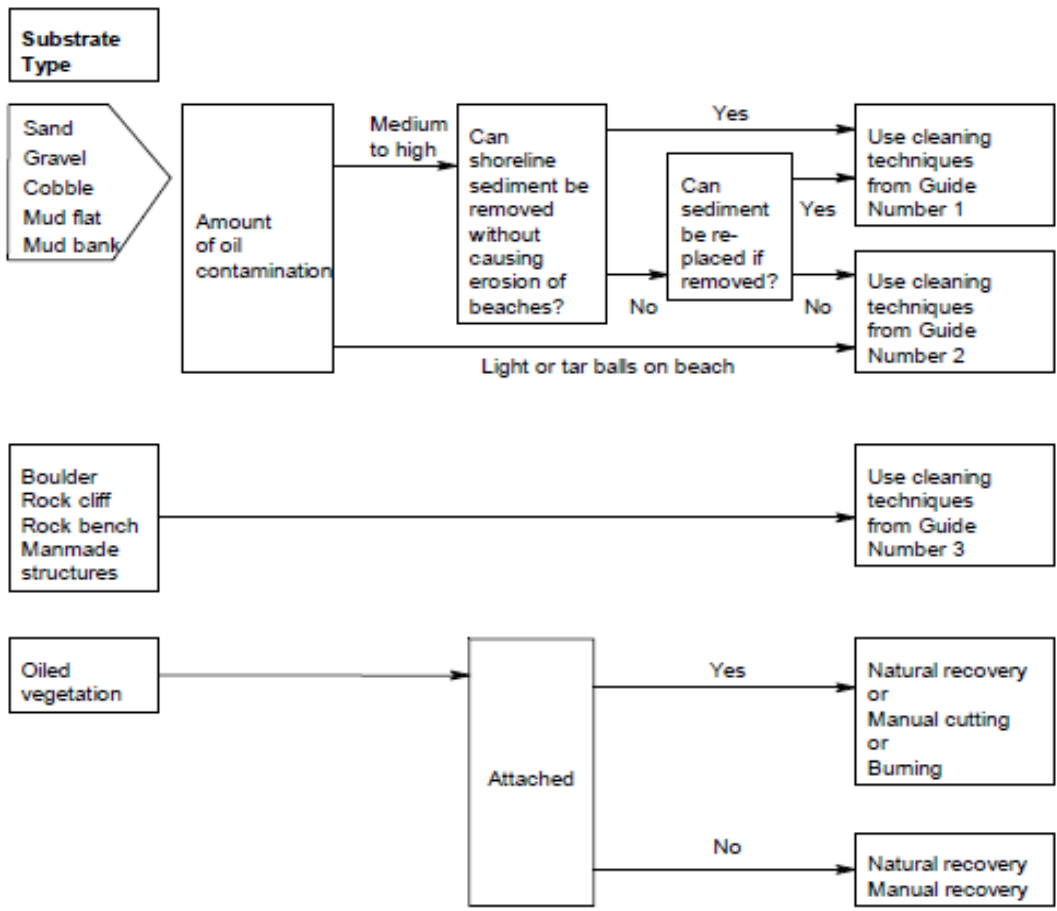


Figure K-1: Shoreline Clean-up Master Decision Guide

Shoreline Cleanup Decision Guide Number 1

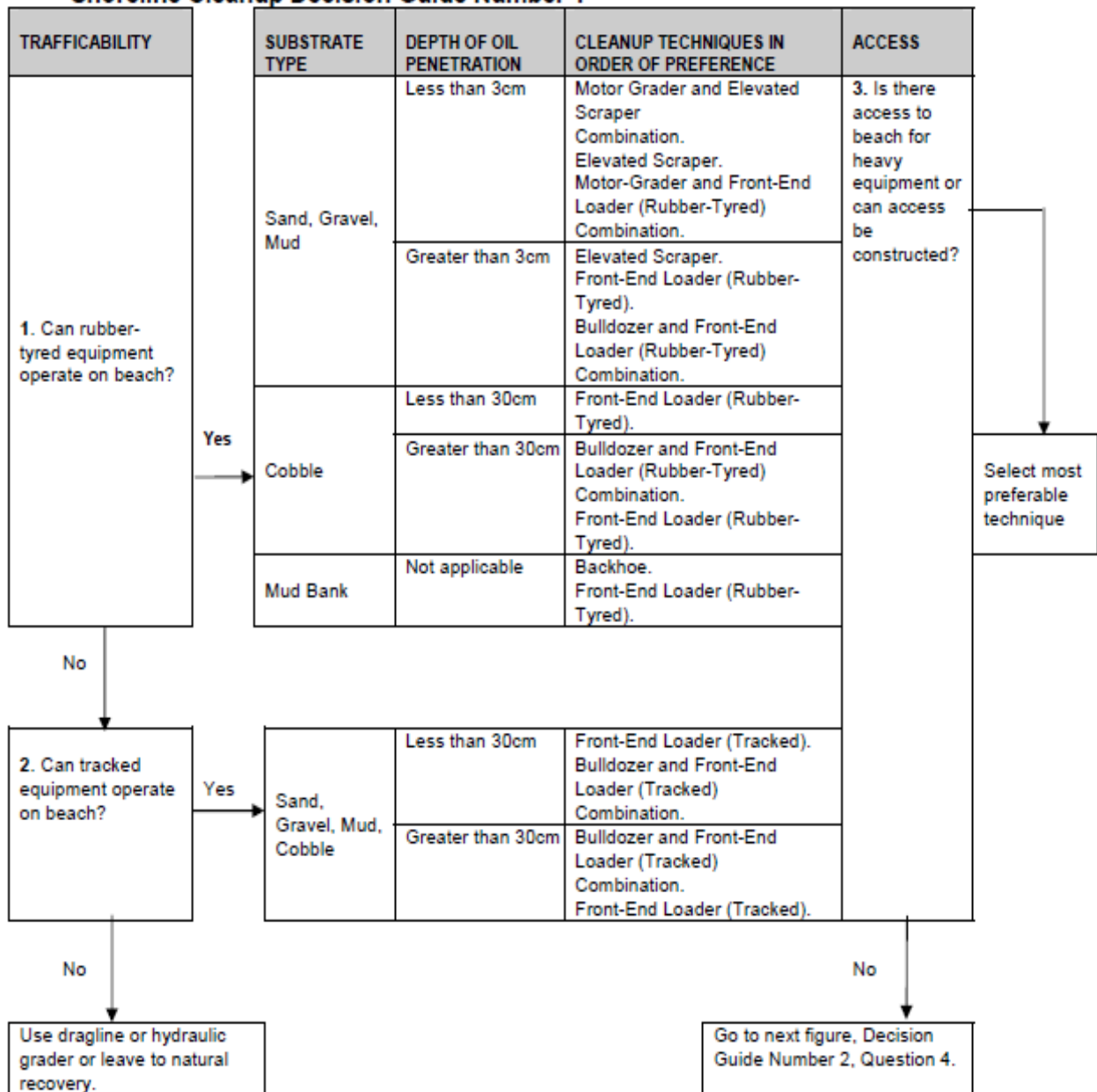


Figure K-2: Shoreline Clean-Up Decision Guide 1

Shoreline Cleanup Decision Guide Number 2

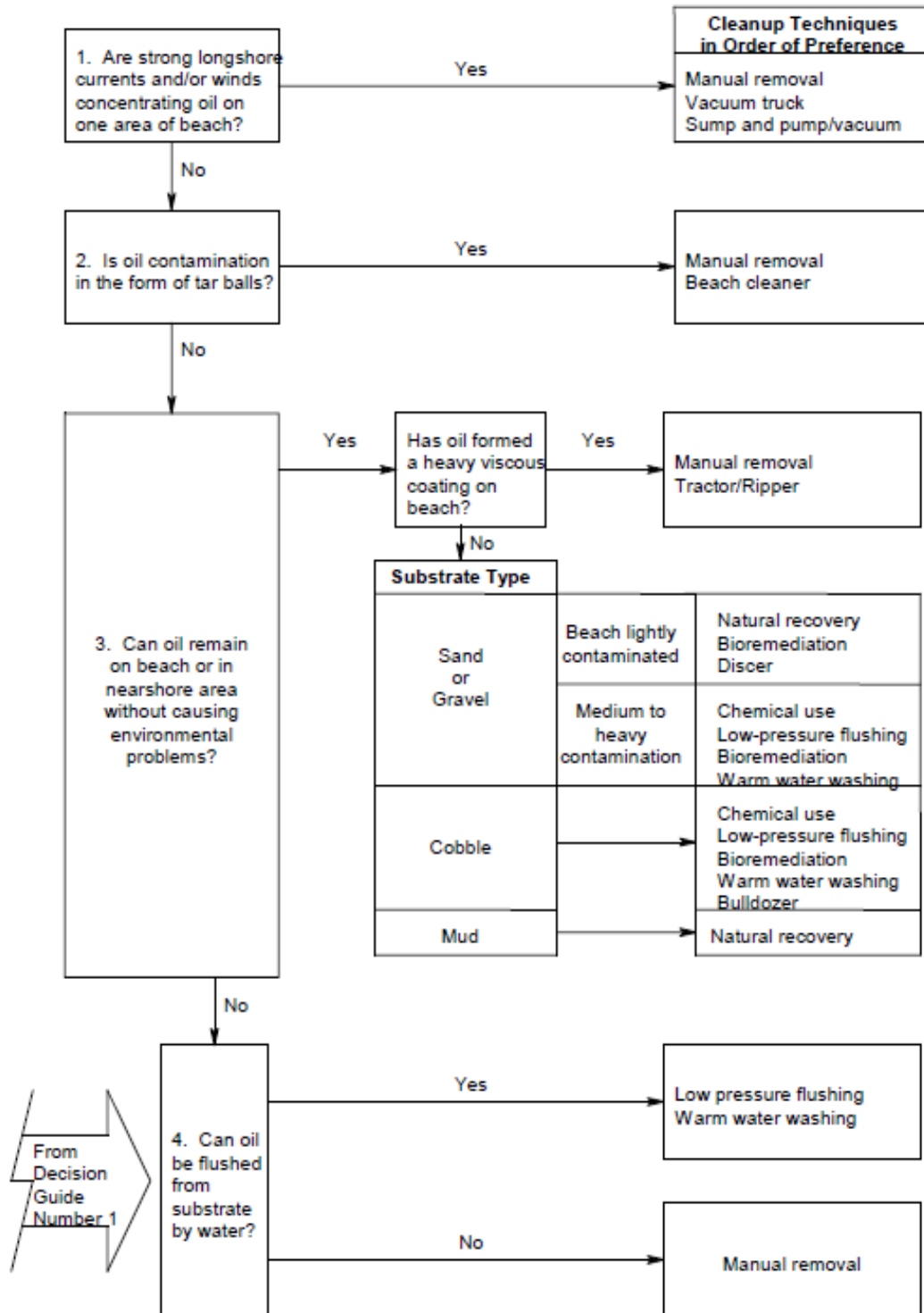


Figure K-3: Shoreline Clean-Up Decision Guide 2

Shoreline Cleanup Decision Guide Number 3

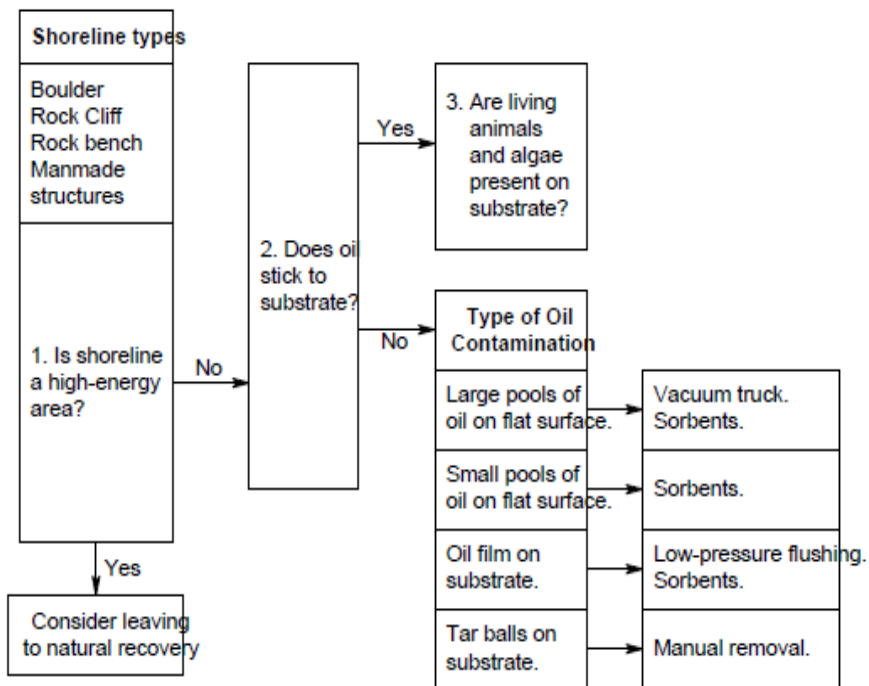


Figure K-4: Shoreline Clean-Up decision Guide 3

Appendix L: Operational Guidelines for Shoreline Response

Operational Guidelines for Shoreline Clean-up activities

1.1.1 Worksite preparation guidelines

The following provides guidelines for the preparation of staging areas supporting shoreline clean-up operations.

Organisation and worksite set-up

The worksite does not only include the polluted areas that require cleaning. Several other specific areas must be identified and cordoned off and routes for pedestrians and vehicles should be signposted.

These specific areas are:

- The polluted area;
- The waste storage area, with different types of containers suitable for the different kinds of waste;
- The decontamination area: whatever the size of the spill, a decontamination phase for operational personnel, equipment and tools must be carried out in order to provide some comfort to personnel after each work session, avoiding oiling clean areas, and group together personal clean-up equipment and protective gear, to facilitate the management of the site (cleaning, storage, re-use);
- A rest area, with at least changing rooms, toilets, a first aid kit and cold and hot beverages. Cold or even hot meals can also be organised on the spot provided that a canteen tent or temporary building is available; and
- A storage area for tools and machinery (or equipment warehouse).

Access to the worksite should be restricted and traffic of vehicles should be strictly regulated to avoid accidents.

Preparation

- Prevent the general public from accessing the worksite;
- Delineate accesses for vehicles and machinery (check load-bearing capacity) and routes;
- Channel vehicle and pedestrian traffic;
- Protect the ground (geotextile, roll out mat system...) during operations in sensitive areas (dunes...);
- Prepare and signpost the different areas of activity (on the beach), living areas (locker room, meals, showers, toilets...) and stockpiling areas presenting a risk (fuel, equipment, waste pit....);
- Define a site for fluid storage away from the locker room:
 - Provide an extinguisher for each cabin
 - Set up a recovery system for fuel leaks
- Provide at least minimum lighting for installations and the surrounding area during the winter.

Basic Equipment	Extra Equipment
✓ Plastic liners, geotextiles	✓ Bins, barrels, skips, tanks
✓ Barrier tape and stakes	✓ Hot and cold beverages (Welfare)
✓ Signposting equipment	✓ Cooking oil, soap (Welfare)
	✓ Earthmoving equipment

PRIMARY STORAGE OF WASTE

A primary storage site is:

- ✓ An emergency staging area of the immediate deposit of the waste collected before its transfer to either an intermediate long term storage site or if possible directly to a treatment facility; and
- ✓ A key stage in the waste management process for sorting, labelling and quantifying the types and volumes of waste collected and when possible, reducing volumes to be transported by pre-treatment.

The storage site must be closed as soon as clean-up operations are completed.

The return of the site to its original condition implies:

- ✓ A contamination diagnosis made by an organisation specialised in ground pollution, decontamination operations if needed and the approval of the authorities; and
- ✓ In some cases, botanical evaluations to define a plant cover restoration operation.

<ul style="list-style-type: none"> ✓ Segregate the different types of waste ✓ Protect containers from rain water and to contain odours ✓ Protect containers from prolonged exposure to sunlight if necessary ✓ Ensure security to prevent unauthorised dumping
--

Primary waste storage sites should meet certain criteria:

- ✓ Close proximity to the site of clean-up;
- ✓ Good access to roads for heavy lorries; and
- ✓ A flat area with enough space away from environmentally-sensitive areas (vegetation, groundwater) and out of reach of the sea tides and waves.

- ✓ Depending on the volume of waste, site characteristics and availability of containers, prepare:
 - Staging areas
 - Pits if necessary
 - Platform within earth berms
 - Platform for bagged solids and liquids in tank.
- ✓ Protect areas using watertight plastic liners
- ✓ Lay fine gravel or sand at the base of the storage area to protect the membranes
- ✓ Prepare rain water or effluent management
- ✓ Ensure correct labelling of the containers to avoid mixing the different types of waste (liquid, solid, non-biodegradable – oiled plastics, contaminated cleanup equipment, biodegradable – oiled seaweed, faunal)
- ✓ Control access to the cleanup sites and protect access routes using lining and/or geotextiles

BASE CAMP/REST AREA

The rest area (base camp) should at least consist of:

- ✓ Changing rooms;
- ✓ Toilets; and
- ✓ A rest area.

At base camp, operators must be provided with:

- ✓ A first aid kit; and
- ✓ Hot and cold beverages, meals.

Selection of the rest area must meet certain criteria:

- ✓ Close proximity to the clean-up site;
- ✓ Easy access; and
- ✓ A flat area with enough space away from environmentally sensitive areas.

Equipment

- ✓ Shelter/rest area (tent, temporary building);
- ✓ Portable toilets (at least one for men and one for women);
- ✓ Locker rooms;
- ✓ First aid kit;
- ✓ Fire extinguisher; and
- ✓ Communication equipment.

STORAGE AREA FOR EQUIPMENT AND MACHINERY

This area consists of an equipped repair and maintenance site.

In order to avoid incidents and clean-up equipment failures, equipment should only be used by trained personnel and all equipment should regularly be checked for conformity with standard operating procedures and safety.

- ✓ Check and adjust daily levels of gasoline, diesel, oil, water and other fluids
- ✓ Regularly maintain the machines (pumps, pressure washers...)
- ✓ Equipment must be checked, counted by the person in charge of logistics and stored daily at the end of the work day
- ✓ Some pieces of equipment must be washed or at least rinsed daily, with proper recovery of cleaning effluent, other kinds of equipment should be washed weekly or at the end of operations
- ✓ Set up a systematic maintenance-cleaning-repair operation at the end of each week
- ✓ Small tools and equipment and even detachable parts of all equipment remaining outside should be securely stored away (eg stainless steel bucket of small sand screeners)
- ✓ In case of interruption of operations, large pieces of equipment should be moved to a supervised site
- ✓ Regularly check equipment for conformity and safety

The storage area for equipment and machinery must meet certain criteria:

- ✓ Close proximity to the site of clean-up;
- ✓ Easy access; and
- ✓ A flat area with enough space away from environmentally-sensitive areas.

Equipment

- ✓ Cabins;
- ✓ Hut;
- ✓ Maintenance equipment and tools; and
- ✓ Cleaning equipment.

1.1.2 Manual clean-up guidelines

Oil, polluted sediment and debris are removed by hand or with the help of manual tools and then stored for disposal.

Conditions of use

- ✓ Pollution : all types ; most often scattered pollution; on large spills, if implementation of other techniques is impossible;
- ✓ Pollutant : all types;
- ✓ Substrate : all types; sufficient load bearing capacity for pedestrians and light equipment; and
- ✓ Site: all types sufficiently accessible and which tolerate intensive traffic.

Equipment

Basic Equipment:

- ✓ Scrapers (paint scrapers, long handle scrapers...), rakes, brushes, forks; and
- ✓ Landing nets, shovels, trowels.

Extra Equipment:

- ✓ Waste containers, big bags, bins, plastic bags; and
- ✓ Front-end loader (for disposal).

PPE: At least protective clothing: overalls, boots, gloves, etc. depending on the nature of the pollutant, exposure and responder activity.

- ✓ Divide the response personnel among three functions:
 - Collection/scraping/gathering
 - Placing in bags/waste containers
 - Disposal
- ✓ Rotate the teams among the three functions;
- ✓ The waste can be disposed of manually or with the use of mechanical means if possible;
- ✓ Don't overfill bins, plastic bags; and
- ✓ Don't remove excessive quantities of sediments.

Impact

- ✓ Impact insignificant to heavy, depending on the type of substrate. Risk of destroying the structure of the substrate in marshes. Erosion;
- ✓ Potentially destructive effects on vegetation (dunes, marshland);
- ✓ Deconstruction and destabilisation of the foot of the dune (upper end of beach); erosion, destruction of the dune and the associated vegetation, decrease in biodiversity and fertility by reduction of the low water mark; and
- ✓ Can tend to fragment the oil in certain conditions.

Performance

This is a highly selective technique, but requires a lot of time and personnel. If not done correctly, there is a risk of removal of large quantities of clean sediment.

1.1.3 Mechanical clean-up guidelines

This technique consists of collecting the oil in order to facilitate its removal from the beach. Collection is carried out using a tractor, ATV or earthmoving vehicle or earthmoving equipment.

Conditions of use

- ✓ Pollution : heavy pollution, continuous slick;
- ✓ Pollutant : slightly to very viscous oil;
- ✓ Substrate : vast, flat foreshore with wet fine-grain sand (very damp to saturated) and a good load-bearing capacity, without ripple marks; and
- ✓ Site: accessible and sufficient load bearing capacity for earthmoving equipment, sufficiently large to allow vehicles to manoeuvre.

Equipment

Basic equipment:

- ✓ Backhoe loader;
- ✓ Grader/bulldozer;
- ✓ Tractor or loader with front blade; and
- ✓ Front-end loader or lorry (for removal).

PPE: At least suitable for heavy machinery operation

Impact

- ✓ Normally only removes the oil, but some sediment may also be taken with it (if the operator is poorly supervised or inexperienced), especially if used on light pollution or an unsuitable site;
- ✓ High risk of disturbance due to traffic and mixing of oil with sediment; and
- ✓ May lead to reduction of beach stability and beach erosion/loss of beach area.

Minimum workforce required: 2 people per vehicle (1 drive + 1 assistant)

Waste: oil mixed with a varying quantity of sediment; but can rapidly become unselective if scraping is carried out on moderate pollution (should be avoided)

- ✓ Consists of bringing the oil together in order to facilitate its removal from the beach. Scraping is carried out using a tractor or earthmoving equipment fitted with a front end blade in an oblique position. According to the viscosity of the oil, two options are available:
 - (case 1) fluid oil: radial or converging scraping towards a collection point on the foreshore; removal by pumping
 - (case 2) more viscous oil /solids: concentration to form windrows, by successive slightly curving passes parallel to the water line; subsequent removal of windrows
- ✓ Should only be carried out on heavy pollution; do not use on moderate to light pollution
- ✓ Inform and supervise operators; use experienced operators
- ✓ Work methodically
- ✓ Set up traffic lanes on the beach in order to reduce oil and sediment mixing

- ✓ Don't remove excessive amounts of non-contaminated materials
- ✓ Don't fill the bucket of loader more than 2/3 capacity
- ✓ Don't drive on polluted materials

1.1.5 Shoreline vessel access guidelines

There are numerous landing craft vessels available in the North West Shelf area. These vessels are capable of grounding out; therefore the vessels can access a contacted area on high tide, ground out, unload equipment and personnel, reload with waste oil then depart on the next high tide. Landing craft vessels are supplied through Quadrant Energy existing vessel suppliers.

Mechanical equipment and PPE are to be mobilised to the nominated marine operational base for onward movement to the affected locations.

For shoreline clean-up of remote islands the following guidelines will be considered so as to minimise the secondary impacts of high numbers of spill response personnel on shorelines:

Vessels are to be mobilised to the designated deployment Port to mobilise shoreline clean-up teams by water. The shoreline clean-up will be undertaken through on-water deployment to the defined shorelines in 4 stages:

- (1) Drop off of 6-person clean-up containers (refer below) to shoreline contact locations defined by IMT through observation data;
- (2) Deployment of marine and environmental specialists to demarcate the clean-up zones with barrier posts and tape to prevent secondary impacts to flora and fauna by the clean-up teams;
- (3) Deployment of small clean-up teams with a trained/competent shoreline responder as a Team Leader to conduct clean-up methods (flushing, bag and retrieve, etc.) with all waste being bagged and stored in temporary bunding made of HDPE above the high-high tide mark; and
- (4) Deployment of the waste pickup barges to retrieve collected wastes from the temporary bunding and to complete the shoreline clean-up and final polishing.

Appendix M: Oiled wildlife response personnel and equipment

In the event of a spill impacting wildlife, Santos will commence arrangements to mobilise personnel and equipment to fill responder positions as identified in the Santos Oiled Wildlife Response Framework Plan (SO-91-BI-20014) and WAOWRP.

This appendix outlines the current OWR equipment, personnel and services available to Santos through current arrangements.

Australian Maritime Safety Authority (AMSA)

AMSA maintains four oiled wildlife response containers/ mobile washing facilities in Darwin, Dampier, Devonport and Townsville. All resources under the NatPlan (including the four OWR containers) are available to Santos through formal request to AMSA under the arrangements of the NatPlan. The containers also include some limited PPE and fresh and wastewater pools.

Western Australia Department of Transport (DoT)

The WA DoT maintains one OWR container/ mobile washing facility which is available through the National Plan on request.

Australian Marine Oil Spill Centre (AMOSC)

Santos is a participating company of AMOSC and as such has access to AMOSC's Level 2/3 oiled wildlife equipment and personnel as outlined in the AMOSPlan.

Equipment

Table M-1 provides a summary of the oiled wildlife response equipment maintained by AMOSC.

Table M-1: AMOSC Oiled Wildlife Response Equipment

Location	Oiled fauna kits (basic medical supplies, cleaning/rehab, PPE)	Fauna hazing and exclusion equipment	Oiled wildlife washdown container (mobile washing facility)
Fremantle	-	1 x fauna hazing & exclusion kit 3 x fauna hazing & capture kit 1 x Breco bird hazing buoy	1 x Oiled Wildlife Response Container
Exmouth	1 x Oiled fauna kit	-	-
Broome	1 x Oiled fauna kit	-	-
Geelong	2 x Oiled fauna kit	1 x fauna hazing & exclusion kit	1 x Oiled Wildlife Response Container
Total	4 x Oiled fauna kit	2 x fauna hazing & exclusion kits 3 x fauna hazing & capture kits 1 x Breco bird hazing buoy	2 x Oiled Wildlife response Containers

Personnel

AMOSC currently has the following arrangements in place for OWR personnel:

- + 1 x AMOSC OWR Officer available to act as an Industry Oiled Wildlife Advisor (OWA)
- + AMOSC call off contract with DWYERtech Response NZ
 - A facilities management group with availability within 24 hours of call off
- + 60 x AMOSC OWR Strike Team members
 - Volunteer OWR trained industry personnel
- + MOU with Phillip Island National Park (PINP), Victoria (best-endeavours availability)
- + Approx. 39 PINP staff – collection/facility ops/rehabilitation
 - Approx. 45 volunteers – collection/facility ops/rehabilitation
 - Approx. 20 staff – animal feeding
 - 6 x PINP staff - wildlife emergency response including cetacean stranding/entanglement
 - 13 x PINP staff - wildlife team leaders

Oil Spill Response Limited (OSRL)

Through the associate membership, Santos has access to the following OWR equipment and personnel services from OSRL.

Equipment

OSRL maintains a Level 3 wildlife equipment stockpile. This equipment is stored across the OSRL base locations and is designed to support the first 48 hours of the response and to ensure availability of critical equipment items that may be difficult to source locally (Note: this equipment does not provide everything that will be required to successfully operate a primary care facility and is focussed primarily on bird casualties (n=100)). Equipment is sorted according to search and rescue (including field first aid), medical, and cleaning and rehabilitation (**Table M-2**).

Table M-2: OSRL Wildlife Equipment (as per OSRL Equipment Stockpile Status Report, June 2022)

OWR Response Package	UK	Singapore	Bahrain	Fort Lauderdale
Wildlife Search and Rescue	1	1	2	-
Wildlife Search and Rescue Medical	1	1	-	-
Cleaning and Rehabilitation	-	-	1	-
Wildlife Cleaning and Rehabilitation Part 1	2	1	-	-
Wildlife Cleaning and Rehabilitation Part 2	2	1	-	-
Wildlife Cleaning and Rehab. Medical	1	1	-	-

Personnel

Through the OSRL Oiled Wildlife SLA, Santos has access to 24/7 technical advice (remote or on-site) from the Sea Alarm Foundation, a small non-governmental organisation based in Brussels, Belgium that works to improve global preparedness and response for oiled wildlife incidents. Santos has the option to mobilise a

Sea Alarm Technical Advisor during an incident. Sea Alarm staff will act in a technical advisory role at the incident management level and will work impartially with all parties (titleholder, local authorities, mobilised experts and local experts, and response groups), with the aim of maximising the effectiveness of the wildlife response.

In 2022, the Global Oiled Wildlife Response Service (GOWRS) will become part of OSRL's SLA. GOWRS is a ready-to-deploy Assessment Team of 4 x wildlife response experts, drawn from ten leading international wildlife response organisations. The Assessment Team will be available 24-7-365 to deploy for a four-day in-country incident assessment. Before formal integration into the SLA, this service is available from OSRL on a best endeavours basis.

In addition, through the SLA, Santos has the option to access OSRL's internal staff with OWR expertise (1 x UK) as part of the 18 personnel commitment for any single incident.

Appendix N: Scientific monitoring plans

1 Scientific Monitoring Principles

1.1 Monitoring Design

In the event of an oil spill the monitoring design will depend upon the nature of the spill, the availability of baseline data in relation to the spill extent and expert opinion. In order to ensure the application of robust designs and sampling approaches which have the highest likelihood of detecting an environmental impact while allowing suitable flexibility, this plan provides a set of Guiding Principles for monitoring design and sampling (**Table 1**). A structured decision making framework for allocating monitoring effort in both time and space is described in **Figure 1**.

Table 1: Guiding Principles for Oil Spill Monitoring Design and Methodologies.

Principle	Explanation	Key guiding references
Match baseline	Designs and methodologies should follow those used in appropriate baseline studies wherever possible.	N/A
Comprehensive sampling	Sampling methods should seek to sample the full range of taxa within each assemblage. This may require the use of several complimentary techniques (the exception is if indicator taxa are employed; see below).	N/A
Reliable indicator taxa	If indicator taxa are targeted then the choice of indicator should be defensible, and a link to the response of the broader assemblage demonstrated. Indicators of ecosystem function should also be considered.	Hilty and Merenlender (2000)
Appropriate sample area or volume	Size of sampling unit should be determined based on the level of clustering of individuals and whether the goal is to quantify this clustering, or establish low inter-sample variability (probably more the latter for oil spill studies).	Kenkel et al. (1989)
Reduce within sample variation over time	Wherever possible repeated measures are carried out on the same sample space in order to reduce within treatment variation.	N/A
Compositing of samples	Appropriate compositing to increase statistical power should be considered.	Carey and Keough (2002)
Account for environmental gradients and partition variations	Sources of variation are considered and compartmentalised to best reduce within treatment variation, and thereby maximise power to detect an impact. This is managed through several means:	English et al. (1997), Snedecor and Cochran (1989)

Principle	Explanation	Key guiding references
	<p>Environmental covariates are considered in sampling design recorded and incorporated statistically.</p> <p>A hierarchical or stratified sampling design is used to address variation at multiple scales</p> <p>Design is standardized, by sampling equivalent strata (e.g., level of exposure, depth etc.).</p>	
Assess statistical power	Where null-hypothesis tests are planned, statistical power of the design is assessed prior to execution.	<p>Gerrodette (1987)</p> <p>Legg and Nagy (2006)</p> <p>Toft and Shea (1982)</p>
Appropriate sampling extent	Sample the range of hydrocarbon concentration (and at least the upper end).	Skalski (1995)
Independence amongst samples	Site selection should aim for independence amongst samples and potential spatial or temporal autocorrelation should be considered.	Hurlbert (1984)
Reduce observation error	Observer bias and amongst observer variation should be considered.	Thompson and Mapstone (1997)
Appropriate spatial replication	Sites are replicated. A limitation is that there is only one spill, but control sites should be replicated and spatially Interspersed. Ideally, the design should be able to detect an impact at several possible scales.	Underwood (Underwood 1991, 1992, 1994)
Appropriate temporal replication	Sampling should account for natural temporal variation.	Underwood (Underwood 1991, 1992, 1994)

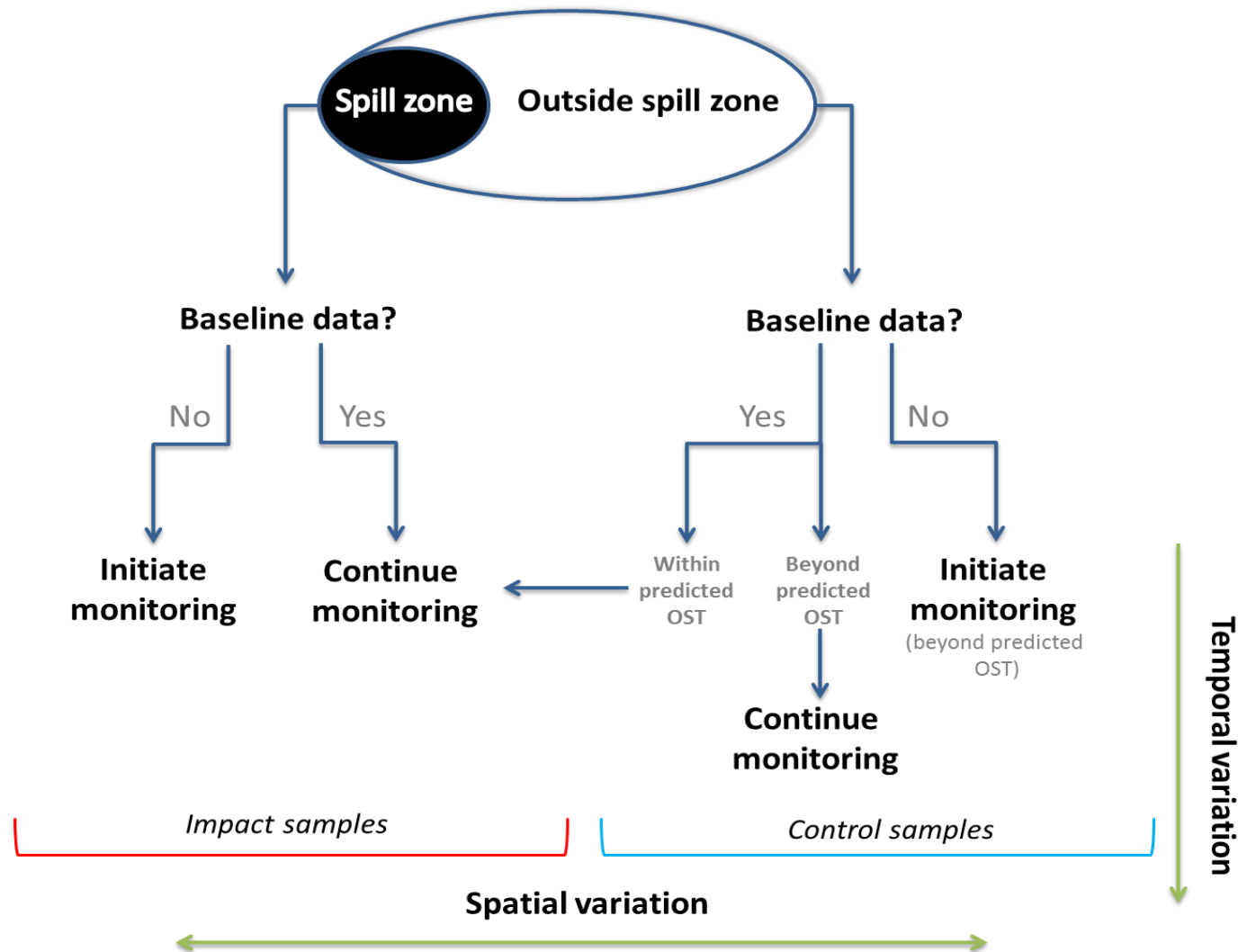


Figure 1: Structured Decision Making Process Based on Gregory et al. (2012) in Reference to Monitoring Programs, the Availability of Baseline Data, and Oil Spill Trajectory. An ideal design sampling would occur across a gradient of exposure rather than 'impact' and 'control' per se.

1.2 Data Analysis

Appendix B details the most important approaches to statistical analysis and related sampling design. These approaches are summarised in Table 2 (below). An important consideration is how this information is best summarised and communicated to guide further decision making and management. **Appendix B** also describes the reporting of environmental outcomes through the use of report card systems and includes a summary of their structure and design.

Table 2: Summary of Data Analysis Techniques.

Analysis type		Description	Strength	Limitations	Addressing limitations
Gradient analysis		Impact is quantified in terms of distance from spill.	Can be established post-spill.	Doesn't account for inherent spatial patterns present prior to spill.	Include spatial covariates in model. Incorporate a temporal component.
Control chart	Univariate	Single variable is monitored and plotted over time, and breaching of control limits tested.	Control sites are not required. Takes account of natural variation in system.	Control limits do not necessarily have biological meaning. Doesn't control for broader spatial scale temporal variation.	Include control charts for control sites which incorporate broad scale temporal variation.
	Multivariate	Multiple variables are combined, monitored and plotted over time, and breaching of control limits tested.	Ability to combine suite of data (e.g. community composition) into one variable. Sites plots not required.	Individual responses are masked. Control limits do not necessarily have biological meaning. Significant control limits challenging to define. Direction of change is undefined.	Compliment with graphical approaches to identify direction of change and individual species responses.
	Reference	Control limits are based on knowledge of biological system (e.g. minimum viable population size, toxicity).	Control limits have recognised biological meaning or consequence.	Control limits may be considered arbitrary.	Use established standards for control limits.

Analysis type	Description	Strength	Limitations	Addressing limitations
BACI	Quantifies state before and after potential impact, and also at impacted and control sites. Impact is tested by statistical interaction of terms.	Controls for natural variation, by incorporating control sites.	Limited power to detect significant impact. Requires appropriate matching of control (non-impacted) sites. Requires pre-impact data.	Increase power by increasing temporal component. Choose indicators with low natural variability.

2 Scientific Monitoring Plans by Receptor

Table 3 provides a glossary of an SMP as prepared in this report.

Table 3: Glossary of Scientific Monitoring Plans.

SMP Receptor	
Rationale	Importance of receptor, possible impact and importance of monitoring program.
Aim	Description of program aim(s)
Baseline	Refer to Table 2 , detailed in Baseline Data Review (Astron Environmental Services 2019) (QE-00-BI-20001)
Contact	Contact is defined as occurring where any aerial, visual or fluorescence observation reports submitted to the Incident Command Team (ICT) show presence or likely presence of oil; or spill fate modelling predicts oil at sensitive receptors of > 1g/m ² for surface oil, and >10 ppb for entrained and dissolved oil. This then activates the relevant SMP, which determines if any impact has occurred based upon applicable thresholds.
Initiation criteria	Initiation criteria, based on data from OMPs.
Termination criteria	Termination criteria based on analysis of Scientific Monitoring data translated to the Incident Management Team (IMT) through the planning function.
Receptor impact	Measured states and pressures according to the State-Pressure-Response model.
Methodological approach	Descriptions of sampling methods in order to carry out scientific monitoring, including reference to methods described in an appendix.
Scope of works	Timeline for scope of works (SoW) development.
Statistically significant	The basis of the significance is determined by the methodological approach as outlined in the relevant SMP.
Resources	List of required resources which may not necessarily be listed within a description of a particular method as described in Appendix C .
Implementation	Mobilisation requirements for service provider(s).
Analysis and reporting	Summary of analysis, data management and reporting.

SMP1 – Marine Water Quality	
Rationale	<p>The release of hydrocarbons at sea will pollute marine waters via floating, entrained or dissolved aromatic hydrocarbons.</p> <p>The water quality SMP may also be used in conjunction with OMP1 (Surveillance and Monitoring), to inform the sampling design of other SMPs where objectives are to evaluate impact to and recovery of sensitive receptors, in relation to hydrocarbon contamination.</p>
Aim	To monitor changes in water quality following an oil spill and associated response activities for the purpose of detecting a potential impact and recovery and for informing other scientific monitoring studies.
Baseline	<p>Refer to the Baseline Data Review (Astron Environmental Services 2021) (SO-91-RF-20022 Rev 0).</p> <p>In addition, relevant available metadata will be reviewed for applicable marine water quality baseline data.</p> <p>In the absence of baseline data for hydrocarbons, data from appropriate reference sites will be used in place of the baseline values.</p>
Initiation criteria	Upon notification of a Level 2 or 3 incident (a level 2 or 3 incident includes those which may have an adverse effect on the environment. This may be informed by operational water quality monitoring)
Termination criteria	<p>Concentrations of hydrocarbon contaminants, attributable to the released hydrocarbon, are not significantly higher than baseline data or similar non-impacted sites data.</p> <p>In the absence of baseline or similar non-impact sites data, concentrations of hydrocarbon contaminants, attributable to the released hydrocarbon, are below the relevant hydrocarbon contaminant trigger level within the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Governments 2018), or the relevant regulatory site-specific trigger level (where these exist), if this is lower and values are not significantly different to reference sites.</p> <p>Forensic fingerprinting of the released hydrocarbon and water quality sample analysis by way of gas chromatography/mass spectrometry (GC/MS) may be used to determine the source of contaminants where this is not otherwise clear from operational monitoring.</p>
Receptor impact	Impacts to specific receptors from hydrocarbons within marine waters are described in individual SMPs.
Methodological approach	<p>Overall sampling design approach will be enacted according to the availability of baseline data guided by the structured decision-making process based on Gregory et al. (2012):</p> <ol style="list-style-type: none"> 1. If sites are contacted in which long-term baseline data is available, a control chart (time-series) design will be applied; 2. If insufficient long-term baseline data is available, where appropriately matched baseline data sites are impacted and non-impacted, a before-after-control-impact (BACI) approach to monitoring will be applied;

SMP1 – Marine Water Quality

3. Where no baseline data sites are involved, a gradient approach to quantifying impacts will be applied.

See **Appendix B** and **Figure 1** for detailed description of these approaches.

The selection of potentially impacted and non-impacted sites will be informed by Operational Monitoring, including operational water quality monitoring and spill trajectory modelling.

Sampling frequency will be dictated by the spatial extent of the spill, the number and location of sampling sites and the philosophy of the sampling design.

Water profiles

SMP1 – Marine Water Quality

A water quality probe will be used to measure conductivity (to derive salinity in PSU), temperature and depth (CTD), dissolved oxygen (% and mg/L), turbidity (FNU or NTU), and fluorometry along a depth profile. Sampling methods will be aligned with the recommended standard operating procedures for the use of sensors for oil spill monitoring found in Appendix F of the Oil Spill Monitoring Handbook (Hook et al. 2016).

Water quality

Water quality samples will be taken along a similar depth profile as the CTD measures using a Niskin bottle, Van Dorn water sampler, rosette sampler or equivalent instrument.

The laboratory(ies) will inform and supply the appropriate sample containers, storage requirements, holding times, detection limits/limit of reporting for required analytes and the analysis required for each sample.

Water samples shall be analysed for key contaminants of concern including polycyclic aromatic hydrocarbons (PAHs), monocyclic aromatic hydrocarbons (including benzene, toluene, ethylbenzene, xylene), and nutrients, metals and chlorophyll-a.

At each site, replicate water samples (at least three samples) will be collected to allow appropriate statistical analyses to be made including samples for quality assurance and quality control (QA/QC) purposes (i.e. split sample, triplicate sample, field blanks, transport blanks).

Water sample collection and handling will align with Standard operating procedures found in the Oil Spill Monitoring Handbook (Hook et al., 2016), specifically the following sections:

- + Appendix A & B hydrocarbon analysis;
- + Appendix C Volatile Organic Compounds Analysis; and
- + Appendix D Surface Oil Analysis.

Environmental DNA (eDNA) will also be collected to detect for the presence of marine species in the water column. Water samples will be collected in Nalgene bottles and sent to an appropriate laboratory for analysis. Sample processing will depend on holding times required (<8 hours ideal) and may involve filtering and freezing of each sample (Grochowski and Stat 2017).

SMP1 – Marine Water Quality	
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP having been activated.
Resources	<ul style="list-style-type: none"> + Marine scientist with experience in water quality sampling + Geographic Information Systems (GIS) personnel + National Association of Testing Authorities (NATA) accredited laboratories for water sample analysis + Vessel and tender in operation + Refuelling facilities + Sample containers and preservative + Sampling equipment + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider able to mobilise within 72 hours of the SoW following approval by Santos (this time allows for costing, preparation of equipment and disposables and travel time to site).
Analysis and reporting	<p>Chemical analysis will be carried out by NATA-accredited laboratories.</p> <p>A government endorsed laboratory for forensic fingerprinting (GS/MS) will be used.</p> <p>Data will be entered to spatially explicit database.</p> <p>Data will be analysed appropriately in order to determine if there was a statistical difference in water quality before and after a hydrocarbon impact. Data and conclusions will be summarised in an environmental report card.</p> <p>Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.</p>

SMP2 – Sediment Quality	
Rationale	Hydrocarbons released during a spill scenario may contact, settle and/or accumulate in marine sediments. Toxic substances found in accumulated hydrocarbons may lead to impacts to ecosystem processes associated with this primary producer habitat. Sediments and marine infauna will be sampled concurrently in order to establish potential correlations amongst the two parameters.
Aim	<p>To monitor the fate and persistence of hydrocarbons in marine sediments following an oil spill and associated response activities.</p> <p>To monitor marine benthic infauna assemblages as an indicator of sediment quality, in relation to an oil spill and associated response activities.</p>

SMP2 – Sediment Quality	
Baseline	<p>Refer to the Baseline Data Review (Astron Environmental Services 2021) (SO-91-RF-20022 Rev 0).</p> <p>In addition, relevant available databases will be reviewed for applicable marine baseline sediment quality and infauna data.</p> <p>In the absence of baseline sediment quality data, hydrocarbon contaminant trigger values for marine sediments as listed in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Governments 2018) will be used as a proxy for baseline levels.</p> <p>Where other regulatory site-specific trigger levels exist, the lower of these levels and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (Australian and New Zealand Governments 2018) levels will be used as proxy baseline levels.</p>
Initiation criteria	Operational Monitoring or SMP1 indicates that contacted sediment or sediment predicted to be contacted by a hydrocarbon spill as defined in Table 1 .
Termination criteria	<p>Concentrations of hydrocarbons in marine benthic and shoreline sediments, attributable to the released hydrocarbon, are not significantly higher than baseline or similar non-impact sites.</p> <p>In the absence of baseline or similar non-impact sites data, concentrations are below marine sediment quality interim guideline levels within the ANZG (2018), or the relevant regulatory site-specific trigger level (where these exist), if this is lower.</p> <p>For infauna assemblages, abundance and species diversity/richness/composition are not significantly different from baseline (where baseline data exists) or are not statistically significantly different from comparable non-impacted benthic infauna assemblages.</p> <p>Forensic fingerprinting of the released hydrocarbon and sediment quality samples by way of GC/MS may be used to determine the source of contaminants where this is not otherwise clear from operational monitoring.</p>
Receptor impact	<p>Impact to sediment quality is measured through change in hydrocarbon content and concentration. Change to sediment quality is also reflected by changes to infaunal assemblages. Potential impact to infaunal assemblages are measured through change(s) in:</p> <ul style="list-style-type: none"> + Taxonomic diversity + Assemblage composition + Abundance of indicator species <p>Other pressures to these states are:</p> <ul style="list-style-type: none"> + Discharge of other toxicants + Physical disturbance including dredging + Sedimentation + Introduction of marine pests

SMP2 – Sediment Quality	
	<ul style="list-style-type: none"> + Shading from marine infrastructure + Climate change
Methodological approach	<p>Overall sampling design approach will be enacted according to the availability of baseline data guided by the structured decision-making process based on Gregory et al. (2012):</p> <ol style="list-style-type: none"> 1. If sites are contacted in which long-term baseline data is available, a control chart (time-series) design will be applied; 2. If insufficient long-term baseline data is available, where appropriately matched baseline data sites are impacted and non-impacted, a before-after-control-impact (BACI) approach to monitoring will be applied; 3. Where no baseline data sites are involved, a gradient approach to quantifying impacts will be applied. <p>See Appendix B and Figure 1 for detailed description of these approaches. The selection of potentially impacted and non-impacted sites will be informed by Operational Monitoring, including operational water quality monitoring and spill trajectory modelling.</p> <p>Sampling frequency will be dictated by the spatial extent of the spill, the number and location of sampling sites and the philosophy of the sampling design</p> <p><u>Sediment quality</u></p> <p>Operational Monitoring (including spill trajectory modelling) and the results of SMP1 Marine Water Quality monitoring will be used to inform the location of potentially impacted sediment sites.</p> <p>Sediment monitoring sites in nearshore and shoreline locations will also consider and align where practicable, with sites selected for habitat monitoring (i.e. SMP3, 4, 5 and 6).</p> <p>Sampling frequency will be dictated by the spatial extent of the spill, the number and location of sampling sites and the philosophy of the sampling design.</p> <p>At each site, replicate sediment samples will be taken including those for QA/QC purposes.</p> <p>Sediment grab (i.e. Van Veen or Box corer) or coring equipment will be selected based on water depth (offshore, inshore or shoreline) and sample size requirements.</p> <p>Sediment sample collection and handling will align with Standard operating procedures found in the Oil Spill Monitoring Handbook (Hook et al. 2016), specifically the following sections according to sampling equipment utilised:</p> <ul style="list-style-type: none"> + Appendix G hydrocarbon analysis (Grab samplers) + Appendix H hydrocarbon analysis (Ship borne corer) + Appendix H Manual push corer, and + Appendix O Sediment infauna. <p>The laboratory(ies) will inform and supply the appropriate sample containers, storage requirements, holding times, detection limits/limit of reporting for required analytes and the analysis required for each sediment sample.</p>

SMP2 – Sediment Quality	
	<p>Sediment samples shall be analysed for key contaminants of concern including metals, hydrocarbons, nutrients, particle size distribution, and nutrients.</p> <p><u>Infauna samples</u></p> <p>A subset of the sediment sample shall be sieved in the field (if time permits) with collected infauna preserved (10% buffered formalin or 70% ethanol as prescribed by the receiving laboratory) and sent to laboratory for identification of infauna to lowest taxonomic resolution possible.</p> <p>eDNA will also be collected to detect for the presence of marine infauna species in sediments. Sediment will be removed from the surface of a subset of the sediment sample and sent to an appropriate laboratory for analysis.</p>
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP having been activated.
Resources	<ul style="list-style-type: none"> + Marine scientist with field experience in deep sea sediment sampling + Scientist with skills in infauna identification + GIS personnel + NATA accredited laboratory for sample contaminant analysis + Laboratory for infauna sorting and taxonomic identification + Vessel with appropriate davit/winch to deploy grab/corer equipment and tender in operation + Refuelling facilities + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	<p>Service provider to be capable of mobilising within 72 hours of the SoW having been approved by Santos.</p> <p>Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.</p>
Analysis and reporting	<p>Sediment samples analysed by NATA-accredited laboratories for presence and concentrations of hydrocarbons associated with the spill including full suite PAHs and total organic carbon.</p> <p>A government endorsed laboratory for forensic fingerprinting (GC/MS) will be used.</p> <p>Infauna samples sorted and identified by qualified marine invertebrate specialist to acceptable taxonomic groups.</p> <p>Data will be entered to spatially explicit database and analysed statistically in order to detect significant differences among sites.</p> <p>Data and conclusions will be summarised in an environmental report card. Final draft report to be prepared within one month of monitoring completion; external peer review</p>

SMP2 – Sediment Quality	
	of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

SMP3 – Sandy Beaches and Rocky Shores	
Rationale	Contact of entrained oil and stranded floating oil of shoreline habitats may occur on sandy beaches and rocky shores. Rocky and sandy shores provide habitat for a variety of intertidal organisms, which in turn provide food for shorebirds. Large tides tend to create a large degree of horizontal zonation amongst taxa. Rocky and sandy shores are included within the one receptor as they are often spatially mixed and both represent high energy regions.
Aim	To monitor changes in biota of sandy and rocky shoreline habitats in relation to an oil spill and associated activities.
Baseline	Refer to the Baseline Data Review (Astron Environmental Services 2021) (SO-91-RF-20022 Rev 0). In addition, relevant available databases shall be reviewed for applicable rocky shoreline and sandy beach biota baseline data.
Initiation criteria	+ Operational monitoring, SMP1 or SMP2 indicates that rocky and/or sandy shorelines are contacted or predicted to be contacted by a hydrocarbon spill as defined in Table 1 .
Termination criteria	Shoreline assemblage structure, and hydrocarbon concentration levels in representative invertebrate species, are not significantly different from their baseline state (where baseline data exists) or are not statistically significantly different from comparable non-impacted assemblages; AND SMP2 Sediment Quality monitoring at the site has been terminated AND Shoreline clean-up at the site has been completed.
Receptor impact	Impact to shoreline invertebrates from pressures including hydrocarbons is measured through change in: + Species diversity + Assemblage composition + Abundance of indicator taxa. Other pressures to these states are: + Physical disturbance + Discharge of toxicants + Litter/waste + Introduction of marine pests

SMP3 – Sandy Beaches and Rocky Shores	
	<ul style="list-style-type: none"> + Over-collection + Nutrification + Climate change.
Methodological approach	<p>Monitoring will be designed as follows:</p> <ol style="list-style-type: none"> 1. Where long-term baseline data sites are contacted, a control chart (time-series) design will be applied. 2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 3. Where no baseline data sites are involved, a post-spill pre-impact (preferable) or gradient approach to quantifying impacts will be applied. <p>Owing to potentially high spatial variation in assemblage structure, post-spill pre-impact monitoring will be a priority where no baseline data exists. If this opportunity is not available, a gradient approach to monitoring will be applied.</p> <p>Sampling frequency will be dictated by the number and location of sampling sites and the philosophy of the sampling design.</p> <p>Rocky shoreline intertidal assemblages (fauna and flora) will be monitored using a quadrat/transect approach, with the positioning of quadrats/transects accounting for any natural variation in assemblage structure along a seaward-landward gradient. Assemblage structure to be recorded through in-situ counts of fauna and flora or still images taken for further analysis.</p> <p>Sandy shoreline infauna will be sampled by way of replicated grab/core samples. Sampling sites within impacted and non-impacted areas to consider any cross-shore gradient in assemblage structure that may exist. Where baseline data exists, the methodology will be adapted to available data so that results are comparable.</p> <p>Samples to be sieved with collected infauna preserved (10% buffered formalin or 70% ethanol as prescribed by the receiving laboratory) and sent to laboratory for identification of fauna to lowest taxonomic resolution possible. Process to follow that for baseline data where this pre-exists.</p> <p>Biomonitoring of hydrocarbon concentrations in shoreline invertebrates will occur through collection of replicated tissue samples from representative, and preferably widely available species, across impact and non-impacted locations.</p> <p>The laboratory(ies) will supply and inform the appropriate method for collection, storage and holding times of tissue samples for required laboratory analysis and to avoid cross-contamination among samples.</p> <p>Where limitations in the distribution and abundance of representative invertebrate species preclude collection of sufficient samples for analysis, in-situ biomonitoring using a locally available species (e.g. the use of caged oysters) shall be considered for assessing spatial and temporal changes in bioaccumulation of hydrocarbon concentrations in invertebrates across impact and reference sites.</p>

SMP3 – Sandy Beaches and Rocky Shores	
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	<ul style="list-style-type: none"> + Senior Scientist with experience in shoreline macroinvertebrates sampling + Supporting Scientist + GIS personnel + Helicopter or available vessel and tender in operation + Refuelling facilities + Sample containers and preservative + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby + Laboratory facilities for sorting and taxonomic identification of specimens
Implementation	<p>With the aim of collecting post-spill pre-impact data, service provider able to mobilise within 72 hours of the SoW having been provided to them (this time allowing for costing, preparation of equipment and disposables and travel to site).</p> <p>Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.</p>
Analysis and reporting	<p>Specimens not identified in situ (in the field) will be processed and identified in the laboratory by appropriately qualified scientists.</p> <p>Biota tissue samples (if collected) analysed for hydrocarbon contaminants by NATA-accredited laboratories.</p> <p>Data will be entered to spatially explicit database and analysed in order to test for significant difference between impacted and non-impacted assemblages. Data and conclusions will be summarised in an environmental report card.</p> <p>Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.</p>

SMP4 – Shorelines and Coastal Habitats - Mangrove Communities	
Rationale	In the event of Tier 2 or 3 spill, mangroves may be contacted by floating or entrained oil. Mangrove health may be adversely affected due to increased concentration of hydrocarbons in sediments and coating due to surface oil, which in turn can lead to leaf-loss, mortality and a reduction in areal extent of mangrove habitat. This plan's focus is mangrove vegetation. Associated monitoring of sediment quality and mudflat fauna is described in SMP2 and SMP5, respectively.

SMP4 – Shorelines and Coastal Habitats - Mangrove Communities	
Aim	To monitor changes to mangrove extent and health in relation to an oil spill and associated activities.
Baseline	Refer to the Baseline Data Review (Astron Environmental Services 2021) (SO-91-RF-20022 Rev 0). Baseline extent and of mangroves is monitored by remote sensing in several regions, and further historical and post-impact data for mangrove health and extent can be obtained as remotely sensed imagery (e.g., Sentinel, Landsat and WorldView).
Initiation criteria	Operational Monitoring, SMP1 or SMP2 indicates that mangroves are contacted or predicted to be contacted by a hydrocarbon spill as defined in Table 1 .
Termination criteria	Mangrove extent and health are not significantly different from their baseline state (where baseline data exists) or are not statistically significantly different from comparable non-impacted mangroves; AND Sediment quality monitoring (SMP2) at the site has been terminated; AND Shoreline response at the site has been completed.
Receptor impact	Impact to mangroves from pressures including hydrocarbons is measured through change in: + Tree health + Aerial extent. Other pressures to these states are: + Physical disturbance + Discharge of toxicants + Litter + Introduction of marine pests + Dust + Sedimentation from human activities + Climate change.
Methodological approach	Remote sensing data will be accessed for the purpose of detecting change in aerial cover and change in canopy health through and index of plant health (e.g., NDVI or MSAVI) (Astron Environmental Services 2013). Where long term on-ground baseline monitoring has occurred, further post impact on-ground monitoring should be carried out to complement any analysis of remote sensing. Analysis of long-term on-ground monitoring data will be as follows: 1. Where long-term baseline data sites (only) are contacted a control chart (time-series) design will be applied.

SMP4 – Shorelines and Coastal Habitats - Mangrove Communities	
	<p>1. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied.</p> <p>2. Where no baseline data sites are involved a gradient approach to quantifying impacts will be applied (See Appendix B for detailed description of these approaches and Figure 1, detailed in Baseline Data Review (Astron Environmental Services 2019) (QE-00-BI-20001)).</p> <p>On-ground monitoring of mangroves will aim to detect change in mangrove health, including canopy cover and plant/leaf health indices.</p> <p>Field methodology will follow the routine monitoring techniques currently employed for Santos operations (Quadrant Energy Australia Limited 2018), adapting where required to align with pre-existing baseline field data, where available.</p> <p>Sampling of sediments as per SMP2 will occur at mangrove health assessment sites to allow any changes in mangrove health to be related to sediment hydrocarbon levels.</p> <p>In-field mangrove health sampling frequency will be dictated by the number and location of sampling sites and the sampling design applied.</p>
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	<ul style="list-style-type: none"> + Senior Scientist with experience in mangrove condition assessment + Supporting Scientist + GIS and remote-sensing personnel + Available vessel in operation + Satellite and/or aerial imagery
Implementation	On-ground monitoring will only occur where long-term baseline data has been collected, and hence no post-spill pre-impact data collection will be required. On-ground post-spill data will be collected at an appropriate time as guided by the analysis of remote sensing imagery, and potential on-ground assessment.
Analysis and reporting	<p>Data will be entered to spatially explicit database and analysed in order to test statistically significant change to parameters associated with hydrocarbon spill. Data and conclusions will be summarised in an environmental report card.</p> <p>Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.</p>

SMP5 – Shorelines and Coastal Habitats - Intertidal Mudflats

Rationale	Intertidal mudflat communities are primary producer habitats which support invertebrate fauna, which in turn provides a valuable food source for shorebirds. High diversity of infauna (particularly molluscs) occur within these habitats and may be affected by
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SMP5 – Shorelines and Coastal Habitats - Intertidal Mudflats	
	penetrating oil. At high tide, these habitats become foraging grounds for vertebrates such as rays and sharks. These habitats are at high risk of impact as the sheltered environments promote high faunal diversity combined with low-energy wave action.
Aim	To monitor changes in intertidal mudflat communities associated with an oil spill and associated activities.
Baseline	Refer to the Baseline Data Review (Astron Environmental Services 2021) (SO-91-RF-20022 Rev 0). In addition, relevant available baseline databases shall be reviewed for applicable intertidal mudflat infauna baseline data.
Initiation criteria	+ Operational Monitoring, SMP1 or SMP2 indicates that mudflat habitats are contacted or predicted to be contacted by a hydrocarbon spill as defined in Table 1 .
Termination criteria	Mudflat infaunal assemblages are not significantly different from their baseline state (where baseline data exists) or are not statistically significantly different from comparable non-impacted assemblages; AND SMP2 Sediment Quality monitoring at the site has been terminated; AND Clean-up of the shoreline site has been completed.
Receptor impact	Impact to mudflat epifauna and infauna from pressures, including hydrocarbons, is measured through change in: + Species diversity + Assemblage composition + Abundance of indicator taxa. Other pressures to these states are: + Physical disturbance + Discharge of toxicants + Overfishing (bait collecting) + Introduction of marine pests + Climate change.
Methodological approach	Monitoring will be designed as follows: 1. Where long-term baseline data sites are contacted, a control chart (time-series) design will be applied. 2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 3. Where no baseline data sites are involved a post-spill pre-impact (preferable) or gradient approach to quantifying impacts will be applied (See Appendix B for detailed description of these approaches and Figure 1).

SMP5 – Shorelines and Coastal Habitats - Intertidal Mudflats	
	<p>Owing to potentially high spatial variation in assemblage structure, post-spill pre-impact monitoring will be a priority if baseline data are not available. If this opportunity is not available, a gradient approach to monitoring will be applied.</p> <p>Mudflat infauna will be sampled by way of replicated grab/core samples. Sampling sites within impacted and non-impacted areas to consider any cross-shore gradient in assemblage structure that may exist. Where baseline data exists methodology to adapt to available data such that results are comparable.</p> <p>Sites selected for mudflat infauna sampling to be concurrently sampled for sediment quality as per SMP2.</p> <p>Sampling frequency will be dictated by the number and location of sampling sites and the philosophy of the sampling design.</p> <p>Samples to be sieved with collected infauna preserved (buffered formalin or 70% ethanol as prescribed by the receiving laboratory) and sent to laboratory for identification of fauna to lowest taxonomic resolution possible. Process to follow that for baseline data where this pre-exists.</p>
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	<ul style="list-style-type: none"> + Senior Scientist with experience in epifauna and infauna assessment and sampling + Supporting Scientist + GIS personnel + Helicopter or available vessel and tender in operation + Refuelling facilities + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	<p>With the purpose of collecting post spill pre-impact data, service provider able to mobilise within 72 hours of the scope of work having been provided to them (this time allowing for costing, preparation of equipment and disposables and travel to site).</p> <p>Actual mobilization time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.</p>
Analysis and reporting	<p>Data will be entered to spatially explicit database and analysed to determine significant differences between impacted and non-impacted assemblages. Data and conclusions will be summarised in an environmental report card.</p> <p>Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.</p>

SMP6 – Benthic Habitats	
Rationale	<p>Benthic habitats are those habitats associated with the seafloor. Major benthic habitats at risk are:</p> <ul style="list-style-type: none"> + Coral reefs (likely high susceptibility to spill) + Macroalgae and seagrass (likely moderate susceptibility to spill) + Non-coral benthic filter feeders (likely moderate susceptibility to spill) + Sub-tidal pavement (likely moderate susceptibility to spill) + Soft-substrate (likely lower susceptibility to spill). <p>Macroalgal and seagrass communities are important primary producers that also provide habitat, refuge areas and food for fish, turtles, dugongs, and invertebrates. Seagrass and macroalgae also increase structural diversity and stabilise soft substrates. Non-coral benthic filter feeders, which include sponges, molluscs, sea whips and gorgonians, are considered indicators of disturbance due to their immobility and long life cycles. Corals are important primary producers that provide food, substrate, and shelter for a diversity of marine life, including invertebrates and fish. They also protect coastlines from wave erosion and provide important substrate for algae. Undisturbed intertidal and subtidal coral reefs occur in several locations throughout the region.</p>
Aim	<p>To monitor changes in the cover and composition of benthic habitats in relation to an oil spill and associated activities.</p> <p>To monitor change in hard coral health and reproduction in relation to an oil spill and associated activities.</p>
Baseline	<p>Refer to the Baseline Data Review (Astron Environmental Services 2021) (SO-91-RF-20022 Rev 0).</p> <p>In addition, relevant available baseline metadata databases will be reviewed for applicable benthic habitat and coral health and reproduction baseline data.</p> <p>Remote sensing data, satellite and aerial imagery previously acquired may also be applicable for shallow clear-water benthic habitats to detect changes in benthic habitat cover and composition.</p> <p>Pollution-induced change to benthic habitat cover and composition may take some time to be detected. Therefore, post-spill, pre-impact benthic survey data will be collected when required to have a baseline state following initial oil contact.</p>
Initiation criteria	<p><u>Benthic habitat cover and composition</u></p> <p>Operational Monitoring, SMP1 or SMP2 indicates that subtidal benthic habitats are contacted or are predicted to be contacted by a hydrocarbon spill.</p> <p><u>Coral health and reproduction</u></p> <ul style="list-style-type: none"> + Operational Monitoring, SMP1 or SMP2 indicates that coral habitat is contacted or is predicted to be contacted by a hydrocarbon spill as defined in Table 1.

SMP6 – Benthic Habitats	
Termination criteria	<p><u>Benthic habitat cover and composition</u></p> <p>Cover and composition of benthic habitats are not statistically significantly different from that of their baseline state (where baseline data exists) or are not statistically significantly different from comparable non-impacted assemblages.</p> <p><u>Coral health and reproduction</u></p> <p>Hydrocarbon concentration in corals, reproductive state and settlement indices are not statistically different from the baseline state (where baseline data exists) or from comparable non-impacted assemblages.</p>
Receptor impact	<p>Impact to benthic habitats from pressures including hydrocarbons is measured through change in:</p> <ul style="list-style-type: none"> + Species diversity + Assemblage composition + Percent cover. <p>Other pressures to these states are:</p> <ul style="list-style-type: none"> + Physical disturbance + Discharge of toxicants + Introduction of marine pests + Shading + Climate change.
Methodological approach	<p>Monitoring design will be as follows:</p> <ol style="list-style-type: none"> 1. Where long-term baseline data sites are contacted, a control chart (time-series) design will be applied. 2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 3. Where no baseline data sites are involved, a gradient approach to quantifying impacts will be applied (See Appendix B for detailed description of these approaches and Figure 1). <p><u>Benthic Habitat Cover and Composition</u></p> <p>Field survey methodology will be based upon acquiring repeat digital imagery (video or still images) of benthic habitats along random transects (preferable), using a stratified sampling approach at each site to target different habitat types and depths where clear gradients in these conditions exist. Site selection and image acquisition methodology will aim to align applicable baseline studies where these exist, such that imagery is comparable.</p> <p>The number of sites and frequency of sampling will depend upon the sampling design philosophy.</p>

SMP6 – Benthic Habitats	
	<p>Divers, towed video or remotely operated vehicles (ROVs) will be employed to collect imagery considering safety aspects and the depth of water at survey locations.</p> <p>Where divers are employed, fish species may also be recorded where practicable (for example following methodologies employed by Babcock et al. (2008) to contribute to SMP11.</p> <p><u>Coral Health and Reproduction</u></p> <p>Using divers, selected coral colonies will have tissue samples removed for the purpose of laboratory analysis of the concentration of accumulated hydrocarbons and for determining reproductive state, noting sampling for reproductive state will be dependent upon the timing of coral spawning. Reproductive state will be determined from measures of gamete size, stage and fecundity determined from in-field examination and laboratory analysis of histological samples.</p> <p>In addition to the standard suite of ecotoxicology testing done on the released hydrocarbon as part of the Operational Monitoring Program, ecotoxicology testing of the released hydrocarbon on the larval competency of representative coral species will be conducted.</p> <p>Settlement plates will be deployed to monitor settlement of coral recruits following spawning periods to ascertain the level of coral recruitment at impacted and non-impacted sites.</p>
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	<ul style="list-style-type: none"> + Senior Marine Scientist with experience in benthic habitat assessment + Supporting Scientist + Divers or ROV operators + GIS personnel + Available vessel in operation + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby + Diving equipment or ROVs + Video recording facilities + Satellite imagery
Implementation	<p>Service provider is to be able to mobilise within 72 hours of the SoW being approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site).</p> <p>Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.</p>

SMP6 – Benthic Habitats	
Analysis and reporting	<p>Digital imagery will be analysed using a point-count technique (using software such as AVTAS, Coral Point Count with Excel extensions (CPCe) or TransectMeasure (SeaGIS)) to estimate the percentage cover of biotic and abiotic categories (in line with the CATAMI classification scheme) comprising the benthic habitat. Biotic categories to include the following as applicable: corals; macroalgae and seagrass; and non-coral benthic filter feeders.</p> <p>Live, dead and bleached coral cover shall be recorded. The imagery collected will allow for the determination of percent cover, abundance, measurement of size (if scaling lasers are included in the image) and a visual assessment of health (Kohler and Gill 2006).</p> <p>NATA accredited laboratory analysis to determine the concentration of hydrocarbons within coral tissue.</p> <p>Reproductive output to be determined by complementary means, including in-field and laboratory analysis of gametes, including microscopic examination of histological samples preserved in the field.</p> <p>Coral larval competency tests to be conducted by ecotoxicological laboratory in addition to standard suite of ecotoxicological tests using released hydrocarbon.</p> <p>Data will be entered to spatially explicit database and analysed to determine significant differences between impacted and non-impacted assemblages. Data and conclusions will be summarised in an environmental report card provided as part of report.</p> <p>Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.</p>

SMP7 – Seabirds and Shorebirds	
Rationale	<p>Marine waters and coastal habitats in the EMBA contain key habitats that are important to birds, including offshore islands, sandy beaches, tidal flats, mangroves and coastal and pelagic waters. These habitats support a variety of birds which utilise the area in different ways and at different times of the year. Birds can be broadly grouped according to their preferred foraging habitat as coastal/ terrestrial birds, seabirds and shorebirds, both migratory and resident. For the purposes of this document, seabirds and shorebirds are defined as:</p> <ul style="list-style-type: none"> + shorebirds – those birds that inhabit and feed in the intertidal zone and adjacent areas and are resident or migratory, using the area principally during the austral summer. + seabirds – those birds associated with the sea and deriving most of their food from it, and typically breeding colonially, including the marine raptors osprey and white-bellied sea eagle.
Aim	Quantify seabirds and shorebirds, in the spill and response areas.

SMP7 – Seabirds and Shorebirds	
	<p>Quantify lethal and/or sub-lethal impacts of hydrocarbon spill exposure on seabirds and shorebirds.</p> <p>Monitor changes in seabird populations (reproductive success) in relation to the hydrocarbon spill and clean-up activities.</p>
Baseline	<p>Refer to the Baseline Data Review (Astron Environmental Services 2021) (SO-91-RF-20022 Rev 0).</p> <p>The Oil Spill Response Atlas (Australian Maritime Safety Authority (AMSA)), National Conservation Values Atlas (Department of Agriculture, Water and the Environment (DAWE) (http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf) and any local oiled wildlife response plans should also be consulted.</p>
Initiation criteria	<p>Operational monitoring indicates that known foraging, roosting or nesting areas for seabirds and/or shorebirds has been contacted, or are predicted to be contacted, by a hydrocarbon spill; OR</p> <p>Operational monitoring indicates that seabirds and shorebirds have been contacted, or are predicted to be contacted, by a hydrocarbon spill as defined in Table 1.</p>
Termination criteria	<p>Detectable levels of hydrocarbons attributable to the hydrocarbon spill are not present in seabird and shorebird tissues; AND</p> <p>Measured variables are not statistically significantly different from their baseline or pre-spill state (where these data exist) or from measured variables at non-impacted sites; AND</p> <p>Monitoring is terminated in consultation with the relevant environmental authority (relevant regional authority and/or DAWE).</p>
Receptor impact	<p>Impact to seabirds and shorebirds from pressures including hydrocarbons is measured through change in:</p> <ul style="list-style-type: none"> + Species diversity + Bird abundance + Health/condition + Breeding success (resident species only). <p>Other pressures to these states are:</p> <ul style="list-style-type: none"> + Physical disturbance of foraging and nesting habitat + Accidental chemical spillage + Entanglement in litter + Displacement by less favourable species (e.g. Silver Gull) + Predation + Climate change.

SMP7 – Seabirds and Shorebirds	
Methodological approach	<p>Monitoring design will be as follows:</p> <ol style="list-style-type: none"> 1. Where long-term baseline data sites are contacted a control chart (time-series) design will be applied. 2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. Given the ease of survey establishment, post-spill pre-impact monitoring will be attempted wherever practicable in order to established pre-impact state. 3. Where no baseline data sites are involved a gradient approach to quantifying impacts will be applied (See Appendix B for detailed description of these approaches and Figure 1, detailed in Baseline Data Review (Astron Environmental Services 2019) (QE-00-BI-20001)). <p>Monitoring for seabirds and shorebirds will measure abundance and diversity in key foraging/roosting areas with the timing of surveys to coincide with seasonal peaks in abundance.</p> <p>The seabird and shorebird roost count monitoring will follow current accepted survey methodology, such as Birdlife Australia’s Australian Shorebird Monitoring Program and survey guidelines standardised by the DAWE (Department of the Environment and Energy 2017).</p> <p>Monitoring of seabirds to focus on nesting (burrow) density, breeding participation and breeding success, taking measurements of the number of adults, eggs and chicks with the timing of surveys to allow assessments immediately after egg laying and immediately prior to chick fledging.</p> <p>Bird mortality to be recorded during monitoring of seabirds and shorebirds with tissue samples taken from dead birds for hydrocarbon analysis in the laboratory.</p> <p>Necroscopies will follow the process of Gagnon and Rawson (2010).</p>
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	<ul style="list-style-type: none"> + Experienced seabird biologist + Experienced shorebird biologist + Personnel with pathology or veterinary skills + NATA accredited laboratory for sample analysis and necropsy + Available vessel and tender in operation + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider able to mobilise within 72 hours of the scope of work having been provided to them (this time allowing for costing, preparation of equipment and disposables and travel to site).

SMP7 – Seabirds and Shorebirds	
	Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	<p>Data will be entered to spatially explicit database and analysed in order to determine significant differences between impacted and non-impacted assemblages. Data and conclusions will be summarised in an environmental report card.</p> <p>Draft annual report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.</p>

SMP8 – Marine Mammals	
Rationale	At least 11 species of listed marine mammals are known to, or are thought to occur, in Australian waters within the environment that may be affected. These include cetaceans (whales and dolphins) and sirenians (dugong). Effects to marine megafauna due to presence of surface oil, entrained oil and dissolved aromatic hydrocarbons may include behavioural (e.g. deviation from migratory routes), physiological (e.g. disruption to digestion) or physical effects. Given large spatial variation in occurrence and broad scale movement, population estimates, and associated change are not often available. This plan will focus on assessing the extent of impacts to animals within the region, and where possible, the level of recovery. This will then be used to deduce potential impacts at a population level.
Aim	To monitor short and long-term environmental effects on marine mammals that may have resulted from the hydrocarbon spill and associated response.
Baseline	<p>Refer to the Baseline Data Review (Astron Environmental Services 2021) (SO-91-RF-20022 Rev 0).</p> <p>The Oil Spill Response Atlas (Australian Maritime Safety Authority (AMSA)), National Conservation Values Atlas (DAWE -http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf) and local oiled wildlife response plans should also be consulted.</p>
Initiation criteria	Operational monitoring indicates that marine mammals are contacted or predicted to be contacted by a hydrocarbon spill as defined in Table 1 .
Termination criteria	<p>Restoration or resumption of key biological processes (e.g. abundance, distribution, breeding) necessary to ensure post-impact recovery is demonstrated. Specific criteria to be developed by Marine Scientist(s) with expertise in marine mammals of the region; AND</p> <p>No further instances of dead marine mammals with detectable levels of hydrocarbons attributable to the hydrocarbon spill; AND</p> <p>Monitoring is terminated in consultation with the relevant environmental authority (relevant regional authority and/or DAWE).</p>

SMP8 – Marine Mammals	
Receptor impact	<p>Impact to marine mammals from pressures including hydrocarbons is measured through observed injury and mortality.</p> <p>Other pressures to these states are:</p> <ul style="list-style-type: none"> + Physical disturbance + Entanglement in fishing gear and litter + Accidental chemical spillage + Climate change + Over-exploitation.
Methodological approach	<p>Aerial and marine surveys will be implemented to identify individuals in proximity of the spill and to quantify damage:</p> <ul style="list-style-type: none"> + Aerial surveys will follow the protocols of Hedley et al. (2011), Appendix C8 + Marine surveys will follow the protocols of Watson et al. (2009), Appendix C8 <p>Tissue sampling of dead or injured animals will follow the protocols of:</p> <ul style="list-style-type: none"> + Department of Environment and Heritage (DEH) (2006) (Cetaceans) + Eros et al. (2000) (Dugongs).
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	<p>Aerial survey</p> <ul style="list-style-type: none"> + Senior Marine Scientist + Trained marine wildlife observers x 2 + Fixed wing aircraft (incl. pilot/s) + Refuelling facilities <p>Vessel-based survey</p> <ul style="list-style-type: none"> + Senior Marine Scientist + Trained marine wildlife observers x 2 + Personnel with pathology or veterinary skills + NATA accredited laboratory for sample analysis and necropsy + Available vessel in operation + Sample container and preservative + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby

SMP8 – Marine Mammals	
Implementation	<p>Service provider able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site).</p> <p>Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.</p>
Analysis and reporting	<p>Data will be entered to spatially explicit database. Data and conclusions will be summarised in an environmental report card.</p> <p>Statistical power related to these receptors is likely to be low, due to observational data and small sample sizes. Therefore, the assessment of quantified impacts will be corroborated with marine scientist(s) with expertise in relevant fauna.</p> <p>Draft annual report to be prepared within one month of annual monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.</p>

SMP9 – Marine Reptiles	
Rationale	<p>At least 10 species of listed marine reptiles are known to, or are thought to occur, in Australian waters within the environment that may be affected. This includes six species of marine turtle that occur in, use the waters, and nest on sandy beaches, two species of sea snake and one species of estuarine crocodile found in most major rivers systems of the Kimberley region and in the Northern Territory. Impacts to marine reptiles due to presence of surface oil, entrained oil and dissolved aromatic hydrocarbons may include behavioural, physiological (e.g. disruption to digestion) or physical effects.</p>
Aim	<p>To observe and quantify the presence of marine reptiles in the spill and response areas, and broader regional areas.</p> <p>To assess and quantify lethal impacts or sub-lethal impacts of this exposure or interactions.</p> <p>To monitor changes in marine reptile populations in relation to an oil spill and associated activities.</p>
Baseline	<p>Refer to the Baseline Data Review (Astron Environmental Services 2021) (SO-91-RF-20022 Rev 0).</p> <p>The Oil Spill Response Atlas (Australian Maritime Safety Authority (AMSA)), National Conservation Values Atlas (DAWE -http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf) and local oiled wildlife response plans should also be consulted.</p>
Initiation criteria	<p>Operational monitoring indicates that marine reptiles or nesting sites are contacted or likely to be contacted by a hydrocarbon spill; OR</p> <p>Operational monitoring indicates that marine reptiles are contacted, or are predicted to be contacted, by a hydrocarbon spill as defined in Table 1.</p>

SMP9 – Marine Reptiles	
Termination criteria	<p>Detectable levels of hydrocarbons attributable to the hydrocarbon spill are no longer present in marine reptile tissues collected from live or dead individuals; AND</p> <p>In the event that an impact attributable to the hydrocarbon spill is detected on marine reptiles, the measured parameters are not statistically significantly different from their baseline or pre-spill state (where these data exist) or from measured parameters at non impacted sites; AND</p> <p>Monitoring is terminated in consultation with the relevant environmental authority (relevant regional authority and/or DAWE).</p>
Receptor impact	<p>Impact to marine reptiles from pressures including hydrocarbons is measured through change in:</p> <ul style="list-style-type: none"> + Abundance + Health/condition + Nesting success (turtles and crocodiles). <p>Impact to other marine reptiles from pressures including hydrocarbons is measured through change in observed injury and condition.</p> <p>Other pressures to these states are:</p> <ul style="list-style-type: none"> + Lighting and flares causing disorientation (turtles) + Vessel strike + Physical disturbance of nesting sites + Predation + Entanglement in fishing gear and litter + Accidental chemical spillage + Habitat loss or change due to dredging + Climate change + Over-exploitation.
Methodological approach	<p>Abundance</p> <p>In-water impacts – aerial surveys.</p> <p>Shoreline impacts – ground surveys (either rapid census survey or tagging program).</p> <p>Health/condition</p> <p>In-water impacts – vessel surveys (collecting observations on animal condition and collection of tissue samples or dead specimens for analysis).</p> <p>Shoreline impacts – ground surveys (collecting observations on animal condition and collection of tissue samples or dead specimens for analysis).</p> <p>Dead reptiles will be collected for autopsy following Gagnon (2009).</p>

SMP9 – Marine Reptiles	
	<p>Reproductive success</p> <p>Shoreline impacts – ground surveys (detailed tagging and/or nesting success studies).</p> <p>Design of ground surveys will be applied as follows:</p> <ol style="list-style-type: none"> 1. Where long-term baseline data sites are contacted a control chart (time-series) design will be applied. 2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 3. Where no baseline data sites are involved, and timing allows, a post spill pre-impact approach will be attempted. 4. If a post-spill pre-impact approach is not practicable, a gradient approach to quantifying impacts will be applied
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	<p>Aerial survey</p> <ul style="list-style-type: none"> + Senior marine scientist + Trained marine wildlife observers x 2 + Fixed wing aircraft (incl. pilot/s) + Refuelling facilities <p>Vessel-based Survey</p> <ul style="list-style-type: none"> + Senior Marine Scientist + Trained marine wildlife observers x 2 + Personnel with pathology or veterinary skills + NATA accredited laboratory for sample analysis and necropsy + Available vessel in operation + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	<p>Service provider to be able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site).</p> <p>Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.</p>
Analysis and reporting	Data will be entered to spatially explicit database. Turtle data will be analysed in order to test for significant differences between impacted and non-impacted assemblages. Data and conclusions will be summarised in an environmental report card.

SMP9 – Marine Reptiles	
	<p>Owing to their observational nature and potentially low sample size, observed impacts to other reptile fauna will be corroborated with marine scientist(s) with expertise in relevant fauna for the region.</p> <p>Draft annual report to be prepared within one month of annual monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.</p>

SMP10 – Seafood Quality	
Rationale	Exposure of commercial and recreationally targeted demersal and pelagic fish species to entrained and dissolved aromatic hydrocarbons can cause flesh tainting and increase the levels of toxicants above human consumption guidelines. Aromatic hydrocarbons are carcinogenic to humans. This scope includes finfish, sharks and invertebrates (principally crustacea).
Aim	To identify potential human health risks due to the presence of hydrocarbon concentrations in the flesh of targeted seafood species for consumption.
Baseline	<p>Refer to the Baseline Data Review (Astron Environmental Services 2021) (SO-91-RF-20022 Rev 0).</p> <p>Human health benchmarks relating to the exposure of PAHs shall be used to determine health effects as per Yender et al. (2002).</p> <p>Flesh samples from non-impacted sites to be used as baseline for olfactory analysis for flesh taint.</p>
Initiation criteria	+ Operational monitoring and results from SMP1 predict or observes contact of oil to target species for consumption as defined in Table 1 .
Termination criteria	<p>The following termination criteria will be adopted in consultation with responsible fisheries and human health agencies.</p> <p>Hydrocarbon concentrations in seafood tissues are not above levels considered a human health risk; AND</p> <p>Flesh taint is not detected from olfactory testing of seafood samples; AND</p> <p>Target species are no longer exposed to hydrocarbons in the water column.</p>
Receptor impact	<p>Impact to seafood quality from hydrocarbons is measured through change in:</p> <ul style="list-style-type: none"> + Toxicity indicators + Olfactory taint. <p>Other pressures to these states are:</p> <ul style="list-style-type: none"> + Accidental chemical spillage + Disease.

SMP10 – Seafood Quality	
Methodological approach	<p>Target fish species determined from water quality monitoring results and relevant and available commercial and recreational-fished species.</p> <p>Sampling of target species will follow a gradient design (Gagnon and Rawson 2012) ranging from impacted to non-impacted (or non-suspect) catches using commercial and recreational fishing techniques undertaken by commercial and recreational fishers. Sampling method (netting, trawling, baited fish traps, spear fishing, line fishing) will be determined by habitat, target species and spill location.</p> <p>If more than one target species is affected, replicate samples of each species shall be collected, with a minimum of five replicate samples.</p> <p>Olfactory testing will follow Rawson et al. (Rawson et al. 2011) in Appendix C10, following the duo-trio method (Standards Australia 2005).</p>
Scope of work	Prepared by monitoring provider for issue within 24 hours of this SMP being activated.
Resources	<ul style="list-style-type: none"> + Senior marine scientist + Marine vessel + Sample containers and preservative + NATA accredited laboratory for sample analysis + Decontamination/washing facilities
Implementation	<p>Service provider to be able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site).</p> <p>Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.</p>
Analysis and reporting	<p>Laboratories will be NATA-accredited for food standards analyses. Data will be stored in spatially explicit database and analysed to test for significant differences between impacted and non-impacted seafood.</p> <p>Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.</p>

SMP11 – Fish, Fisheries and Aquaculture	
Rationale	<p>Impacts to fisheries species due to presence of entrained hydrocarbons may include lethal and sub-lethal physiological effects (e.g. reduced growth) and physical effects. The region comprises the Indo-West Pacific area which consists of a high diversity of fish species and assemblages and provides important spawning and nursery grounds for several fisheries species. Fish are concentrated in a number of biodiversity hotspots. The environment is also conducive to aquaculture including pearl production. Fisheries species that spawn or</p>

SMP11 – Fish, Fisheries and Aquaculture	
	inhabit near shore areas face a greater risk to an oil spill than finfish found in deeper waters.
Aim	<p>To monitor changes in structure and distribution of fish assemblages in relation to an oil spill and associated activities.</p> <p>To monitor the effect of hydrocarbon exposure and physiological condition on fisheries and aquaculture species.</p>
Baseline	<p>Refer to the Baseline Data Review (Astron Environmental Services 2021) (SO-91-RF-20022 Rev 0).</p> <p>In addition, available relevant survey databases shall be reviewed for applicable baseline data.</p>
Initiation criteria	+ Operational monitoring indicates fish, fisheries or aquaculture are contacted or likely to be contacted by a hydrocarbon spill as defined in Table 1.
Termination criteria	<p>Fish assemblages are not statistically significantly different than those of baseline or similar non-impacted assemblages; AND</p> <p>Hydrocarbon concentrations, physiological condition indices, and biomarker levels in affected fish and aquaculture species are not statistically significantly different from those of non-impacted samples; AND</p> <p>Termination of monitoring is done in consultation with the responsible fisheries agencies.</p>
Receptor impact	<p>Impact to fish, fisheries and aquaculture from pressures including hydrocarbon concentrations is measured through change in:</p> <ul style="list-style-type: none"> + Species diversity + Abundance of indicator taxa + Assemblage structure + Health. <p>Other pressures to these states are:</p> <ul style="list-style-type: none"> + Accidental chemical spillage + Overfishing + Introduction of marine pests + Habitat disturbance + Climate change.
Methodological approach	Fish assemblages will be assessed using the stereo-baited remote underwater videos (BRUVs) following Shortis et al. (2009), Appendix C11 . Fish assemblages will be randomly sampled within discrete habitats at cross-shelf impact areas and non-impact areas.

SMP11 – Fish, Fisheries and Aquaculture	
	<p>Sampling design for fish assemblages will be as follows:</p> <ol style="list-style-type: none"> 1. Where long-term baseline data sites are contacted a control chart (time-series) design will be applied. 2. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 3. If baseline data is not available, a gradient approach to quantifying impacts will be applied (See Appendix B for detailed description of these approaches and Figure 1). <p>Where relevant, data available from responsible fisheries agencies including catch/effort data, will be assessed to determine potential changes from baseline levels in fishing grounds potentially affected by an oil spill compared to after the event.</p> <p>For fish and aquaculture species potentially exposed to an oil spill, species will be sampled across the contamination gradient as per Gagnon and Rawson (2012).</p> <p>Hydrocarbon concentrations (particularly PAH) within tissues of fish and aquaculture species will be determined. Exposure to hydrocarbons on fish health will also be determine through analysis of physiological indices and biochemical markers following Gagnon and Rawson (2012).</p> <p>If fish kills are observed, whole specimens will be obtained and preserved (frozen) for necropsy to determine the cause of death.</p>
Scope of work	Prepared by monitoring provider for issue within 24 hours of this SMP being activated.
Resources	<ul style="list-style-type: none"> + Senior marine scientist + Marine scientist trained in fish identification and necropsy + Marine scientist with BRUV experience + NATA accredited laboratory for sample analysis + Available vessel and tender in operation + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby + Resources to analyse BRUV data.
Implementation	<p>Service provider to be able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site).</p> <p>Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.</p>
Analysis and reporting	<p>BRUV imagery will be processed using EventMeasure (SeaGIS) software.</p> <p>NATA-accredited laboratories will be employed for health analyses.</p> <p>Data will be entered to spatially explicit database and analysed to test for statistically significant differences between non-impacted and impacted fish assemblages.</p>

SMP11 – Fish, Fisheries and Aquaculture	
	<p>Data and conclusions will be summarised in an environmental report card.</p> <p>Final draft report to be prepared within one month of monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.</p>

SMP12 – Whale Sharks	
Rationale	<p>The whale shark (<i>Rhincodon typus</i>) is known to occur within the region. One of the best known aggregation sites occurs along the central and north-west coast of Western Australia from March to July. Whale sharks are also known to be highly migratory and a biologically important area for foraging extending into the Kimberley region of Western Australia also overlaps with the environment that may be affected. Effects to the whale shark due to presence of surface oil, entrained oil and dissolved aromatic hydrocarbons may include behavioural (e.g. deviation from migratory routes), physiological (e.g. disruption to digestion) or physical effects. Given large spatial variation in occurrence and broad scale movement, population estimates and associated change are not often available. This plan will focus on assessing the extent of impacts to animals within the region, and where possible, the level of recovery. This will then be used to deduce potential impacts at a population level.</p>
Aim	To quantify impacts of an oil spill on whale sharks within Biologically Important Areas (BIAs) along the north-west and north Western Australian coastline.
Baseline	<p>Refer to the Baseline Data Review (Astron Environmental Services 2021) (SO-91-RF-20022 Rev 0).</p> <p>The Oil Spill Response Atlas (Australian Maritime Safety Authority (AMSA)), National Conservation Values Atlas (DAWE -http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf) and Pilbara Region Oiled Wildlife Response Plan (Department of Parks and Wildlife and Australian Marine Oil Spill Centre 2014) should also be consulted.</p>
Initiation criteria	Operational monitoring indicates that whale shark aggregations are contacted or likely to be contacted by a hydrocarbon spill as defined in Table 1 .
Termination criteria	<p>Measured parameters of whale shark abundance and distribution are not significantly different to baseline levels; AND</p> <p>The water quality at feeding/aggregation sites has been measured as not significantly different to baseline levels.</p>
Receptor impact	<p>Impact to whale sharks from pressures including hydrocarbons is measured through observed injury and mortality.</p> <p>Other pressures to these states are:</p> <ul style="list-style-type: none"> + Intentional and unintentional mortality from fishing outside Australian waters

SMP12 – Whale Sharks	
	<ul style="list-style-type: none"> + Boat strike + Habitat disruption from mineral exploration, production and transportation + Marine debris + Climate change.
Methodological approach	<p>During spill activities may require the following surveys and sampling:</p> <ul style="list-style-type: none"> + Aerial surveys + Satellite tagging + Toxicology + Food chain studies + Photo-identification + Vessel and plane logs + Acoustic tagging. <p>The methodologies adopted will follow the approaches of those baseline studies identified allowing consistency of data from baseline to impact and recovery phases.</p>
Scope of work	Prepared by monitoring provider for issue within 24 hours of this SMP being activated.
Resources	<ul style="list-style-type: none"> + Senior marine scientist + Trained marine wildlife observers x 2 + Fixed wing aircraft (incl. pilot/s) + Refuelling facilities + Personnel with pathology or veterinary skills + NATA accredited laboratory for sample analysis + Available vessel and tender in operation + Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	<p>Service provider to be able to mobilise within 72 hours of the scope of work having been approved by Santos (this time allowing for costing, preparation of equipment and disposables and travel to site).</p> <p>Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.</p>
Analysis and reporting	Draft annual report to be prepared within one month of annual monitoring completion; external peer review of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

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Appendix O: SMP activation process

Oil Spill Operational and Scientific Monitoring Activation Form

Instructions

In the event of a spill requiring a response from Astron follow these steps:

- 1. Activate a response – call 1300 902 700**
- 2. Immediately complete this Activation Form and email to spillresponse@astron.com.au**

You will receive a call back from the Monitoring Coordinator within 30 minutes. In the event that a call back is not received, please call 1300 902 700 again.

Note: If new information should become available after submitting this form, or the situation changes, please advise the Astron Monitoring Coordinator as soon as possible.

Section 1: Contact Details

Name of notifying person		
Position in Incident Command Team		
Direct phone		
Mobile		
Email address		
Command centre location		
Command centre direct phone		
Date and time of notification	Click here to enter a date.	Enter time, i.e. 1400 WST

Section 2: Spill Details

Date and time of spill	Click here to enter a date.	Enter time, i.e. 1400 WST	
Spill source location (GDA94, MGA Zone 50)	Insert coordinates in GDA94 MGA Zone 50 format (easting and northing).		
	Insert location description		
Source of spill			
Cause of spill (if known)			
Status of spill	<input type="checkbox"/> Secured <input type="checkbox"/> Uncontrolled <input type="checkbox"/> Unknown		
Release rate	Instantaneous release	<div style="text-align: right;">State units</div>	
	OR		
	Continuous release	<div style="text-align: center;">per hour for</div> <input type="checkbox"/> Hours <input type="checkbox"/> Days	
Description of spill	Estimated quantity	<div style="text-align: right;">State units</div>	
	Incident tier		<input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3
	Direction of travel		
	Trajectory		
Modelling provider log in details			

Oil Spill Operational and Scientific Monitoring Activation Form

Section 3: OMP/SMP activation

SMPs to be activated.

Where there is doubt whether an SMP should be activated the SMP should be selected. Refer to the Oil Spill Scientific Monitoring Plan (EA-00-RI-10099) for initiation criteria for SMPS.

- SMP1 – Water quality
 - Operational water quality monitoring
- SMP2 – Sediment quality
- SMP3 – Sandy beaches and rocky shores
- SMP4 – Mangroves
- SMP5 – Intertidal mudflats
- SMP6 – Benthic habitats
- SMP7 – Seabirds and shorebirds
- SMP8 – Marine megafauna
- SMP9 – Marine reptiles
- SMP10 – Seafood quality
- SMP11 – Fish, fisheries and aquaculture
- Yet to be determined
- Other: _____

Section 4: Safety

Detail any known safety or security risks

Section 5: Approval

I authorise the activation of a response by Astron Environmental Services Pty Ltd in connection with the above incident under the terms of Contract # [insert contract].

Signature:

Date and Time:

Activate Our Team

In the event of a spill requiring scientific monitoring response call:

1300 902 700

Advise the operator:

- 1. Your company**
- 2. Your name and contact number**
- 3. Brief reason for call (i.e. Exercise or Spill)**

A message will be relayed to our team to call you back.



Provide additional details as requested by the Monitoring Coordinator on call-back



Complete and submit the
Activation Form



Astron initiates Oil Spill Scientific Monitoring Activation & Response Process
– refer to next page

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Oil Spill Scientific Monitoring - Standby and Response Manual, April 2020

Oil Spill Scientific Monitoring Activation and Response Process

Step	Responsibility	Action	Timeframe [#]	Resources	Date/Time Complete
Phase 1 – Activation					
1	Santos IMT (Environmental Team Leader (ETL))	Astron Monitoring Coordinator notified of incident.	On approval from Santos Incident Commander	Astron oil spill response phone number and answering service	
2	Astron Monitoring Coordinator (MC)	Call back client for further details, request <i>Activation Form</i> if not received.	Within 30 minutes of receiving initial notification	Activation Form	
3	Astron MC	Call Planning & Logistics Officer to advise of incident.	Immediately following Step 2	n/a	
4	Santos IMT (ETL)	Complete <i>Activation Form</i> and submit to Astron via email.	Within one hour following initial notification (Step 2)	Activation Form	
5	Astron Planning & Logistics Officer (PLO)	Notify MCT, Technical Advisors and key subcontractors via SMS Global.	Within 30 minutes of Step 3	SMS Global Guidance	
6	Astron PLO	Notify all staff of incident via SMS Global.	Within one hour of receiving Activation Form	SMS Global Guidance	
Phase 2 – Response Planning					
7	Astron MC	Maintain verbal communication with Santos IMT (ETL).	At least twice daily (0800 and 1700)	n/a	

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Oil Spill Scientific Monitoring - Standby and Response Manual, April 2020

Step	Responsibility	Action	Timeframe [#]	Resources	Date/Time Complete
8	Astron MC Astron Operations Officer Astron PLO	Maintain Functional Log.	Daily	Functional Log	
9	Astron PLO	Set up Command Room.	Within 4 hours of activation (Step 5)	Command Room Resource Checklist	
10	Astron MC, PLO and BMT Oceanica Operations Officer	Attend Santos incident briefing and relay information to MCT.	As advised by the Santos IMT (ETL)	n/a	
11	Astron Operations Officer	MCT and Technical Advisors to meet at Royal St office, review personnel and equipment resource status.	Within 6 hours of activation (Step 5)	Capability report Training matrix Resource chart	
12	Astron PLO	Confirm availability of additional personnel and equipment resources.	Within 16 hours of activation (Step 5)	External Supplier Details Requisition Request Form	
13	Santos IMT (ETL)	Provide spill trajectory modelling and sensitive receptor information to Astron.	When available	APASA modelling Department of Transport database Santos GIS Mapping	
14	Astron MC in consultation with Santos ETL	Define the scale of response - identify which SMPs are activated. Identify if operational water quality monitoring is required.	Within 2 hours of receiving spill and receptor information (Step 13).	Scientific Monitoring Plan * Relevant OPEP Spill trajectory modelling Operational monitoring results	

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Oil Spill Scientific Monitoring - Standby and Response Manual, April 2020

Step	Responsibility	Action	Timeframe [#]	Resources	Date/Time Complete
15	Astron Technical Advisors in consultation with Santos ETL	<p>Determine monitoring locations for activated SMPs:</p> <ul style="list-style-type: none"> • Identify monitoring locations in order of priority for activated SMPs based on: <ul style="list-style-type: none"> o nature of hydrocarbon spill o spill trajectory modelling and time to shoreline impacts o sensitive receptors impacted or potentially at risk of being impacted o state of current baseline data o current environmental conditions o current results of operational monitoring. • Determine if post-spill pre-impact data is required to be collected from any locations. See SMP Work Method Statements for decision making process when considering availability of baseline data. 	Within 6 hrs of relevant SMP activation (Step 14).	<p>Relevant SMPs</p> <p>Information from Astron:</p> <ul style="list-style-type: none"> • baseline information for relevant receptors. <p>Information from Santos IMT:</p> <ul style="list-style-type: none"> • sensitive receptor information (including relevant conservation/management plans) from relevant EP, Santos GIS mapping and online resources (DoT oil spill response atlas, DoE conservation values atlas, DoE species profile and threats database) • oil spill trajectory modelling • response strategies and priority protection areas • results from OMPs currently activated • baseline information for relevant receptors as reference in the relevant SMP. 	
16	Astron Technical Advisors in consultation with Santos ETL	Submit Department of Parks and Wildlife Licence applications	Within 12 hrs of relevant SMP activation (Step 14)	<ul style="list-style-type: none"> • Proposed monitoring locations • SMP methods 	

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Step	Responsibility	Action	Timeframe [#]	Resources	Date/Time Complete
17	Astron Operations Officer, PLO & Technical Advisors in consultation with Santos ETL	<p>Determine personnel requirements:</p> <ul style="list-style-type: none"> • Identify number and competencies of personnel required for monitoring teams for each SMP based on: <ul style="list-style-type: none"> o activated SMPs o number of locations to be monitored o number of locations where pre-spill baseline data needs to be collected o timing of hydrocarbon spill and overlap with sensitive receptors in activated SMPs o logistical and equipment resource constraints. • Arrange additional personnel if required. 	Within 12 hrs of activation if pre-impact data is needed.**	<p>Information from Astron:</p> <ul style="list-style-type: none"> • Capability report • Training matrix • Resource chart • relevant SMPs and WMS. <p>Information from Santos IMT:</p> <ul style="list-style-type: none"> • sensitive receptor information • oil spill trajectory modelling • response strategies and priority protection areas • equipment (i.e. vessels, aircraft) availability • logistics (availability of flights, accommodation, etc). 	
18	Astron Operations Officer, PLO & Technical Advisors in consultation with Santos ETL	<p>Determine equipment requirements:</p> <ul style="list-style-type: none"> • Identify number and competencies of equipment required for each SMP based on: <ul style="list-style-type: none"> o activated SMPs o number of locations to be monitored o number of field teams and timing of mobilisation to the field o logistical and equipment resource constraints. • Arrange additional equipment resources if required. 	Within 12 hrs of activation if pre-impact data is needed.**	<p>Information from Astron:</p> <ul style="list-style-type: none"> • Resource chart • relevant SMPs and WMS. <p>Information from Santos IMT:</p> <ul style="list-style-type: none"> • equipment (i.e. vessels, aircraft) availability • logistics (availability of flights, accommodation, etc). 	

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Step	Responsibility	Action	Timeframe [#]	Resources	Date/Time Complete
19	Astron MC, Operations Officer, PLO & Technical Advisors	<p>Prepare and submit Monitoring Action Plan (mission, objectives, strategies, tactics, tasks), including scope of works.</p> <p>Prepare and submit cost estimate.</p> <p>Prepare and submit logistics request:</p> <ul style="list-style-type: none"> Allocate personnel and equipment resources to field teams for relevant SMPs. Submit SOW and logistics request for each activated SMP to Santos IMT for approval. 	Within 24hrs of request for SoW (Step 15) for relevant SMP if pre-impact data is needed.**	<p>Information from Astron:</p> <ul style="list-style-type: none"> Resource chart relevant SMPs and WMS agreed monitoring locations Mobilisation and Logistics Form (incorporating SOW) Monitoring Action Plan. <p>Information from Santos IMT:</p> <ul style="list-style-type: none"> request for SoW agreed monitoring locations. 	
20	Santos IMT (ETL)	Santos to approve SOW, provide purchase order and initiate logistical arrangements.	Within 24 hours of SOW submission (Step 19).	Astron Mobilisation and Logistics Request	
21	Astron MC	Advise field personnel by email meeting invite, or phone if not in office.	Within 24 hours of SOW approval (Step 20).	Field team allocation	
22	Astron	Conduct incident briefing with all available Astron personnel.	Within 24 hours of SOW approval (Step 22).	Briefing template Monitoring Action Plan	
Phase 3 – Mobilisation					
24	Astron PLO	GIS and device preparation requests (field maps, data capture) submitted, and discussed with Geospatial team.	Within 24 hours of SOW approval (Step 22).	https://voyager/	
25	Astron Operations Officer	Conduct field team overview briefing, allocate tasks.	Within 36 hours of SOW approval (Step 22).	Briefing Template	

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Step	Responsibility	Action	Timeframe [#]	Resources	Date/Time Complete
26	Field Team Leaders	Compile SMP grab packs, GIS information, field equipment, and prepare and submit HSE documentation to Santos IMT.	Within 48 hours of SOW approval (Step 22).	Information from Astron <ul style="list-style-type: none"> • SoW • Grab packs, SMP WMS and HSE documentation • GIS information/field maps • field equipment. Information from Santos IMT: <ul style="list-style-type: none"> • booking and logistics confirmations. 	
27	Astron Technical Advisors	Conduct scope specific pre-mobilisation briefings.	Prior to mobilisation.	Pre-mob Briefing Template	
28	Santos ETL	Santos to approve HSE plan.	Within 24 hours of receiving HSE Plan.	Mobilisation and Logistics Form HSE plan	
29	Astron PLO	Personnel mobilised to site.	Within 72 hrs of SOW approval (Step 22) if pre-impact data is needed.**	Approved SOW	
Phase 4 – Response Operations					
30	Astron MC	Conduct Monitoring Action Plan review with MCT and Technical Advisors and communicate to Santos IMT (ETL).	Daily	Monitoring Action Plan template	
31	Astron PLO	Hold post-demobilisation debrief with field teams.	Within 3 days of demobilisation.	Demob Meeting Template	
32	Santos ETL	Santos to arrange approval of Monitoring Action Plan revisions and any additional mobilisation/logistics requirements.	Daily or as required	Monitoring Action Plan Mobilisation and Logistics Form	
33	Astron Field Team Leaders	Provide activity reports to Santos ETL.	Daily	Daily Activity Report Template	

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Timeframes are indicative and may be require adjustment where activities are dependent on information availability or affected by logistical constraints

*The Scientific Monitoring Plan (EA-00-RI-10099) provides the most up to date list of SMPs and activation criteria. Refer to the OPEP for operational water quality monitoring requirements.

**If post-spill, pre-impact data is not required then timeframes will be specific to each SMP. The lead times for resourcing, preparation of SoW and mobilisation of field teams may be longer depending on the timing of the spill, likely trajectory and life stages of receptors present or likely to be impacted.

For example, in SMP4 if post-spill, pre-impact data collection is not required then mangrove decline is likely to take several weeks to occur and there is lower priority for mobilisation of field teams for this SMP within the 72 hr timeframe. In this case, mobilisation within 30 days may be more appropriate.

Abbreviations

EMBA – Environment that May Be Affected

IMT – Incident Management Team

OMP – Operational Monitoring Program

OPEP – Oil Pollution Emergency Plan

Santos – Santos Energy Australia Limited

SMP – Scientific Monitoring Plan/Program

SoW – Scope of Works

WMS – Work Method Statement

Appendix P: Scientific monitoring capability

Scientific Monitoring Assurance and Capability Assessment

Assurance arrangements

Astron Environmental Services (Astron) is currently Santos' primary Monitoring Service Provider for the implementation of SMPs 1-11. A contractual arrangement exists with Astron to maintain standby arrangements as per the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162); Astron have the resourcing capability to implement a first-strike response at all times. Astron maintains a relationship with a primary sub-contractor (BMT) for the provision of scientific monitoring for those SMPs where Astron does not have the required capability. Between Astron and BMT, capability exists to deliver first strike resourcing against SMPs 1-11. SMP 12 will be conducted by capability obtained through the Australian Institute of Marine Science (AIMS).

Assurance on the continued maintenance of capability is provided through the delivery of monthly capability reports. These reports are generated by the Astron and BMT Planning and Logistics Officers and delivered to the Santos Spill Response Adviser along with a summary of any changes in resourcing, and if required, how gaps in resourcing have been managed. Since the establishment of the scientific monitoring contract in 2015 Astron has always demonstrated through this process that it has the required capability to meet first strike resourcing as per the standby services contract.

Santos ensures that Astron/BMT standby arrangements are adequate through its exercise and auditing program. Santos regularly conducts exercises and tests with Astron and BMT to ensure that Santos IMT roles and Astron/BMT monitoring roles are familiar with the SMP activation arrangements while providing spot checks on resource availability. Santos has previously also undertaken an audit of Astron against its Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162). Assurance activities to date have demonstrated a high degree of compliance with standby service requirements.

Continuous improvement

Santos is committed to further improving its oil spill scientific monitoring capability. To that end, Santos is participating in a Joint Industry Operational and Scientific Monitoring Plans project, governed through an APPEA-Industry Steering Committee. This project, being progressed throughout 2022, is working towards a joint-industry capability for implementing a common suite of oil spill operational and scientific monitoring plans. The project aims to deliver efficiencies in implementing and testing oil spill scientific monitoring arrangements while increasing the level of resourcing and capability available to participating companies.

Baseline Data and Capability Assessment

Santos is committed to undertaking a review of the status, availability, currency and suitability of existing baseline data for oil spill scientific monitoring sources every 2 years. The latest review was undertaken in 2021 by Astron (Baseline Data Review document SO-91-RF-20022) and looked at all high biodiversity value receptors in the Santos EMBA.

The Santos approach to undertaking a baseline assessment is to focus on those sensitive receptors for which modelling predicts contact within seven days at a probability > 5%. It is considered that contact¹⁹ within seven days would require an enhanced understanding of available baseline data to ensure a timely response. The

¹⁹ Contact is defined as oil concentrations at sensitive receptors of >1 g/m² for surface oil and > 10 ppb for entrained and dissolved oil.

Scientific Monitoring Priority Areas identified include the Vernon Islands, Tiwi Islands, Newby Shoals, The Boxers, and Flat Top Bank (**Table P-1**), noting that there was no shoreline contact with a probability >5% within seven days.

A capability assessment was undertaken to understand whether existing scientific monitoring capability would be sufficient to mount a first-strike monitoring program to gather baseline data within a short-timeframe (<7 days); noting that in the event of very short contact timeframes mobilisation of scientific monitoring teams to priority receptor sites may not be possible within contact timeframes and experimental designs not relying on pre-impact baseline would have to be employed. These experimental approaches are outlined in the Santos Oil Spill Scientific Monitoring Plan (EA-00-RI-10099) and are selected as appropriate to the receptor type.

Astron's overall capability and competency requirements are outlined in **Table P-2** and are deemed sufficient for a spill associated with the Bayu-Undan to Darwin Gas Export Pipeline activities taking into consideration that it would be unlikely that all the locations listed would be contacted given they have been derived from stochastic modelling.

Table P-1: Bayu-Undan vessel collision modelling results for locations with a probability of contact > 5% (RPS, 2022)

Submerged Locations	Total contact probability (%) entrained hydrocarbons >10 ppb (Season)	Minimum arrival time >10 ppb (days)
Newby Shoals	9 (Winter)	4.4
The Boxers	13 (Winter)	2.9
Flat Top Bank	19 (Winter)	2.5
Tiwi Islands	18 (Summer)	1
Vernon Islands	8 (Summer)	4.8

Table P-2: Astron Environmental Services Capability

SMP	No. personnel per team	No. teams	Survey type	Required Competencies
SMP 1 - Water quality	2	3	Undefined	One team member in each team to have experience in water sampling
SMP 2 - Sediment quality				One team member in each team to have experience in deep sea sediment sampling
SMP 3 - Sandy beaches/rocky shore	2	2	Undefined	One team member in each team to have experience in shoreline macrofauna/infauna assessment
SMP5 - Intertidal mudflats				
SMP 6 - Benthic habitats	2	2	Undefined	One team member in each team to have experience in benthic habitat assessment
				ROV operator or divers
SMP 7 - Seabirds/shorebirds	2	1	Ground survey	One team member in each team to be experienced ornithologist
SMP 8 - Marine mammals (can be concurrent with SMP9)	2	1	Aerial survey	Both team members to be experienced wildlife observers
	2	1	Vessel-based survey	Both team members to be experienced wildlife observers
SMP 9 - Marine reptiles (can be concurrent with SMP 8)	2	1	Aerial surveys	Both team members to be experienced wildlife observers
	2	1	Vessel-based survey	Both team members to be experienced wildlife observers
	2	1	Ground survey	One team member with experience in turtle survey techniques

SMP	No. personnel per team	No. teams	Survey type	Required Competencies
SMP 10 - Seafood quality	3	2	Undefined	One team member in each team to have experience in fish identification and necropsy
SMP 11 - Fish, fisheries and aquaculture			Undefined	One team member in each team to have baited remote underwater video (BRUV) experience

Appendix Q: Forward operations guidance

The IMT operate from Perth within the Santos IMT room. These rooms are equipped and subject to reviews and updates as detailed in the Santos Incident Command and Management Manual (SO-00-ZF-00025).

To facilitate a streamlined response, forward operational bases are required close to the response operational areas equipped with near duplicated IMT equipment and personnel.

Forward Operating Base (FOB)

For a significant Level 2 response requiring coordination of resources to be deployed to the field, Santos will establish an FOB. For a Level 2 spill crossing from Commonwealth to Territory waters (cross-jurisdictional spills) NT IMT will establish an FOB.

For a Bayu-Undan to Darwin GEP activity spill response, Santos will establish a FOB at the Santos Logistics and Supply Base, located at East Arm Wharf, Darwin Harbour. The Santos Logistics and Supply Base at East Arm Wharf is connected to the Santos internet and telephone system.

The IMT will develop a communication strategy to support the FOB/s and forward staging areas.

Table Q-1: Darwin facilities with operational value for response

Facility	Owner/Operator	Potential Uses
Port of Darwin	Darwin Port	Staging area for vessel loading for spill response and equipment and waste management Storage of oil spill response equipment Vessel loading for spill response equipment and waste management Office facilities for Marine-based Command Centre
Darwin International Airport	Australian Government	Air freight spill response equipment Storage sheds for oil spill response equipment Office facilities for Aviation-based Command Centre
Batchelor Airfield	NT Government	Air freight spill response equipment Storage sheds for oil spill response equipment Office facilities for Aviation-based Command Centre

Facility	Owner/Operator	Potential Uses
Mantra Pandanas Double Tree by Hilton Esplanade Darwin Double Tree by Hilton Darwin Mantra on the Esplanade Others	Various (independent)	Spill responders and IMT accommodation Accommodation and messing for clean-up personnel
Santos Logistics and Supply Base, East Arm Wharf	Santos	FOB OCC Office Transfer yard for truck-based equipment deliveries and waste management, Maintenance and Cleaning Facility Materials consolidation Marine equipment storage, staging and repairs Oiled wildlife response centre Laydown / storage area Bunded washing facility for oil booms Staging area for vessel loading for spill response and equipment and waste management Storage of oil spill response equipment Vessel loading for spill response equipment and waste management Office facilities for Marine-based Command Centre
Toll Darwin Logistics Supply Base	Toll	Transfer yard for truck-based equipment deliveries and waste management, Maintenance and Cleaning Facility Materials consolidation Laydown / storage area
Local boat ramps in Darwin Harbour	Broome Council	Load out for near-shore marine-based operations Boat launching