Mutineer, Exeter, Fletcher, Finucane Plug and Abandonment Oil Pollution Emergency Plan

PROJECT / FACILITY	Mutineer, Exeter, Fletcher, Finucane Project
REVIEW INTERVAL	60 Months
SAFETY CRITICAL DOCUMENT	NO

Rev	Owner	Reviewer/s Managerial/Technical/Site	Approver	Functional Endorser
	Senior Oil Spill Response Coordinator	Team Leader – Environment Emergency Response Coordinator	Manager – HSE Offshore WA	Crisis, Emergency Response and Security
0				

Any hard copy of this document, other than those identified above, are uncontrolled. Please see the Santos Offshore Document Management System for the latest revision.

Rev No	Date	Revision
A	07/07/2022	Internal review
B	22/07/2022	Internal review
0	12/08/2022	For issue

Distribution	.pdf
Intranet – Emergency Preparedness	link only
Manager – HSE Offshore Division	link only
Drilling Superintendent	link only
Drilling Supervisor	link only
Senior Oil Spill Response Coordinator	link only
Santos Company Site Representative (CSR)	link only
IMT Room – Perth office	●
AMOSC	●
DoT	●
AMSA	●
OSRL	●

Santos

Contents

Santos

List of tables

List of figures

Appendices

List of acronyms

Abbreviation	Description
AIS	automatic identification system
ALARP	as low as reasonably practicable
AMOSC	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
BRUV	Baited Remote Underwater Video
CMT	Crisis Management Team
CSR	company site representative
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DISR	Department of Industry, Science and Resources
DMIRS	Department of Mines, Industry Regulation and Safety
DoT	Department of Transport
DPIRD	Department of Primary Industries and Regional Development
DWER	Department of Water and Environment Regulation
EMBA	environment that may be affected
EP	Environment Plan
ER	emergency response
FOB	forward operating base
GIS	geographic information system
GPS	global positioning system
HMA	Hazard Management Agency
HR	human resources
IAP	Incident Action Plan
ICC	incident command centre
IMT	Incident Management Team
IR	industrial relations
IRT	Incident Response Team
LOWC	loss of well control
LWIV	Light Well Intervention Vessel
MARPOL	International Convention for the Prevention of Pollution from Ships
MEECC	Maritime Environmental Emergency Coordination Centre
MEER	Maritime Environmental Emergency Response

Abbreviation	Description
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
OPEP	Oil Pollution Emergency Plan
OPGGS(E) Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OSC	On-Scene Commander
OSRL	Oil Spill Response Limited
OSTM	oil spill trajectory modelling
OWR	oiled wildlife response
ROV	Remotely Operated Vehicle
SCP	Source Control Plan
SFRT	Subsea First Response Toolkit
SHP-MEE	State Hazard Plan for Maritime Environmental Emergencies
SIMA	spill impact mitigation assessment
SMP	Scientific Monitoring Plans
SMPC	State Marine Pollution Coordinator
SMPEP	Shipboard Marine Pollution Emergency Plan
SOPEP	Shipboard Oil Pollution Emergency Plans
TRP	Tactical Response Plan
VOC	volatile organic compound
VOO	vessels of opportunity
VPO	Vice President Offshore Upstream WA
WA	Western Australia
WAOWRP	Western Australian Oiled Wildlife Response Plan
WOMP	Well Operation Management Plan
WSP	waste service provider
WWC	wild well control

1. Quick reference information

<table>
<tr><th>Parameter</th><th colspan="3">Description</th><th>Further information</th></tr>
<tr><td>Petroleum Activity</td><td colspan="3">Mutineer, Exeter, Fletcher, Finucane Plug and Abandonment. Plug and abandonment activities to be performed using a moored Mobile Offshore Drilling Unit (MODU) or dynamically positioned Light Well Intervention Vessel (LWIV), with auxiliary activities including support vessels, helicopters and Remotely Operated Vehicles (ROV).</td><td>Section 2: Environment Plan (EP)</td></tr>
<tr><td>Location</td><td colspan="3">Commonwealth waters approximately 160 km North of Dampier</td><td>Section 2.1.1: EP</td></tr>
<tr><td>Petroleum title/s (Blocks)</td><td colspan="3">Production Licenses WA-26-L, WA-27-L and WA-54-L</td><td>N/A</td></tr>
<tr><td>Vessels</td><td colspan="4">Up to three anchor handling tug and supply (AHTS) vessels (for a MODU campaign)
Supply vessel (for either MODU or LWIV campaign)</td></tr>
<tr><td>Water depth</td><td colspan="3">130–160 metres (m)</td><td>Figure 3-1</td></tr>
<tr><td rowspan="4">Worst-case spill scenarios</td><td>Scenario</td><td>Hydrocarbon</td><td>Worst-case volume</td><td rowspan="4">Section 6.1</td></tr>
<tr><td>Loss of Well Control (LOWC) – surface release</td><td>Mutineer-Exeter crude</td><td>15,890 m^3</td></tr>
<tr><td>LOWC- subsea release</td><td>Mutineer-Exeter crude</td><td>15,890 m^3</td></tr>
<tr><td>Surface diesel release (surface spill)</td><td>Marine Diesel Oil (MDO)</td><td>604 m^3</td></tr>
<tr><td rowspan="2">Hydrocarbon properties</td><td colspan="3">MDO:
Density at 25 °C = 829 kg/m^3
Dynamic viscosity = 4 cP @ 25 °C
API Gravity = 37.6°
Wax content = 1%
Pour point = −14 °C
Oil property classification = Persistent (medium)</td><td rowspan="2">Appendix A</td></tr>
<tr><td>Mutineer-Exeter crude
Specific gravity = 0.8091
Viscosity = 3.027 cP @ 20 °C
API Gravity = 43.4
Wax content = 3%
Pour point = 12 °C</td><td colspan="2">Vale (analogue)
Specific gravity = 0.816
Viscosity = 37 cP @ 13°C
API Gravity = 42
Wax content = 3.26%
Pour point = −9 °C</td></tr>
<tr><td>Weathering potential</td><td>MDO is a mixture of volatile and persistent hydrocarbons with low viscosity. It will spread quickly and thin out to low thickness levels, thereby increasing the rate of evaporation. Up to 60% will generally evaporate over the first two days. Approximately 5% is considered ‘persistent’,</td><td colspan="2">Mutineer-Exeter Light Crude is characterised by a low viscosity and is considered a Group 2 oil (light) hydrocarbon, as per the grouping classification presented by AMSA (2015). If spilt on the sea surface, the hydrocarbon would rapidly spread and thin out resulting</td><td>Appendix A</td></tr>
</table>

Parameter	Description		Further information
	which are unlikely to evaporate and will decay over time.	in a large surface area of hydrocarbon available for evaporation.	
Protection priorities	Clerke Reef, Imperieuse Reef, Montebello Islands, Barrow Island, Muiron Islands		

2. First-strike response actions

If the spill is from a vessel, the initial response actions to major oil spill incidents will be undertaken by the relevant Santos Company Site Representative or Vessel Master. If the spill is related to the MODU, the rig Offshore Installation Manager will be notified. The On-scene Commander (OSC) is either the Santos Company Site Representative (if present) or Vessel Master for vessel-based incidents; or the OIM if the spill is related to the MODU. The OSC will be determined during the initial activation stages of the activity.

Following those initial actions undertaken by the OSC to ensure the safety of personnel on the vessel or MODU, 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 support 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 OPEP is concerned primarily with a large scale (Level 2/3) 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. Level 1 spills are managed through on-site response and the IMT is available to assist with regulatory requirements/notifications and support if 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 2/3 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 – **Section 7**
Level 2/3 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
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

When (indicative)	Activations		Who
	Objective	Action	
	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 Leader/ Safety Officer Oil Spill Response Organisations (Australian Marine Oil Spill Centre [AMOSC] 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 10.7**) Shoreline Clean-up Assessment (**Section 10.8**)	Operations Section Chief Logistics Section Chief/ Supply Unit Leader Environment Unit Leader
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**	Activate the source control plan. Go to **Section 9**	Operations Section Chief (Source Control Branch Director as appropriate to scenario) Logistics Section Chief/ Supply Unit Leader
Activate on Day 1 for applicable scenarios Refer **Section 12** and **13**	Reduce exposure of shorelines and wildlife to floating oil through mechanical/ chemical dispersion	Activate the Mechanical and/ or Chemical Dispersion Plan Go to **Section 12** and **13**	Operations Section Chief Logistics Section Chief/ Supply Unit Leader

When (indicative)	Activations		Who
	Objective	Action	
Activate on Day 1 for applicable scenarios Refer **Section 11**	Implement containment and recovery tactics to reduce the volume of surface hydrocarbons to reduce contact with protection priorities	Activate the Containment and Recovery 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 6.7**)	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 14**	Protect identified shoreline protection priorities	Activate the Shoreline Protection and Deflection Plan Go to **Section 14**	Operations Section Chief Logistics Section Chief /Supply Unit Leader Environment Unit Leader
If/ when initiated Refer **Section 16**	Prevent or reduce impacts to wildlife	Activate the Oiled Wildlife Response Plan Go to **Section 16**	Environment Unit Leader Operations Section Chief Logistics Section Chief/ Supply Unit Leader
If/ when initiated Refer **Section 18**	Assess and monitor impacts from spill and response	Activate the Scientific Monitoring Plan Go to **Section 18**	Environment Unit Leader Logistics Section Chief/ Supply Unit Leader Operations Section Chief
If/ when initiated	Clean-up oiled shorelines	Activate Shoreline Clean-Up Plan	Operations Section Chief

When (indicative)	Activations		Who
	Objective	Action	
Refer **Section 15**		Go to **Section 15**	Logistics Section Chief/ Supply Unit Leader
If/when initiated Refer **Section 17**	Safely transfer, transport and dispose of waste collected from response activities.	Activate the Waste Management Plan. Go to **Section 17**	Operations Section Chief Logistics Section Chief/ Supply Unit Leader
IMT Actions (48+ hours)			
Ongoing	+ 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 Western Australia (WA) Department of Transport (DoT) may be relevant Control Agencies (see **Section 4.2**). + Where another Control Agency has taken control of aspects of the response, Santos will provide support to that Control Agency. Santos' support to WA DoT (for a WA State waters response) is detailed in **Section 4.6.1**.		Control Agency IMT Santos to provide the following roles to DoT Maritime Environmental Emergency Coordination Centre (MEECC) / IMT for WA State waters response (refer to **Table 5-5**): + CMT Liaison Officer + Deputy Incident Controller + Deputy Intelligence Officer + Deputy Planning Officer + Environment Support Officer + Deputy Public Information Officer + Deputy Logistics Officer + Deputy Waste Management Coordinator + Deputy Finance Officer + Deputy Operations Officer + Deputy Division Commander – Forward Operating Base (FOB)

3. Introduction

This document is the accompanying Oil Pollution Emergency Plan (OPEP) to the Mutineer, Exeter, Fletcher and Finucane (MEFF) Plug and Abandonment Environment Plan (EP) (9885-236-EMP-0002) 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 Ltd. (Santos) is preparing to plug and permanently abandon well infrastructure within the MEFF field (production licences WA-26-L, WA-27-L & WA-54-L). The MEFF field is located in Commonwealth waters approximately 160 km offshore of Dampier, Western Australia (**Figure 3-1**). Water depth in the vicinity of the MEFF field is 130–160 m.

The plug and abandonment activity will be carried out using either a mobile offshore drilling unit (MODU) or a lightweight intervention vessel (LWIV) with support vessels and helicopters. The plug and abandonment activity may also include an ROV vessel for pre, during and/or post campaign work.

Refer to Section 2 of the MEFF Plug and Abandonment EP (9885-236-EMP-0002) for a comprehensive description of the activity.

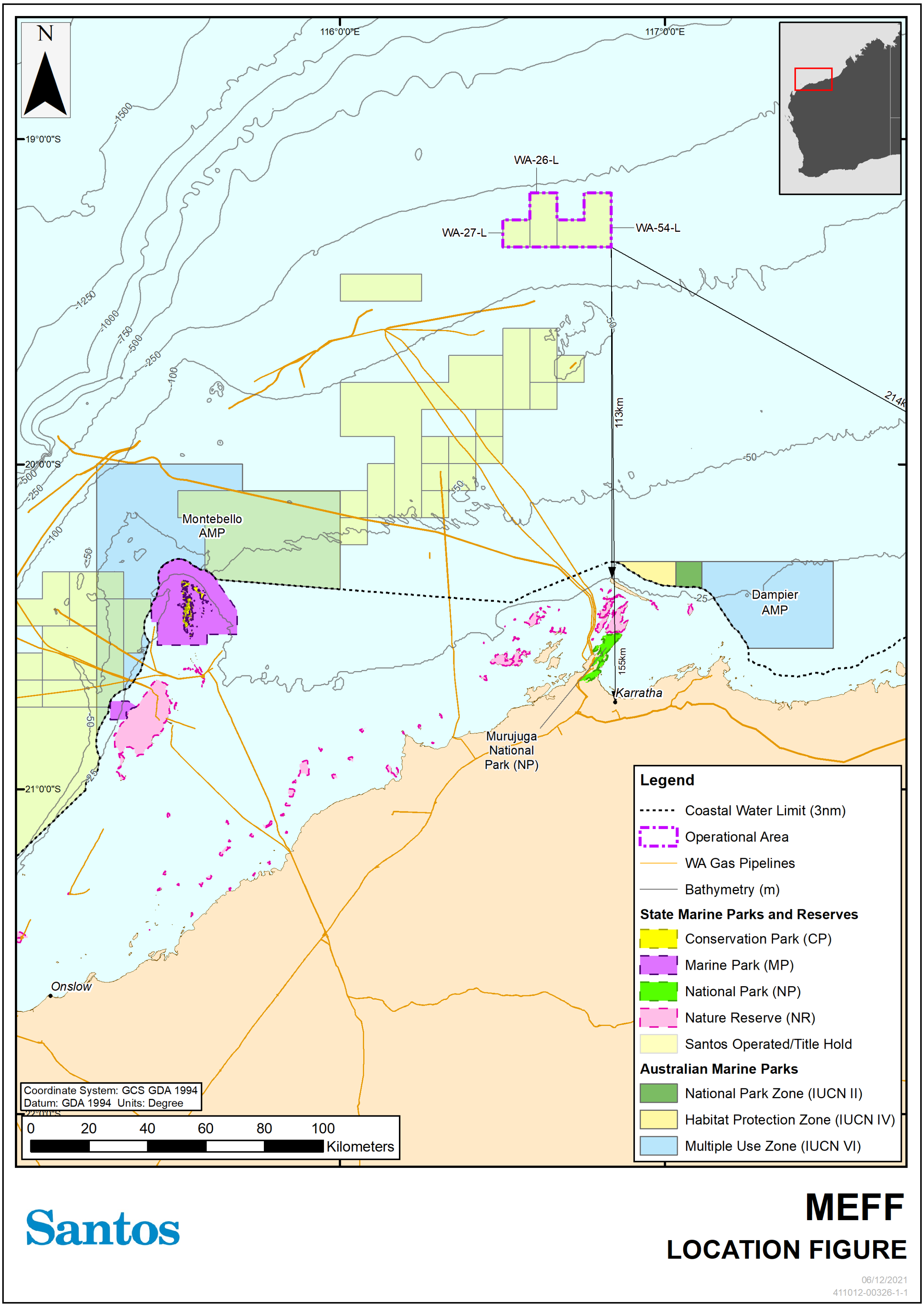


Figure 3-1: MEFF Plug and Abandonment Operational Area

3.2 Purpose

The purpose of this OPEP is to describe Santos' response to a hydrocarbon spill during MEFF plug and abandonment activities.

This OPEP has been developed to meet all relevant requirements of the Commonwealth OPGGS (E) Regulations. It is consistent with the national and State (WA) systems for oil pollution preparedness and response, being the National Plan for Maritime Environmental Emergencies (AMSA, 2020) managed by AMSA; and the WA State Hazard Plan for Maritime Environmental Emergencies (SHP-MEE) (WA DoT, 2021).

This OPEP is to be read in conjunction with the MEFF Plug and Abandonment EP (9885-236-EMP-0002) 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 MEFF Plug and Abandonment EP (9885-236-EMP-0002) 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 MEFF field is located approximately 160 km due north of Dampier on the north-west coast of Australia.

The field lies in permits WA-26-L (Mutineer), WA-27-L (Exeter) and WA-54-L (Fletcher-Finucane) in water depths ranging from approximately 130 m to 160 m (**Figure 3-1**). Section 5 of the MEFF Plug and Abandonment EP (9885-236-EMP-0002) 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)
- MEFF Plug and Abandonment Environment Plan (EP) (9885-236-EMP-0002)
- 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 Response 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 (SO-91-RF-20022)
- 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).
- Santos Oil Spill Response – Forward Operating Base Guideline (SO-91-IF-20017).

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
  - details the cooperative arrangements for response to oil spills by Australian oil and associated industries.
- Offshore Petroleum Incident Coordination Framework

  - 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
  - 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.
- HazPlan – Western Australia State Hazard Plan for Maritime Environmental Emergencies (SHP-MEE)
  - details the management arrangements for preparation and response to a marine pollution incident occurring in State waters.
- WA DoT Oil Spill Contingency Plan
  - defines the steps required for the management of marine oil pollution responses that are the responsibility of the DoT
    - DoT's Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (go to: DoT's Offshore Petroleum Industry Guidance Note – Marine Oil pollution: Response and Consultation Arrangements).
- Western Australia Oiled Wildlife Response Plan
  - establishes the framework for responding to potential or actual wildlife impacts in WA waters, within the framework of an overall maritime environmental emergency;
  - outlines risk reduction strategies, preparedness for, response to and initiation of recovery arrangements for wildlife impacts during a marine oil pollution incident.
- Western Australia Oiled Wildlife Response Manual
  - a companion document to the Western Australia Oiled Wildlife Response Plan for Maritime Environmental Emergencies, designed to standardise operating procedures, protocols and processes for wildlife response.
- 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.
- 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:
  - 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 2/3 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) and the WA SHP- MEE (WA DoT, 2021). 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.

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.

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 State waters and for vessel and petroleum activity spills.

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

- In Commonwealth waters, 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 includes facilities 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 and Volume 2, Part 6.8, Section 640 of the *OPGGS Act 2006*.

Table 4-2: Jurisdictional and Control Agencies for hydrocarbon spills

<table>
<tr><th rowspan="2">Jurisdictional boundary</th><th rowspan="2">Spill source</th><th rowspan="2">Jurisdictional Authority</th><th colspan="2">Control Agency</th><th rowspan="2">Relevant documentation</th></tr>
<tr><th>Level 1</th><th>Level 2/3</th></tr>
<tr><td rowspan="2">Commonwealth waters (three to 200 nautical miles from territorial/state sea baseline)</td><td>Vessel[1]</td><td>AMSA</td><td colspan="2">AMSA</td><td>Vessel SOPEP
National Plan
MEFF Plug and Abandonment OPEP (this document)</td></tr>
<tr><td>Petroleum activities[2]</td><td>NOPSEMA</td><td colspan="2">Titleholder</td><td>MEFF Plug and Abandonment OPEP (this document)</td></tr>
<tr><td rowspan="2">Western Australian (WA) state waters (State waters to three nautical miles and some areas around offshore atolls and islands)</td><td>Vessel</td><td>WA Department of Transport (DoT)</td><td>WA DoT</td><td>WA DoT</td><td>Vessel SOPEP
State Hazard Plan: Maritime Environmental Emergencies (WA DoT, 2021)
Oil Spill Contingency Plan (OSCP) (WA DoT, 2015)
MEFF Plug and Abandonment OPEP (this document)</td></tr>
<tr><td>Petroleum activities</td><td>WA DoT</td><td>Titleholder</td><td>WA DoT</td><td>MEFF Plug and Abandonment OPEP (this document)
State Hazard Plan: Maritime Environmental Emergencies (WA DoT, 2021)</td></tr>
<tr><td>International waters</td><td>All activities</td><td>Relevant foreign authority</td><td colspan="3">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.</td></tr>
</table>

[1] Vessels are defined by Australian Government Coordination Arrangements for Maritime Environmental Emergencies (AMSA, 2017) as a seismic vessel, supply or support vessel. Note: this definition does not apply to WA State waters.

[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 *OPGGSA 2006*.

4.3 Petroleum activity spill in Commonwealth waters

For an offshore petroleum activity spill in Commonwealth waters, the Jurisdictional Authority is the 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.

WA Department of Transport (DoT) manages the SHP – MEE (WA DoT, 2021) and is the Control Agency for all vessel-based spills in WA waters outside of a port proclaimed pursuant to the *Port Authorities Act 1999* (WA). For vessel-based spills within a port proclaimed pursuant to the *Port Authorities Act 1999* (WA), the relevant Port Authority or DoT may be the Control Agency.

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, materials 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 18**).

4.5 Cross-jurisdictional spills

4.5.1 Cross-jurisdictional petroleum activity spills

If a level 2/3 petroleum activity spill crosses jurisdictions between Commonwealth and State waters, the Jurisdictional Authority remains true to the source of the spill (i.e. NOPSEMA for Commonwealth waters; and DoT for State waters).

Where a level 2/3 spill originating in Commonwealth waters moves into State waters two Control Agencies will exist: DoT and the petroleum titleholder (Santos), each with its own IMT and Lead IMT responsibilities. The arrangements between DoT and Santos for sharing resources and coordinating a response across both Commonwealth and State waters are further detailed in **Section 4.6.**

4.5.2 Cross-jurisdictional vessel spills

If a level 2/3 vessel spill crosses jurisdictions between Commonwealth and State waters, two Jurisdictional Authorities will exist: AMSA for Commonwealth waters; and DoT for WA State waters. The Control Agency will remain with the original nominated agency or organisation unless otherwise appointed through agreement between the HMA / Jurisdictional Authority of both waters. Santos will continue to provide all necessary resources (including personnel and equipment) as a supporting agency, as detailed in **Section 4.6.**

AMSA may request that DoT manage a vessel incident in Australian Commonwealth waters (WA DoT, 2021).

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 Western Australia – Department of Transport

If a Marine Oil Pollution Incident enters, or has potential to enter, State waters, the DoT is the Hazard Management Agency (HMA) (DoT Chief Executive Officer or proxy). The Assistant Executive Director (or proxy) has been nominated by the HMA to perform the role of State Marine Pollution Coordinator (SMPC) (as prescribed in Section 1.3 of the SHP – MEE (WA DoT, 2021)) and DoT will take on the role as a Control Agency. The role of the SMPC is to provide strategic management of the incident response on behalf of the HMA.

For any oil spill entering or within WA State waters/shorelines, DoT as the Control Agency is the ultimate decision maker regarding identification and selection of protection priorities. DoT will utilise their internal processes which typically includes the following:

+ evaluation of situational awareness information, including all surveillance, monitoring and visualisation data provided by the Titleholder;
+ evaluation of resources at risk including use of the WA Oil Spill Response Atlas and any other relevant WA/Commonwealth government databases or other information sources;
+ evaluation of shoreline types, habitat types and seasonality of environmental, socio-economic and cultural values and sensitivities;
+ consultation with the State Environmental Scientific Coordinator and other relevant State and Federal government departments with environmental responsibilities;
+ consultation with other relevant oil spill agencies, including the AMSA Environment, Science and Technology network or any other experts as necessary;
+ all information is utilised in a NEBA/SIMA type process, to determine protection priorities and response strategies.

DoT will adjust/amend their internal processes to suit the spill situation at the time.

Santos will notify the DoT Maritime Environmental Emergency Response (MEER) unit as soon as reasonably practicable (within 2 hours of spill occurring) if an actual or impending spill occurs within or may impact WA State waters. On notification, the SMPC will activate their MEECC and the DoT IMT. Titleholders will work in partnership with DoT during such instances, as outlined within the DoT's Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (WA DoT, 2020).

Santos will conduct initial response actions in State waters as necessary in accordance with its OPEP and continue to manage those operations until formal handover of incident control is completed. Appendix 1 in DoT's Offshore Petroleum Industry Guidance Note (WA DoT, 2020) provides a checklist for formal handover. Beyond formal handover, Santos will continue to provide all necessary resources, including personnel and equipment, to assist the DoT in performing duties as the Control Agency.

For a cross-jurisdictional response, there will be a Lead IMT (DoT or Santos) for each spill response activity, with DoT's control resting primarily for State waters activities.

Appendix 2 in DoT's Offshore Petroleum Industry Guidance Note (WA DoT, 2020) provides guidance on the allocation of a Lead IMT to response activities for a cross-jurisdictional spill.

To facilitate coordination between DoT and Santos during a cross-jurisdictional response, a Joint Strategic Coordination Committee will be established. The Joint Strategic Coordination Committee will be jointly chaired between the SMPC and a nominated senior representative of Santos and will ensure alignment of objectives and provide a mechanism for de-conflicting priorities and resourcing requests.

For a cross-jurisdictional response Santos will be responsible for ensuring adequate resources are provided to DoT as Control Agency, initially 11 personnel to fill roles in the DoT IMT or FOB (refer to **Section 5.2**) and operational personnel to assist with those response strategies where DoT is the Lead IMT. Concurrently DoT will also provide two of their personnel to the Santos IMT as described in **Table 5-4**. Santos' CMT Liaison Officer and the Deputy Incident Controller are to attend the DoT Fremantle Incident Command Centre (ICC) as soon as possible after the formal request has been made by the SMPC. It is an expectation that the remaining initial cohort will attend the DoT Fremantle ICC no later than 8am on the day following the request being formally made to Santos by the SMPC. Santos personnel designated to serve in DoT's FOB will arrive no later than 24 hours after receipt of formal request from the SMPC.

Figure 4-1 shows the organisational structure of Santos incident management personnel within Santos IMT and embedded within DoT's MEECC/ IMT.

Figure 4-2 shows the overall cross-jurisdictional organisational structure referenced from the SHP-MEE.

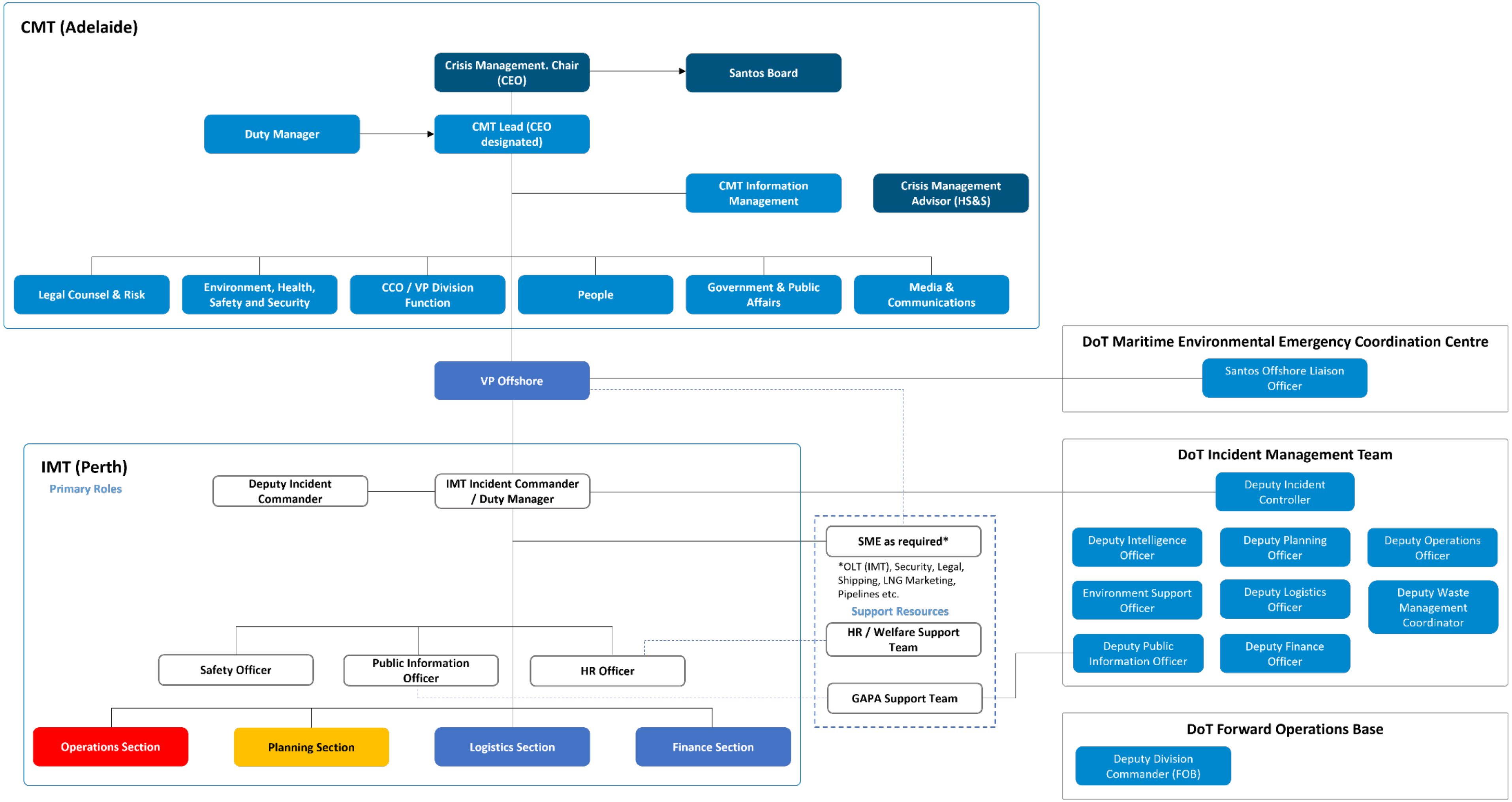


Figure 4-1: Santos cross-jurisdictional incident management structure for Commonwealth waters Level 2/3 facility oil pollution incident entering WA State waters

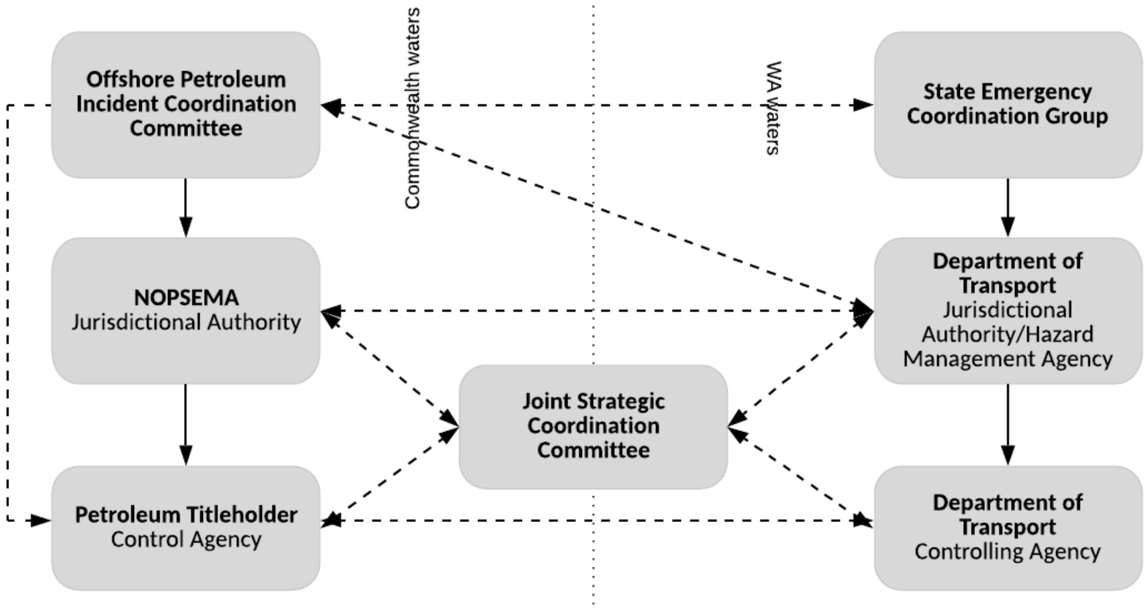


Figure 4-2: Overall control and coordination structure for offshore petroleum cross-jurisdiction incident

4.6.3 Western Australian Department of Biodiversity, Conservation and Attractions

The Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) has responsibilities associated with wildlife and activities in national parks, reserves and State marine parks. The *Biodiversity Conservation Act 2016* (WA) is the legislation that provides DBCA with the responsibility and Statutory Authority to treat, protect, and destroy wildlife. In State waters, DBCA is the Jurisdictional Authority for Oiled Wildlife Response (OWR), providing advice to the Control Agency (DoT). The role of DBCA in an OWR is outlined in the Western Australian Oiled Wildlife Response Plan (WAOWRP) (DBCA, 2022a).

For a level 2/3 petroleum spill that originates within or moves into State waters, DoT will be the Control Agency responsible for overall command of an oiled wildlife response. Santos will provide all necessary resources (equipment and personnel primarily through AMOSC membership) to DoT to facilitate this response.

For matters relating to environmental sensitivities and scientific advice in State waters DBCA may provide an Environmental Scientific Coordinator (ESC) to support the SMPC and/or DoT Incident Controller.

This may include advice on priorities for environmental protection, appropriateness of proposed response strategies and the planning and coordination of scientific monitoring for impact and recovery assessment.

4.6.4 Use of Dispersant in State Waters

The ESC is involved in the consent process for the use of dispersant in State waters and will seek advice from the DoT MEER unit on this matter. During a response to either a shipping or offshore petroleum activity marine oil pollution incident in State waters, regardless of source, the use of dispersants requires the written consent of the HMA. Where the application of dispersant in adjacent waters could impact State waters, the HMA requests early notification. This notification is to be provided to DoT through the HMA (or SMPC if activated).

In seeking the consent of the HMA/SMPC to use dispersants in State waters, the Incident Commander is expected to have had the option assessed by a panel formed within the IMT. This panel should be chaired by the Incident Commander and include the participation of the ESC. The involvement of the CSIRO or other SMEs on the panel should also be considered. In formulating its position on the potential use of dispersants, the panel is to use the decision-making process outlined in the AMSA Protocol for Obtaining Approval for the Application of Oil Spill Control Agents to Oil at Sea or on Shorelines. This process must be documented, and a record retained within the IMT.

The HMA/SMPC will confirm the recommendation of the ESC, who may grant or refuse consent for the use of dispersants in State waters. In granting consent, the HMA/SMPC may attach conditions to the consent. It should be noted that the consent can be removed by the HMA/SMPC at any time. It should also be noted that other restrictions on dispersant use (as described in **Table 13-3** and **Table 13-6**), may still apply.

4.6.5 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.

4.6.6 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 2/3 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, Woodside and Jadestone have signed a memorandum of understanding (MoU) that defines the group's mutual aid arrangements. Under this MoU, Santos, BHP, Chevron, Woodside and Jadestone 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 2/3 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).

4.7.3 Wild Well Control

Santos maintains a contract with Wild Well Control Inc. (WWCI) for well control specialist services including relief well drilling and capping stack deployment. WWCI maintains well control response teams on standby at all times to ensure a rapid response to a well control event anywhere in the world. WWCI maintains an inventory of well control, firefighting, and special services equipment at its Houston headquarters and at other locations in the US and internationally.

4.7.4 The Response Group

The Response Group (TRG) is an international provider of crisis management and emergency response services including oil spill response. TRG are available to Santos 24/7 and can provide personnel for emergency response support.

4.8 Resourcing Requirements

The oil spill response resourcing requirements have been considered within this OPEP for each response strategy. To fulfill the required roles, resources have been selected from the various available OSROs and pools of specialist personnel available to Santos within the industry, based on the worst-case response needs which have been identified from the oil spill modelling results.

The resourcing requirements have focused on specialist roles requiring a minimum level of training and competence (i.e. supervisors/ team leaders). Other personnel required to execute a response have been considered, and are based on resourcing from general labour hire, with some requiring a minimum level of induction type training.

The resourcing requirements have been considered on a cumulative basis to ensure adequate availability of specialist response personnel, if all response strategies identified in this OPEP are required simultaneously. **Appendix R** presents the cumulative response capability assessment for the MEFF plug and abandonment activities.

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 2/3 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 2/3 spill is the formation of an IMT and establishment of an incident command centre (ICC)[3]. 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 MEFF Plug and Abandonment incident includes:

- Facility-based Emergency Response Team
- 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.

If the incident involves a LOWC, the Santos Source Control Branch would also be included in the incident response structure. This team would be comprised of the following sub-teams, according to the applicable source control strategies:

- Relief Well Team
- Well Intervention Team.

The Santos Source Control Branch (**Figure 5-2**) would report directly to the Operations Section Chief and would be responsible for:

- coordination of engineering safety and operational activities
- managing source control technical personnel from third parties (e.g. Wild Well Control)
- developing task-specific plans and procedures
- identification and sourcing of required tools and equipment

[3] The Santos ICC is located in the Santos WA Perth office.

- approving source control components of IAPs.

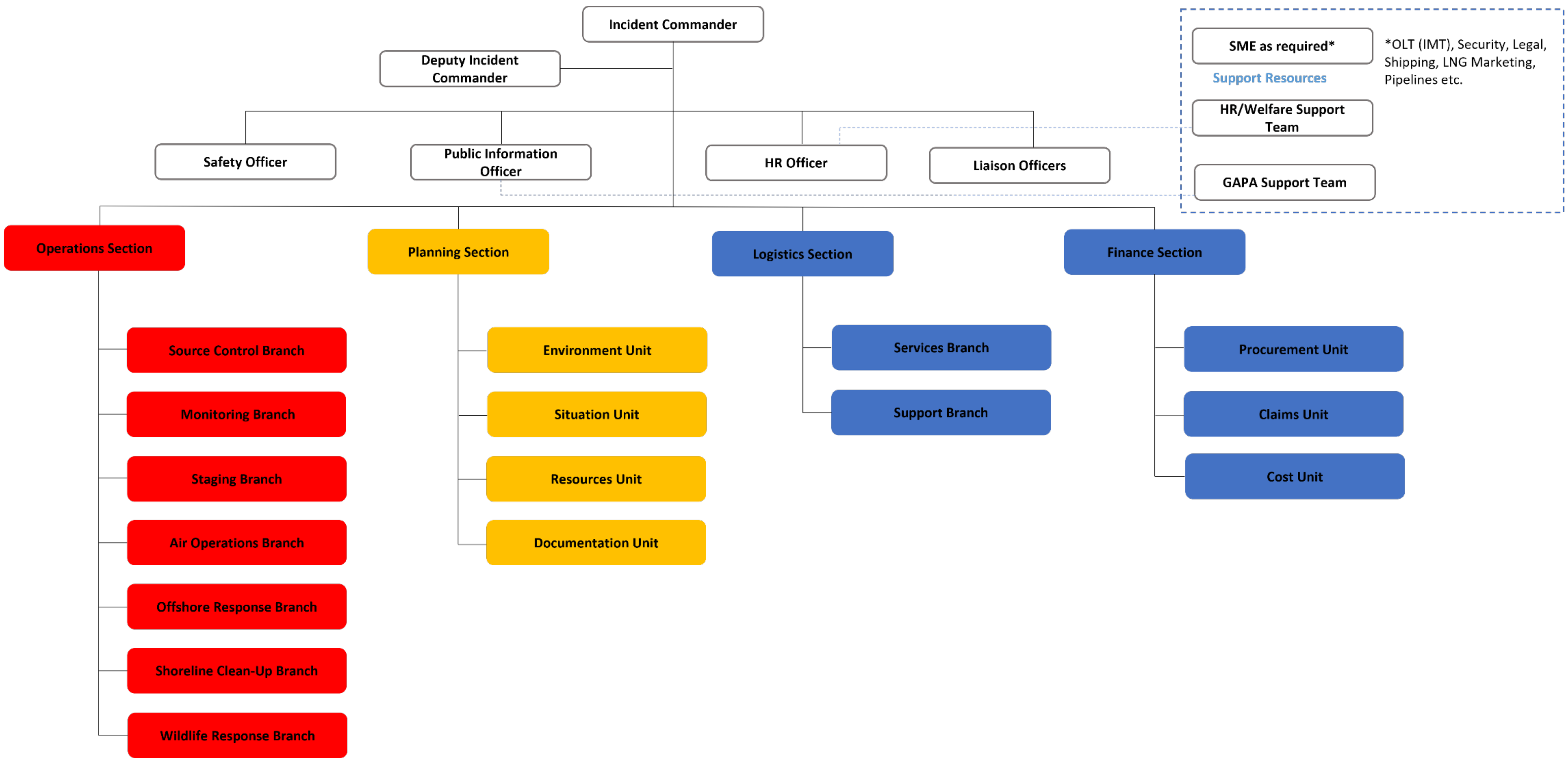


Figure 5-1: Santos incident management team organisational structure

Note: For a Level 2/3 petroleum activity spill whereby DoT is involved as a Control Agency, either within a single jurisdiction (State water only spills) or cross-jurisdictional (spills from Commonwealth to State waters), Santos will work in coordination with DoT in providing spill response capability. Santos' expanded organisational structure for these situations is detailed in ***Section 4.6.2****.*

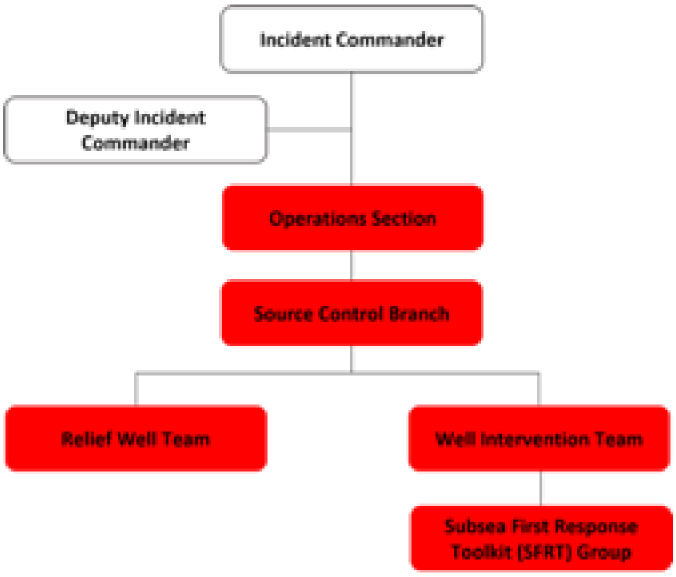


Figure 5-2: Santos Source Control Branch Structure

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**). Not all of the roles listed in **Table 5-2** are shown in **Figure 5-1**, as some of the roles in **Table 5-2** are support roles or are specific to a particular response strategy. The IMT and field-based teams are scalable to the nature and scale of the response i.e. one person can take on multiple roles or one role can be filled by multiple people, where circumstances permit.

Also provided are the roles and responsibilities of Santos personnel required to work within DoT's organisational structure (**Table 5-5**), where DoT has responsibilities for spill response as a Control Agency, as per DoT's Offshore Petroleum Industry Guidance Note – Marine Oil pollution: Response and Consultation Arrangements.

DoT will provide a Liaison Officer/Duty Incident Commander and the Santos IMT in a coordinated response, as outlined for reference (Table 5-4).

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

Santos CMT Role	Main Responsibilities
Crisis Management Chair (CEO)	The CM Chair (Santos Chief Executive Officer) is responsible for the following: + 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. + Engage with the CM Lead to endorse the crisis resolution plan. + Liaise with the Santos Board and strategic stakeholders. + Provide the full extent of the company's resources to bring about a resolution and recovery from the crisis impact.

Santos CMT Role	Main Responsibilities
CMT Leader/ Duty Manager	The CMT Leader is responsible for: + Determine the need for establishing a Level 3 response and for activating the CMT. + Determine which / if any Crisis Management Support Teams (CMST) are mobilised. + Leading 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	The CMT Information Managers directly support the CMT as follows: + Support the CMT during crisis management operations. + Sets up the crisis management room, assist with set-up of communications, video conferences and information transfer within the CMT. + Advises on CMT operating processes and available resources. + Assisting with reserving break out rooms for the CMT functions and CMSTs. + Ensuring CMT crisis resolution forms are used and displayed on the monitors. + Provides incident action plan information when an IMT is established. + Monitoring and managing the welfare needs of the CMT.
Crisis Management Advisor	The Crisis Management Advisor is responsible for the following: + 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. + Work with CMT Information Managers to manage roster and handovers for extended CMT operations. + Schedules and facilitates post crisis debriefs and after-action reviews.: + The Crisis Management Advisor will support the CMT Leader as follows: + 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. + Provide tools to the CMT Leader for review and crisis assessment meetings.

Santos CMT Role	Main Responsibilities
CMT Core Function Leaders	CMT Core Function Leaders include Leaders for the following areas: + Legal Counsel and Risk, + Environment Health Safety and Security, + COO/VP Division/ Function, + People, + Government and Public Affairs, + Media and Communications + The CMT Core Function Leaders are responsible for the following: + 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. + Ensures critical actions, decisions or points of strategic criticality are included in the CMT log. + Participates 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	+ 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	+ HR Officer is responsible for advising and assisting the Incident Commander, Command Staff and Section Chiefs on any HR 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.

Santos Management/ IMT Role	Main Responsibilities
Source Control Branch Director	+ The Source Control Branch Director will be responsible for the implementation of the Source Control Plan (Source Control Planning and Response Guideline – DR-00-OZ-20001). The Source Control Branch Director will activate and supervise source control elements in accordance with the Incident Action Plan and direct its execution.
Relief Well Team Leader	+ The Relief Well Team Leader is responsible for the management and coordination of relief well design and operations. The Relief Well Team Leader coordinates the development of the drilling plans and procedures, secures resources and manages relief well operations to ensure the relief well reaches its target + Create groups as required to acquire relief well MODU, equipment and services and perform detailed relief well planning.
Well Intervention Team Leader	+ The Well Intervention Team Leader is responsible for well intervention activities including initial site survey and debris clearance.
Staging Branch Director	+ The Staging Branch Director is responsible for supervising the Staging Area Managers as well as coordinating their activities including assigning Staging Area Managers, receiving, maintaining, checking in/out, storing and distributing resources.
Air Operations Branch Director	+ The Air Operations Branch Director is ground-based and is primarily responsible for the coordination of the air operations section (ICS 220) of the IAP and for providing logistical support to incident aircraft.
Monitoring Branch Director	+ Working closely with the Environmental Unit, the Monitoring Branch Director will be responsible for implementing the operational and scientific monitoring plans required based on the nature and scale of the incident.
Wildlife Response Branch Director	+ Working with relevant state authorities, the Wildlife Response Branch Director will be responsible for implementing the OWR plan for the incident including the deployment of equipment and personnel required.
Shoreline Clean-up Branch Director	+ The Shoreline Clean-up Branch Director is responsible for leading all shoreline response activities working closely with the Shoreline Response Program Manager and shoreline clean-up supervisors and various locations.
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.
Situation Unit Leader	+ The Situation Unit Leader is responsible for collecting, processing, and organizing incident information relating to escalation, mitigation or intelligence activities taking place in an incident. The Situation Unit will be responsible for preparing future projections of incident growth, maps, and intelligence information.
Resources Unit Leader	+ The Resource Unit Leader is responsible for maintaining the status of all assigned tactical resources and personnel at an incident. The Resource Unit will oversee the check-in of all tactical resources and personnel, maintaining a status-keeping system indicating current location and status of all the resources.
Documentation Unit Leader	+ The Documentation Unit Leader us responsible for maintenance of accurate, up-to-date incident files including Incident Action Plans. Incident reports, communication logs, situation status reports etc.
Environment Unit Leader	+ The Environment Unit Leader is responsible for environmental matters associated with the response, including strategic assessment, modelling, surveillance and environmental monitoring and permitting.

Santos Management/ IMT Role	Main Responsibilities
Shoreline Response Programme (SRP) Manager	+ The SRP Manager reports to the Environment Unit Leader and is responsible for managing shoreline response + Provides input to Planning and Operations Section Chiefs on shoreline response program to minimise shoreline impacts and SCAT program.
SCAT Programme Coordinator	+ SCAT Program Coordinator is the primary point of contact, through SRP Manager, within the IMT for all SCAT activities + SCAT Program Coordinator act as the project manager for SCAT program and will design and direct the SCAT program for any incidents + SCAT Program Coordinator will implement and manage the day-today activities for the SCAT program including establishing good management practices and safety protocols for the field teams, chairing SCAT Field Survey Team briefings and debriefings and producing daily and weekly summaries of field reports.
SCAT Field Coordinator	+ SCAT Field Coordinator works with SCAT Program Coordinator to develop daily missions and rolling strategy for the field teams and to provide the necessary logistics and equipment support as required.
SCAT Data Manager	+ SCAT Data Manager reports to the SCAT Program Coordinator and is responsible for processing field data, quality assurance, data storage and dissemination within the IMT, and for providing the SCAT Field Survey Teams with the maps and data required to conduct their missions.
Shoreline Treatment Recommendations (STR) Manager	+ The STR Manager is responsible for the preparation of the Shoreline Treatment Recommendations (STRs) + STR Manager will work with the Environment Unit to obtain reconnaissance information to assess priority areas for initial SCAT surveys and gain approval for land access where appropriate + STR Manager ensures all approvals are obtained (e.g. concerning any endangered species, cultural, historical resources etc.) prior to undertaking shoreline activities + STR Manager will work with the Environment Unit's Technical Specialists, subject matter experts and stakeholders to ensure that their requirements and constraints are incorporated into shoreline treatment recommendations + STR Manager will work with the Operations Section to obtain advice on the feasibility, practicality and effectiveness of potential treatment strategies and tactics + STR Manager will track the progress of approved STRs to generate and update progress reports.
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.
Services Branch Director	+ Service Branch Director, when activated is under the supervision of the Logistics Section Chief and is responsible for the management of all service activities for the incident including the operations of the Communications, Medical and Food Units
Support Branch Director	+ Support Branch Director, when activated, is under the supervision of Logistics Section Chief and is responsible for the development and implementation of logistics plan in support of the IAP. The Support Branch supervises the operations of the Supply, Facilities, Ground Support and Vessel Support Units.

Santos Management/ IMT Role	Main Responsibilities
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
Procurement Unit Leader	+ Procurement Unit Leader us responsible for administering all financial matters pertaining to vendor contracts and leases. The Procurement Unit Leader will execute all procurements in accordance with the policies and procedures of Santos
Claims Unit Leader	+ The Claims Unit Leader is responsible for the management and direction of all administrative matters pertaining to compensation and claims related matters for any incident
Cost Unit Leader	+ The Cost Unit Leader is responsible for collecting all cost data and providing cost estimated and any cost saving recommendations for the incident

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

Field-based position	Main responsibilities
On-Scene Commander[4]	+ 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	+ 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)	+ 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	+ 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 On-Scene Commander	+ Coordinate the field response as outlined in the Incident Action Plan developed by the IMT. + Command an FOB for the coordination of resources mobilised to site.

[4] The OSC is either the OIM (MODU spills); or the Santos Company Representative or the Vessel Master (vessel spills).

Field-based position	Main responsibilities
Off-Asset Oil Spill Response Teams	+ 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
Source Control Branch	+ Respond to incidents involving well loss of containment to stop the flow of oil to sea. + Refer to the Santos Source Control Planning and Response Guideline (DR-00-OZ-20001) for detailed descriptions of roles and responsibilities within the Source Control Branch.
Wildlife Response Branch	+ Respond to oiled wildlife incidents to minimise the impacts to wildlife. + Refer to the Western Australia Oiled Wildlife Response Plan (WAOWRP) for detailed descriptions of roles and responsibilities within the Oiled Wildlife Response Team.
Monitoring Branch	+ 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.

Table 5-4: Department of Transport roles embedded within Santos' CMT/IMT

DoT roles embedded within Santos' CMT/IMT	Main responsibilities
DoT Liaison Officer (before DoT assuming role of Control Agency) **Deputy Incident Controller – State Waters** (after DoT assumes role of Control Agency)	+ Provide a direct liaison between the Santos IMT and the State MEECC. + Facilitate effective communications between DoT's State Marine Pollution Coordinator (SMPC)/SMEEC/the Incident Controller and Santos' appointed CMT Leader/Incident Commander. + Provide enhanced situational awareness to DoT of the incident and the potential impact on State waters. + Assist in the provision of support from DoT to Santos. + Facilitate the provision of technical advice from DoT to Santos' Incident Commander as required.
Media Liaison Officer	+ Provide a direct liaison between the Santos Media team and DoT IMT Media team. + Facilitate effective communications and coordination between the Santos and DoT media teams. + Assist in the release of joint media statements and conduct of joint media briefings. + Assist in the release of joint information and warnings through the DoT Information and Warnings team. + Offer advice to the Santos Media Coordinator on matters pertaining to DoT and wider Government media policies and procedures.

Table 5-5: Santos personnel roles embedded within the WA State Maritime Environmental Emergency Coordination Centre/Department of Transport Incident Management Team/ Forward Operations Base

Santos roles embedded within the State MEECC/ DoT IMT/ FOB	Main responsibilities
CMT Liaison Officer[5]	+ Provide a direct liaison between the Santos CMT and the State MEECC. + Facilitate effective communications and coordination between the Santos CMT Leader and the SMPC. + Offer advice to SMPC on matters pertaining to Santos crisis management policies and procedures.
Deputy Incident Controller	+ Provide a direct liaison between the DoT IMT and the Santos IMT. + Facilitate effective communications and coordination between the Santos Incident Commander and the DoT Incident Controller. + Offer advice to the DoT Incident Controller on matters pertaining to the Santos incident response policies and procedures. + Offer advice to the Safety Coordinator on matters pertaining to Santos safety policies and procedures particularly as they relate to Santos employees or contractors operating under the control of the DoT IMT.
Deputy Intelligence Officer	+ As part of the DoT Intelligence Team, assist the Intelligence Officer in the performance of their duties in relation to situation and awareness. + Facilitate the provision of relevant modelling and predications from the Santos IMT. + Assist in the interpretation of modelling and predictions originating from the Santos IMT. + Facilitate the provision of relevant situation and awareness information originating from the DoT IMT to the Santos IMT. + Facilitate the provision of relevant mapping from the Santos IMT. + Assist in the interpretation of mapping originating from the Santos IMT. + Facilitate the provision of relevant mapping originating from the Santos IMT.
Deputy Planning Officer	+ As part of the DoT Planning Team, assist the Planning Officer in the performance of their duties in relation to the interpretation of existing response plans and the development of incident action plans and related sub-plans + Facilitate the provision of relevant IAP and sub-plans from the Santos IMT. + Assist in the interpretation of the Santos OPEP from Santos. + Assist in the interpretation of the Santos IAP and sub-plans from the Santos IMT. + Facilitate the provision of relevant IAP and sub-plans originating from the DoT IMT to the Santos IMT. + Assist in the interpretation of Santos' existing resource plans. + Facilitate the provision of relevant components of the resource sub-plan originating from the DoT IMT to the Santos IMT. (Note this individual must have intimate knowledge of the relevant Santos OPEP and planning processes).

[5] The role described as Santos Offshore Liaison Officer in **Figure 4-1**.

Santos roles embedded within the State MEECC/ DoT IMT/ FOB	Main responsibilities
Environment Support Officer	+ As part of the Intelligence Team, assist the Environment Coordinator in the performance of their duties in relation to the provision of environmental support into the planning process. + Assist in the interpretation of the Santos OPEP and relevant Tactical Response Plan (TRPs). + Facilitate in requesting, obtaining and interpreting environmental monitoring data originating from the Santos IMT. + Facilitate the provision of relevant environmental information and advice originating from the DoT IMT to the Santos IMT.
Deputy Public Information Officer[6]	+ As part of the Public Information Team, provide a direct liaison between the Santos Media team and DoT IMT Media team. + Facilitate effective communications and coordination between Santos and DoT media teams[7]. + Assist in the release of joint media statements and conduct of joint media briefings. + Assist in the release of joint information and warnings through the DoT Information & Warnings team. + Offer advice to the DoT Media Coordinator on matters pertaining to Santos media policies and procedures. + Facilitate effective communications and coordination between Santos and DoT Community Liaison teams. + Assist in the conduct of joint community briefings and events. + Offer advice to the DoT Community Liaison Coordinator on matters pertaining to Santos community liaison policies and procedures. + Facilitate the effective transfer of relevant information obtained from the Contact Centre to the Santos IMT.
Deputy Logistics Officer	+ As part of the Logistics Team, assist the Logistics Officer in the performance of their duties in relation to the provision of supplies to sustain the response effort. + Facilitate the acquisition of appropriate supplies through Santos' existing OSRL, AMOSC and private contract arrangements. + Collects Request Forms from DoT to action via the Santos IMT. (Note this individual must have intimate knowledge of the relevant Santos logistics processes and contracts).
Deputy Waste Management Coordinator	+ As part of the Operations Team, assist the Waste Management Coordinator in the performance of their duties in relation to the provision of the management and disposal of waste collected in State waters. + Facilitate the acquisition of appropriate services and supplies through Santos' existing private contract arrangements related to waste management; + Collects Waste Collection Request Forms from DoT to action via the Santos IMT.

[6] In the event of an incident, access to media and communications response strategy and a comprehensive stakeholder list inclusive of all potentially relevant stakeholders, including indigenous organisations are contained via Santos' internal intranet site for use by CMT/IMT members

[7] In the event DoT assumes the role of Control Agency in State Waters, Santos acknowledges that the DoT IMT will be the lead IMT for public information and warnings and community liaison. In such circumstances, Santos retains the right to manage its own media interests, but acknowledges the strong preference for DoT and Santos to issue joint media statements and conduct joint media conferences and the importance of close liaison between the respective Media Teams.

Santos roles embedded within the State MEECC/ DoT IMT/ FOB	Main responsibilities
Deputy Finance Officer	+ As part of the Finance Team, assist the Finance Officer in the performance of their duties in relation to the setting up and payment of accounts for those services acquired through Santos' existing OSRL, AMOSC and private contract arrangements. + Facilitate the communication of financial monitoring information to Santos to allow them to track the overall cost of the response. + Assist the Finance Officer in the tracking of financial commitments through the response, including the supply contracts commissioned directly by DoT and to be charged back to Santos.
Deputy Operations Officer	+ As part of the Operations Team, assist the Operations Officer in the performance of their duties in relation to the implementation and management of operational activities undertaken to resolve an incident. + Facilitate effective communications and coordination between the Santos Operations Section and the DoT Operations Section. + Offer advice to the DoT Operations Officer on matters pertaining to Santos incident response procedures and requirements. + Identify efficiencies and assist to resolve potential conflicts around resource allocation and simultaneous operations of Santos and DoT response efforts.
Deputy Division Commander (FOB)	+ As part of the Field Operations Team, assist the Division Commander in the performance of their duties in relation to the oversight and coordination of field operational activities undertaken in line with the IMT Operations Section's direction. + Provide a direct liaison between Santos' Forward Operations Base/s (FOB/s) and the DoT FOB. + Facilitate effective communications and coordination between Santos FOB Operations Commander and the DoT Division Commander. + Offer advice to the DoT FOB Operations Commander on matters pertaining to Santos incident response policies and procedures. + Assist the Safety Coordinator deployed in the FOB in the performance of their duties, particularly as they relate to Santos employees or contractors. + Offer advice to the Senior Safety Officer deployed in the FOB on matters pertaining to Santos safety policies and procedures.

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. DoT) and third-party spill response service providers.

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 border 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 5-6**.

Table 5-6: Training and exercise requirements for incident management team positions

IMT Role	Exercise	Training
Incident Commander Operations Section Chief / Source Control Branch Director	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] HR Officer		+ PMAOMIR320 + AMOSC – Oil Spill Response Familiarisation Training
Relief Well Team Leader Well Intervention Team Leader		+ Drilling Well Control accredited training through International Well Control Forum (IWCF) + Level 4 (Well Site Supervisor 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 5-7**).

Table 5-7: 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

[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

Responder	Role	Training	Available Number
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[10] 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 80 responders may be approved under best endeavours
TRG Response Personnel	Emergency response personnel provided by arrangement with Santos	As per TRG training and competency matrix	60
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
Santos Source Control Personnel	Management and coordination of source control strategies including relief well drilling and subsea intervention	Internal Santos training and exercises. IWCF Level 4 certification	60
Oiled Wildlife Response Roles	Refer to Section **16** and **Appendix M**		

[10] An average of 63 personnel as of August 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 5-7**, 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, containment and recovery crews, and shoreline clean-up personnel, 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, 2021).
+ WA SHP-MEE: State Response Team (SRT) – Oil pollution response team available to assist under the jurisdiction of the DoT in State waters. SRT members remain trained and accredited in line with the SHP-MEE requirements (WA DoT, 2021).

In the event of a spill, the trained spill responders listed in **Table 5-7** 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:

+ Contract/ Plan Review
+ Audit
+ Notification/ Communication Check

+ Desktop Exercise
+ Deployment Exercise
+ Level 2/3 IMT Exercise

The above tests and the testing schedule are detailed in full within the Santos Offshore Oil Spill Response Readiness Guideline (SO-91-OI-20001); an excerpt of the testing arrangements plan is provided in **Figure 5-3**. Objectives are set for the various tests identified for each of the response arrangements. The effectiveness of response arrangements against these objectives are assessed using pre-identified Key Performance Indicators (KPIs).

#	Response Arrangements & Critical Components	Type of Test	Schedule	Objectives	KPIs
1	**Source Control**				
	Source Control a) Relief Well Drilling - Access to MODU	Review - MODU Register	Once per month for the duration of drilling campaign	Identify suitable MODU that can be utilized in the event of a Source control incident requiring a relief well	Document the identified suitable MODU by: •Name •MODU Type •Location •Contract Status
	Source Control b) Well Capping - Access to Capping Stack	Review - Contract/Agreement	Annually (when drilling activity is occurring)	To confirm access to capping stack for well capping	Review to confirm access to Capping Stack through maintenance of service provision contract
	Source Control c) Access to Source Control Emergency Response Personnel	Desktop Exercise	Annually (when drilling activity is occurring)	To check arrangements for access to Well Control Specialists from WWC as per Source Control Planning and Response Guideline DR-00-OZ-20001	Confirmation (email) from WWC that listed Well Control specialists can be made available and will be mobilized within 72 hours of a notification
	Source Control d) Vessel Fuel Tank Rupture - SOPEP	Review - Plan	Prior to vessel arrival in field	To confirm that each vessel within the field has an approved SOPEP in place	Review to confirm approved SOPEP in place for vessels
2	**Operational Monitoring**				
	Operational Monitoring - Vessel Surveillance a) Access to vessels	Review - Contract/Agreement	Annually	To confirm access to vessels for surveillance	Review to confirm Master Service Agreements (MSAs) with vessel providers to gain access to vessels
	Operational Monitoring - Aerial Surveillance a) Access to aircrafts	Review - Contract/Agreement	Annually	To confirm access to aircrafts for surveillance	Review to confirm Master Service Agreements (MSAs) with aircraft providers to gain access to aircrafts for surveillance
	Operational Monitoring - Aerial Surveillance b) Access to trained aerial observers	Review - Contract/Agreement	Annually	To confirm access to trained aerial observers	Review to confirm access to trained aerial observers through; •Trained Santos personnel or •AMOSC Member Contract or •OSRL Associate Member Contract

Figure 5-3: Excerpt of testing arrangement plan, taken from Santos Offshore Oil Spill Response Readiness Guideline (SO-91-OI-20001)

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.

Source control testing arrangements have been formulated with reference to industry guidelines including the APPEA Offshore Titleholders Source Control Guideline (June 2021) and the NOPSEMA Information Paper: Source Control Planning and Procedures IP1979 (June 2021).

Source control objectives and KPIs are developed in order to test the response arrangements specified in this OPEP and the Source Control Planning and Response Guideline (DR-00-OZ-20001). In addition to objectives and KPIs, test frequency and type of test are also detailed in the Santos Offshore Oil Spill Response Readiness Guideline (SO-91-OI-20001).

For each source control exercise, a copy of the exercise materials is recorded in the EHS toolbox. Action items identified are tracked in EHS toolbox to completion. Lessons learnt are incorporated into Santos guidelines and procedures as part of a process of continual improvement.

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 MEFF plug and abandonment activities. Of the credible spill scenarios identified in the MEFF Plug and Abandonment EP (Section 7), all have been selected to represent worst-case spills from a response perspective, taking into account the following characteristics:

+ They represent all hydrocarbon types that could be spilt during MEFF plug and abandonment activities.
+ They represent maximum credible release volumes.
+ Those scenarios that represent the greatest spatial extent from a response perspective based on surface oil and shoreline accumulation as these are the key factors contributing to response.
+ Proximity to sensitive receptors, shorelines, State/Commonwealth boundaries etc.

The worst-case credible spill risks selected to inform this OPEP are presented in **Table 6-1.** The MEFF Plug and Abandonment EP (Sections 7.6 to 7.8) details the derivation of these maximum credible spills.

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 MEFF plug and abandonment activities

Worst-case credible spill scenario	Approx. depth of spill	Hydrocarbon type	Maximum credible volume released (m^3)	Release duration
LOWC – surface release	0 m	Light crude oil	15,890	77 days
LOWC – subsea release	162 m	Light crude oil	15,890	77 days
Surface diesel release	0 m	MDO	604	20 minutes

6.2 Response planning thresholds

Environmental impact assessment thresholds are addressed in Section 7.6.4 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 thresholds are provided as a guide for response planning based on case studies that have demonstrated some response strategies require certain oil spill thicknesses and conditions to be effective.

For example, 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/m^2.

Surface chemical dispersants are most effective on hydrocarbons that are at a thickness of 50–100 g/m^2 on the sea surface. EMSA (2010) recommends thin layers of spilled hydrocarbons should not be treated with dispersant. This includes Bonn Agreement Oil Appearance Codes (BAOAC) 1–3 (EMSA, 2010).

Response planning thresholds are provided in **Table 6-2.**

Table 6-2: Surface hydrocarbon thresholds for response planning

Hydrocarbon concentration (g/m²)	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
>100	Estimated floating hydrocarbon threshold for effective containment and recovery and surface dispersant application Estimated minimum shoreline accumulation threshold for shoreline clean-up

6.3 Stochastic spill modelling results

As detailed in Section 7.6.2 of the EP, modelling was conducted using a hydrocarbon analogue (SINTEF's Vale) to represent Mutineer-Exeter Crude. Across properties influencing weathering behaviour (e.g. density, boiling point curve, pour point) Vale and Mutineer-Exeter Crude are well matched (refer to Section 7.6.3 of the EP). The specific gravity/ API of the modelling analogue Vale is close to that of Mutineer-Exeter Crude. Vale has a higher proportion of heavier, more persistent components and is therefore a more conservative selection in this regard. Asphaltene content is an exact match and wax content is a very close match. These parameters are key drivers of emulsification potential, since emulsification increases with the proportion of these parameters, especially over a threshold >0.5% for asphaltene content (CSIRO, 2016).

Comparative distillation curves of Vale and Mutineer-Exeter Crude match very closely (GHD, 2021). On this basis, and in view of the similarity in other factors influencing weathering and persistence in the environment (refer Section 7.6.3 of the EP), the modelling conducted is considered representative of how Mutineer-Exeter Crude would behave in the environment.

For the purpose of spill response preparedness, outputs relating to floating oil and oil accumulated on the shoreline are most relevant (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.

The worst-case shoreline accumulation volumes and/or probability of total contact at more than 1 g/m² (percentage) for all emergent and intertidal receptors is presented in **Table 6-3** and **Table 6-4** for the surface and subsea LOWC respectively; and **Table 6-5** for the MDO scenario. For each scenario, these results represent the worst shoreline accumulation or floating oil contact probability for each receptor from all stochastic modelling runs (150 simulations) across all seasons. As a conservative measure, all intertidal reefs were classified as permanently exposed in the model, however this is only the case for the small dry emergent areas of Sandy Islet on South Scott Reef, Cunningham Island on Imperieuse Reef, and Bedwell Island on Clerke Reef. All other intertidal reefs are submerged for a large proportion of the time.

The subsea and surface LOWC scenarios have broadly similar results. The rapid surfacing time of the large oil droplets generated at the subsea discharge point yielded similar results to the surface spill, and therefore similar accumulation of surface oil on shorelines between the two scenarios.

Santos uses the modelling results for entrained oil from the worst-case scenarios for the purposes of identifying scientific monitoring priority areas (**Appendix P**). Refer to Section 7.6.4 of the EP for dissolved and entrained thresholds and Section 7.6.5 for potential impacts to receptors.

Table 6-3: Worst-case spill modelling results – Mutineer-Exeter Plug and Abandonment surface LOWC (GHD, 2022)

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation >10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >10 g/m²	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Kimberley Coast PMZ	NC	NC	10.0	65.0	16.9	0.7	91.1	13.2	34.0
Cartier Island AMP	NC	NC	16.0	67.1	0.4	3.3	67.1	0.4	0.6
Ashmore Reef AMP	NC	NC	26.7	47.6	2.2	10.7	49.4	2.0	4.0
Browse Island	NC	NC	19.3	61.3	0.6	6.0	65.6	0.6	0.5
Camden Sound	NC	NC	10.7	59.8	49.4	5.3	59.8	42.7	80.7
Seringapatam Reef	NC	NC	36.0	33.9	6.7	19.3	39.7	6.2	12.7
Scott Reef North	NC	NC	38.0	33.5	8.4	12.7	44.8	7.6	12.7
Scott Reef South#	NC	NC	45.3	33.5	50.1	28.7	39.0	49.2	51.0
Adele Island	NC	NC	15.3	54.9	18.0	8.0	54.9	18.0	3.2
King Sound	NC	NC	15.3	40.2	66.7	7.3	45.1	58.2	68.0
Broome North Coast	NC	NC	17.3	28.9	52.7	6.0	28.9	47.6	97.7
Clerke Reef MP#	3.3	28.3	75.3	12.6	184.4	52.7	12.6	183.6	34.0
Imperieuse Reef MP#	3.3	17.3	76.7	8.2	498.5	66.7	8.2	497.8	46.7
Port Hedland-Eighty Mile Beach	NC	NC	6.7	25.4	4.5	2.0	42.8	1.0	4.2

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation >10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >10 g/m²	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Karratha-Port Hedland	NC	NC	5.3	43.5	0.8	NC	NC	NC	NC
Dampier Archipelago	NC	NC	10.7	7.7	1.9	0.7	54.4	0.9	4.2
Northern Islands Coast	NC	NC	4.0	48.2	2.2	0.7	92.9	1.3	4.2
Montebello Islands	NC	NC	49.3	14.4	21.1	15.3	14.4	20.2	25.5
Lowendal Islands	NC	NC	9.3	27.9	0.9	2.0	46.8	0.9	4.2
Barrow Island	NC	NC	58.0	11.3	34.9	21.3	17.5	33.3	42.5
Middle Islands Coast	NC	NC	4.7	46.6	1.0	NC	NC	NC	NC
Thevenard Islands	NC	NC	26.0	16.9	2.3	5.3	28.1	2.3	4.2
Southern Islands Coast	NC	NC	44.0	13.5	5.2	16.0	15.5	5.2	8.5
Muiron Islands	NC	NC	46.0	14.1	4.6	22.0	14.1	4.6	8.5
Exmouth Gulf Coast	NC	NC	2.7	54.8	0.2	NC	NC	NC	NC
Ningaloo Coast North	NC	NC	54.0	16.9	15.3	8.7	25.2	7.9	21.2
Ningaloo Coast South	NC	NC	24.7	31.1	2.3	NC	NC	NC	NC
Shark Bay – Coast Outer	NC	NC	16.7	48.6	3.4	NC	NC	NC	NC

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation >10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >10 g/m²	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Zuytdorp Cliffs – Kalbarri	NC	NC	6.0	68.2	1.0	NC	NC	NC	NC
Kalbarri – Geraldton	NC	NC	2.0	66.1	0.2	NC	NC	NC	NC
Geraldton – Jurien Bay	NC	NC	0.7	101.1	0.1	NC	NC	NC	NC
Abrolhos Islands Wallabi Group	NC	NC	4.7	67.3	0.2	NC	NC	NC	NC
Abrolhos Islands Easter Group	NC	NC	2.0	76.7	0.3	NC	NC	NC	NC
Abrolhos Islands Pelsaert Group	NC	NC	6.0	58.1	0.3	NC	NC	NC	NC
Rottnest Island	NC	NC	2.0	88.9	0.2	NC	NC	NC	NC
Geographe Bay – Augusta	NC	NC	1.3	66.7	0.1	NC	NC	NC	NC
Indonesia – East	NC	NC	25.3	48.3	44.0	12.0	48.3	16.9	51.0
Indonesia – West	NC	NC	8.0	63.2	50.2	4.7	67.5	31.2	93.5
Geographe Bay	NC	NC	0.7	91.2	0.1	NC	NC	NC	NC
Eighty Mile Beach	NC	NC	6.7	30.1	4.5	NC	NC	NC	NC
Broome – Roebuck	NC	NC	10.7	32.3	6.5	4.0	32.3	4.1	12.7

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation >10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >10 g/m²	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Roebuck – Eighty Mile Beach	NC	NC	8.0	43.2	1.4	NC	NC	NC	NC
Jurien Bay – Yanchep	NC	NC	3.3	81.7	0.2	NC	NC	NC	NC
Perth Northern Coast	NC	NC	2.0	102.5	0.2	NC	NC	NC	NC
Bedout Island	NC	NC	8.0	24.2	1.7	6.0	27.0	1.7	1.1
Christmas Island	NC	NC	20.7	51.6	5.4	5.3	51.6	3.9	17.0
Mermaid Reef AMP	4.0	19.5	NC	NC	NC	NC	NC	NC	NC
Glomar Shoals	17.3	4.4	NC	NC	NC	NC	NC	NC	NC
Rankin Bank	8.0	22.0	NC	NC	NC	NC	NC	NC	NC
Montebello AMP	4.7	10.2	NC	NC	NC	NC	NC	NC	NC
Rowley Shoals surrounds	31.3	6.4	NC	NC	NC	NC	NC	NC	NC
Ningaloo – Offshore	17.3	7.8	NC	NC	NC	NC	NC	NC	NC

The spill model treats these receptors as completely emergent features (all of the intertidal reef + islands) and consequently has likely significantly overestimated the amount of oil that would accumulate at these receptors, which are mostly intertidal receptors with small sandy islands

Table 6-4: Worst-case spill modelling results – Mutineer-Exeter Plug and Abandonment subsea LOWC (GHD, 2022)

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation >10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >10 g/m²	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Kimberley Coast PMZ	NC	NC	10.0	65.6	11.9	0.7	93.3	7.7	21.2
Cartier Island AMP	NC	NC	16.7	59.5	0.2	3.3	69.9	0.2	0.6
Ashmore Reef AMP	NC	NC	28.0	47.7	2.7	10.7	59.4	2.7	5.0
Browse Island	NC	NC	18.0	60.5	0.4	6.7	60.5	0.4	0.5
Camden Sound	NC	NC	10.7	50.6	41.2	5.3	57.6	36.9	72.2
Seringapatam Reef	NC	NC	38.7	33.9	7.8	20.0	33.9	7.8	17.0
Scott Reef North	NC	NC	38.0	33.4	7.1	12.7	47.5	6.2	17.0
Scott Reef South#	NC	NC	44.7	33.5	39.4	30.7	35.7	38.5	46.7
Adele Island	NC	NC	16.0	50.4	22.9	9.3	50.4	22.9	3.2
King Sound	NC	NC	16.0	36.8	50.9	7.3	45.1	44.2	59.5
Broome North Coast	NC	NC	17.3	29.9	63.3	6.7	29.9	58.2	123.2
Clerke Reef MP#	NC	NC	71.3	12.4	192.6	54.0	12.4	192.6	34.0
Imperieuse Reef MP#	NC	NC	76.0	8.5	502.8	65.3	8.5	501.8	46.7
Port Hedland-Eighty Mile Beach	NC	NC	6.7	12.4	10.9	6.7	12.4	5.9	12.7

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation >10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >10 g/m²	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Karratha-Port Hedland	NC	NC	6.7	27.1	2.8	NC	NC	NC	NC
Dampier Archipelago	NC	NC	15.3	5.5	3.7	2.7	17.5	1.3	4.2
Northern Islands Coast	NC	NC	6.7	29.8	1.6	NC	NC	NC	NC
Montebello Islands	NC	NC	48.7	13.4	16.6	12.7	13.9	16.6	25.5
Lowendal Islands	NC	NC	10.0	29.6	1.4	1.3	58.8	1.4	4.2
Barrow Island	NC	NC	49.3	14.0	30.3	19.3	16.9	29.2	38.2
Middle Islands Coast	NC	NC	6.7	45.0	1.7	1.3	57.5	1.2	4.2
Thevenard Islands	NC	NC	21.3	16.8	1.5	5.3	29.9	1.5	4.2
Southern Islands Coast	NC	NC	37.3	12.8	2.9	10.0	12.8	2.8	8.5
Muiron Islands	NC	NC	44.0	13.5	2.9	11.3	13.5	2.4	8.5
Exmouth Gulf Coast	NC	NC	0.7	30.6	0.2	NC	NC	NC	NC
Ningaloo Coast North	NC	NC	52.0	15.9	13.2	5.3	24.8	5.4	21.2
Ningaloo Coast South	NC	NC	20.7	25.8	1.9	NC	NC	NC	NC
Carnarvon – Inner Shark Bay	NC	NC	1.3	83.8	0.1	NC	NC	NC	NC

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation >10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >10 g/m²	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Shark Bay – Coast Outer	NC	NC	17.3	45.1	1.5	NC	NC	NC	NC
Zuytdorp Cliffs – Kalbarri	NC	NC	4.0	59.1	0.4	NC	NC	NC	NC
Kalbarri – Geraldton	NC	NC	2.0	69.2	0.2	NC	NC	NC	NC
Geraldton – Jurien Bay	NC	NC	2.7	70.8	0.2	NC	NC	NC	NC
Abrolhos Islands Wallabi Group	NC	NC	2.0	74.2	0.3	NC	NC	NC	NC
Abrolhos Islands Easter Group	NC	NC	2.7	75.4	0.3	NC	NC	NC	NC
Abrolhos Islands Pelsaert Group	NC	NC	1.3	72.8	0.2	NC	NC	NC	NC
Geographe Bay – Augusta	NC	NC	1.3	101.4	0.1	NC	NC	NC	NC
Indonesia – East	NC	NC	28.7	48.7	49.9	12.0	48.7	25.9	76.5
Indonesia – West	NC	NC	8.0	64.1	47.3	6.0	64.1	26.6	85.0
Mandurah – Dawesville	NC	NC	0.7	95.0	0.1	NC	NC	NC	NC
Eighty Mile Beach	NC	NC	7.3	32.1	9.2	0.7	63.4	1.3	4.2
Broome – Roebuck	NC	NC	10.7	32.1	7.8	4.0	32.1	4.1	12.7

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation >10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >10 g/m²	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Roebuck – Eighty Mile Beach	NC	NC	8.7	43.4	2.1	0.7	54.4	0.9	4.2
Jurien Bay – Yanchep	NC	NC	4.7	63.7	0.2	NC	NC	NC	NC
Perth Northern Coast	NC	NC	1.3	84.8	0.1	NC	NC	NC	NC
Bedout Island	NC	NC	8.7	23.2	3.5	7.3	23.2	3.5	1.1
Christmas Island	NC	NC	22.0	52.6	5.0	5.3	59.1	4.0	12.7
Minor Indonesian Islands	NC	NC	0.7	96.0	0.4	NC	NC	NC	NC
Mermaid Reef AMP	2.0	19.6	NC	NC	NC	NC	NC	NC	NC
Imperieuse Reef MP	6.7	16.8	NC	NC	NC	NC	NC	NC	NC
Glomar Shoals	20.7	3.7	NC	NC	NC	NC	NC	NC	NC
Rankin Bank	4.7	37.8	NC	NC	NC	NC	NC	NC	NC
Montebello AMP	5.3	10.1	NC	NC	NC	NC	NC	NC	NC
Rowley Shoals surrounds	30.0	6.3	NC	NC	NC	NC	NC	NC	NC
Ningaloo – Offshore	18.0	7.4	NC	NC	NC	NC	NC	NC	NC

[#] *The spill model treats these receptors as completely emergent features (all of the intertidal reef + islands) and consequently has likely significantly overestimated the amount of oil that would accumulate at these receptors, which are mostly intertidal receptors with small sandy islands*

Table 6-5: Worst-case spill modelling results – vessel collision (marine diesel oil) (GHD, 2021)

Location	Total contact probability (%) floating oil >1 g/m²	Minimum arrival time floating oil >1 g/m² (days)	Total probability (%) shoreline oil accumulation >10 g/m²	Minimum arrival time shoreline oil accumulation >10 g/m² (days)	Total probability (%) shoreline oil accumulation >100 g/m²	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Maximum length of shoreline oiled (km) >100 g/m²
Clerke Reef MP#	NC	NC	0.3	14.7	NC	NC	NC	NC
Imperieuse Reef MP#	0.3	16.3	1.5	10.0	0.5	11.7	12.4	11.0
Southern Islands Coast	NC	NC	0.3	10.8	NC	NC	NC	NC
Glomar Shoals	2.0	0.4	NC	NC	NC	NC	NC	NC
Montebello AMP	0.3	4.8	NC	NC	NC	NC	NC	NC
Rowley Shoals surrounds	2.8	6.8	NC	NC	NC	NC	NC	NC
Ningaloo – Offshore	0.8	4.8	NC	NC	NC	NC	NC	NC

#The spill model treats these receptors as completely emergent features (all of the intertidal reef + islands) and consequently has likely significantly overestimated the amount of oil that would accumulate at these receptors, which are mostly intertidal receptors with small sandy islands

6.4 Deterministic modelling

Deterministic modelling is a useful tool for response planning. It uses a single spill run from the group of stochastic runs to help understand the likely behaviour and impacts of a single simulation of a worst-case spill scenario. This allows for effective scaling of response strategies.

The Santos approach for containment and recovery and dispersant application planning is to undertake these responses only outside of a defined exclusion zone around the well. The intention of the exclusion zone is to allow the majority of natural evaporation (which is the primary weathering mechanism for this oil) to occur prior to responding to the surface oil. An exclusion zone of 18 km was determined to be appropriate for this instance, based on the distance surface oil would travel with a typical current speed, and allowing an average travel time of 24 hours to allow the majority of natural evaporation to occur. For informing containment and recovery, the realisation that resulted in the greatest weekly averaged surface oil with a thickness exceeding 50 µm outside of the exclusion zone was selected.

The deterministic results for shoreline accumulation >100 g/m^2 were interrogated for shoreline clean-up planning purposes (**Section 15.4**).

6.4.1 Surface loss of well control scenario

Upon interrogating the stochastic results for containment and recovery planning, only two model cells outside of the exclusion zone were noted to have surface oil (emulsion) thicknesses that exceeded the recovery/dispersant response threshold of 50 µm. Furthermore, the maximum exposure time for oil exceeding 50 µm within either of these two cells was only 2 hours (i.e. one model timestep), indicating natural weathering processes rapidly mitigate thick oil slicks for this scenario. On this basis of these observations, deterministic simulations to inform containment and recovery and dispersant application were deemed to be unnecessary.

To inform shoreline clean-up, deterministic simulations were undertaken for stochastic realisation #127 which resulted in the highest accumulated shoreline above 100 g/m^2 of 675 tonnes across all shorelines. A summary of the deterministic results is presented in **Table 6-6**.

Table 6-6: Surface LOWC realisation #127- Summary of shoreline accumulation exceeding 100 g/m^2 (GHD, 2022)

Receptor	Peak mass ashore (tonnes)	Minimal Arrival (days)	Peak loading (days)	Maximum length of shoreline oiled (km)
Adele Island	3.2	56.9	72.6	3.2
King Sound	6.4	65.2	100.1	17.0
Lacepede Islands	6.4	43.7	86.1	4.2
Broome North Coast	18.8	62.8	85.0	63.7
Clerk Reef MP	66.7	33.1	101.9	29.7
Imperieuse Reef MP	373.2	30.7	94.4	42.5
Broome- Roebuck	2.5	67.2	84.2	4.2

6.4.2 Subsea loss of well control scenario

Interrogation of the stochastic results showed that no realisations beyond the 18 km exclusion zone exceed the recovery/dispersant response threshold of 50 µm.

To inform shoreline clean-up, deterministic simulations were undertaken for stochastic realisation #127 which resulted in the highest accumulated shoreline above 100 g/m^2 of 679 tonnes across all shorelines. A summary of the deterministic results is presented in **Table 6-7**.

Table 6-7: Subsurface LOWC realisation #127- Summary of shoreline accumulation exceeding 100 g/m² (GHD, 2022)

Receptor	Peak mass ashore (tonnes)	Minimal Arrival (days)	Peak loading (days)	Maximum length of shoreline oiled (km)
Camden Sound	0.9	94.9	100.0	4.2
Adele Island	2.6	56.3	86.0	3.2
King Sound	6.5	66.3	81.1	21.2
Lacepede Islands	6.3	42.8	86.8	4.2
Broome North Coast	35.7	52.3	75.7	89.2
Clerke Reef MP	66.4	34.2	104.8	29.7
Imperieuse Reef MP	364.3	30.8	91.3	42.5
Broome- Roebuck	2.4	66.1	85.0	4.2

6.5 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 6-8**).

Note: The information contained in **Table 6-8** 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 2/3 spills within or entering State waters, DoT will ultimately determine the strategies and controls implemented for most State water activities with Santos providing resources and planning assistance.

Table 6-8: Evaluation of applicable response strategies

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Mutineer-Exeter Crude	MDO	
Source Control	Spill kits	✓ 1	✓ 1	Relevant for containing spills that may arise onboard a vessel.
	Secondary containment	✓ 1	✓ 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	✗	✓ 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. 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.
	Capping stack	✓ 2	✗	A Capping Stack installed onto a subsea wellhead can be used to divert the flow of hydrocarbons and potentially reduce the release rate of hydrocarbons prior to well kill via a relief well. Capping stack is a secondary response measure with deployment limited to appropriate conditions (e.g., blowout rates within safe operating limits, safe vertical access) and when operating conditions permit (wind speed, wave height, current and plume radius). Debris clearance using the Subsea First Response Toolkit (SFRT) would be implemented prior to Capping Stack installation.
	Relief well drilling	✓ 1	✗	Relevant to LOWC. Relief well drilling is the primary method for killing the blow-out well. To be conducted as per the Source Control Emergency Response Plan (DR-00-OZ-20001) and Well-specific Source Control Plan.
In-Situ Burning	Controlled burning of oil spill	✗	✗	Not applicable to wells with light hydrocarbons due to safety hazards. Not applicable to diesel spills due to inability to contain marine diesel 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.

<table>
<tr><th rowspan="2">OSR Strategy</th><th rowspan="2">Tactic</th><th colspan="2">Applicability and Designated Primary (1) or Secondary (2) Response Strategy</th><th rowspan="2">Considerations</th></tr>
<tr><th>Mutineer-Exeter Crude</th><th>MDO</th></tr>
<tr><td rowspan="5">Monitor and Evaluate Plan (Operational Monitoring)</td><td>Vessel surveillance</td><td>✓ 1</td><td>✓ 1</td><td>Provides real-time information on spill trajectory and behaviour (e.g. weathering).
Informs implementation of other response strategies.
Vessel personnel may not be trained observers.
Vessel observers on leaking vessel may not have capacity to observe oil during emergency response procedure implementation.
Constrained to daylight.
Limited to visual range from the vessel.
Limited capacity to evaluate possible interactions with sensitive receptors.</td></tr>
<tr><td>Aerial surveillance</td><td>✓ 1</td><td>✓ 1</td><td>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.</td></tr>
<tr><td>Tracking buoys</td><td>✓ 1</td><td>✓ 1</td><td>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).</td></tr>
<tr><td>Trajectory Modelling</td><td>✓ 1</td><td>✓ 1</td><td>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.</td></tr>
<tr><td>Satellite Imagery</td><td>✓ 1</td><td>✓ 1</td><td>Can work under large range of weather conditions (e.g. night-time, cloud cover, etc.).
Mobilisation restricted to image availability.</td></tr>
</table>

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Mutineer-Exeter Crude	MDO	
				Requires processing. May return false positives.
	Operational Water Quality Monitoring	✓ 1	✓ 1	Fluorometry surveys are used to determine the location and distribution of the entrained oil and dissolved aromatic hydrocarbon components of a continuous subsea spill and validate the spill fate modelling predictions.
	Shoreline Clean-up Assessment	✓ 1	✓ 1	Provides information on shoreline oiling (state of the oil, extent of pollution, etc). Can provide information on amenability of shoreline response options (e.g. clean-up, protect and deflect). Provides information on status of impacts to sensitive receptors. Considerable health & safety considerations. Requires trained observers. Constrained to daylight. Delayed response time.
Chemical dispersion	Vessel Application	✓ 2	✗	**Mutineer-Exeter Crude** Spill modelling of the surface LOWC scenario predicted that natural weathering processes result in no slicks > 50 g/m^2 (which is typically considered the lowest threshold for effective surface dispersant application), with an exposure time > 2 hours, and outside of the 18 km exclusion zone. Interrogation of the stochastic modelling results revealed that only two model cells outside of the exclusion zone had a surface oil thickness that exceeded 50 g/m^2, however, this only lasted 2 hours before reducing in thickness to below 50 g/m^2. Hence chemical dispersant application is a secondary response strategy, limited to amenable scenarios at the time of a spill, where the surface slick thickness exceeds 50 g/m^2 and is over an exposure timeframe that allows surface dispersants application to occur. **Marine Diesel** Marine diesel is not considered a persistent hydrocarbon and has high natural dispersion rates in the marine environment. Chemical dispersant application is not recommended as a beneficial option for diesel 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.
	Aerial Application	✓ 2	✗	

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Mutineer-Exeter Crude	MDO	
	Subsea dispersant injection (SSDI)	✓ 2 (subsea only)	✗	The subsea LOWC scenario has relatively low entrainment due to the relatively slow-release rates of oil, gas and water for this scenario. The low velocity of the subsea plume results in minor turbulence at the discharge point and allows for the formation of relatively large oil droplets that have high associated buoyancies and reach the sea surface in a relatively short duration (GHD, 2022). Evaporation is the primary weathering mechanism for the modelling analogue Vale and under moderate wind speeds of 5 m/s, approximately 60% of the surface slick evaporates after 5 days, while a further ~18% is dispersed into the water column and the surface slick makes up the remaining ~22%. SSDI is shown to reduce surface concentrations of hydrocarbons, thereby reducing the exposure of seabirds and surfacing marine fauna to hydrocarbons (French-McCay et al., 2018). A potential drawback of this response tactic is that it will result in smaller droplet sizes and entrainment of hydrocarbons into the water column, which may affect some oceanic and benthic organisms (e.g. fish, plankton). However, this is likely to be temporary and restricted to the top ~3 m of the water column whilst SSDI is being used (RPS, 2019). This increase in entrainment is partially offset by significant increases in biodegradation rates. SSDI is known to reduce VOC levels at the sea surface (French-McCay and Cowley, 2018), making conditions safer for responders and source control personnel. In this case, SSDI may have an overall environmental benefit, as enabling source control personnel access to the site to bring the release under control (e.g. for BOP intervention and/or deployment of Capping Stack) may reduce the overall volume of hydrocarbons being released into the environment. SSDI would be employed as a secondary strategy and only if it was determined to have an overall environmental benefit in consideration of enhancing safety for source control personnel and environmental benefits associated with a reduction in the surface oil versus potential detrimental environmental impacts (such as increased toxicity and reducing the opportunity for evaporation).
Offshore Containment and Recovery	Use of offshore booms/ skimmers or other collection techniques deployed from vessel/s to	✓ 2	✗	**Mutineer-Exeter Crude** Spill modelling of the surface LOWC scenario predicted that natural weathering processes result in no slicks > 50 g/m², with an exposure time >2 hours, and outside of the 18 km exclusion zone. Interrogation of the stochastic modelling results revealed that two model cells outside of the exclusion zone had a surface oil thickness that exceeded 50 g/m², however, this only lasted 2 hours before

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Mutineer-Exeter Crude	MDO	
	contain and collect oil			reducing in thickness to below 50 g/m^2. Containment and recovery is therefore a secondary response strategy which may be considered at the time of a spill based on the criteria outlined in **Table 11-2**. **Marine Diesel** Not suitable for marine diesel given its rapid weathering nature. Marine diesel spreads quickly to a thin film, making recovery via skimmers difficult and ineffective.
Mechanical Dispersion	Vessel prop- washing	✓ 2	✓ 2	Safety is a key factor and slicks with potential for high volatile organic compound (VOC) emission are not suitable. 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. 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. Marine diesel 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. Mechanical dispersion may be considered for targeted small breakaway patches of crude but may have limited effectiveness. 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 ad 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 entrained so is most beneficial in calm conditions) and the type, proximity and depth (as applicable) of sensitivities in the area. 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 undertaking primary strategies may be used opportunistically.

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Mutineer-Exeter Crude	MDO	
Protection and Deflection	Booming in nearshore waters and at shorelines	✓ 1	✓ 2	**Mutineer-Exeter Crude** Modelling shows high probability of contact, above impact and response thresholds for the LOWC scenarios. The effectiveness of this response will be dependent on local bathymetry, sea state, currents, tidal variations and wind conditions at the time of implementation. It is typically more effective in areas with low to moderate tidal ranges on low energy coastline types such as sandy beaches. Moderate to high tidal ranges generally include stronger currents and larger/longer intertidal areas that make it less effective and more difficult to keep booms in place. Protection and deflection are feasible in locations where access to the coastline allows vehicles and vessels to undertake operations. Activities would focus on areas of high protection value in low energy environments based upon real time operational surveillance, provided the environmental and metocean conditions are favourable for an effective implementation. Consequently, this strategy may not be applicable across all areas or receptors identified as priority for protection. **Marine Diesel** Modelling shows very low probability of contact with shorelines and minimal shoreline accumulation >100 g/m^2. 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 marine diesel, it would be better to focus on the priority area for protection. This strategy is 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 marine diesel.
Shoreline clean-up	Activities include physical removal, surf washing, flushing, bioremediation, natural dispersion	✓ 1	✓ 2	**Mutineer-Exeter Crude** Shoreline clean-up has the ability to reduce stranded oil on shorelines and/or reduce remobilisation of oil. However, this response has potential to cause more impacts than benefits, especially if oiling is light. Shoreline assessments as part of operational monitoring provide site-specific guidance on the applicability and likely benefits of different clean-up techniques. Intrusive activities such as physical removal of waste using manual labour or mechanical aids requires careful site-specific planning to reduce secondary impacts of habitat disturbance, erosion and spreading oil beyond shorelines. Secondary impacts can be minimised through the use of trained personnel to lead operations. Logistically, clean-up operations will require site access,

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Mutineer-Exeter Crude	MDO	
				decontamination, waste storage, personal protective equipment, catering and transport services to support personnel working on shorelines. Flushing may be considered if the oil enters high priority/slow recovery habitats such as mangroves. Natural dispersion will occur as the hydrocarbon is remobilised from rock shelves and hard substrates, while residual hydrocarbons will biodegrade. **Marine Diesel** Modelling shows 0.5% probability of shoreline accumulation at more than 100 g/m². 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 marine diesel, it would be better to focus on high priority areas for clean-up. This strategy is considered to be a secondary response strategy for MDO where it is safe and practical to implement and where protection priority areas are at risk of impacts from marine diesel.
Oiled wildlife response	Activities include hazing, pre-emptive capture, oiled wildlife capture, cleaning and rehabilitation	✓ 1	✓ 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 and associated	✓ 1	✓ 1	Monitoring activities include: + 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 + marine megafauna (incl. whale sharks and mammals)

OSR Strategy	Tactic	Applicability and Designated Primary (1) or Secondary (2) Response Strategy		Considerations
		Mutineer-Exeter Crude	MDO	
	response activities			+ marine reptiles (incl. turtles) + seafood quality + fish, fisheries and aquaculture 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.

6.6 Identification of priority protection areas and initial response priorities

Combined spill modelling results were used to predict the Environment that may be Affected (EMBA) for MEFF plug and abandonment activities (refer to Section 3.1 of the MEFF Plug and Abandonment EP (9885-236-EMP-0002)). The EMBA is the largest area within which effects from hydrocarbon spills associated with this activity, could extend. Within the EMBA, Santos has determined Hot Spots (key areas of high ecological value that have the greatest potential to be impacted by a MEFF plug and abandonment spill) for which detailed oil spill risk assessment has been conducted (refer to Section 7.6.5 of the MEFF Plug and Abandonment EP).

From these Hot Spot areas, priority protection areas for spill response have been identified. In the spill response preparedness strategy, it is not necessary for all Hot Spots to have detailed planning. For example, wholly submerged Hot Spots may only be contacted by entrained oil, and the response would be largely to implement scientific monitoring to determine impact and recovery. Hot Spots with features that are not wholly submerged (i.e., emergent features) are considered for Priority for Protection. This final determination of ‘Priority for Protection’ sites, for the oil spill response strategy, is based on the worst-case estimate of floating oil concentration, shoreline accumulation and minimum contact time at response threshold concentrations. **Table 6-9** details the hotspots and Priority Protection Areas (PPA) from the list of contacted receptors from both the subsea and surface LOWC scenarios. Rationale is included in the table when a hotspot is included, or not included, as a priority for protection.

Table 6-9: Determination and rationale for the priorities for protection

Hotspots	Type	HEV ranking	Hotspot	PPA	Rationale
Ashmore Reef AMP	Emergent	1	Y	N	+ Prolonged time to contact
Camden Sound	Emergent	3	Y	N	+ Prolonged time to contact
Scott Reef North	Intertidal	3	Y	N	+ Prolonged time to contact
Scott Reef South	Emergent	3	Y	N	+ Prolonged time to contact
Adele Island*	Emergent	5	Y	N	+ Prolonged time to contact
Broome North Coast*	Emergent	4	Y	N	+ Prolonged time to contact
Clerke Reef MP	Emergent	3	Y	Y	+ High shoreline accumulation + Short time to contact + HEV rank 3
Imperieuse Reef MP	Emergent	3	Y	Y	+ High shoreline accumulation + Short time to contact + HEV rank 3
Montebello Islands	Emergent	3	Y	Y	+ Shoreline accumulation + Short time to contact + HEV rank 3
Barrow Island	Emergent	3	Y	Y	+ Shoreline accumulation + Short time to contact + HEV rank 3

Hotspots	Type	HEV ranking	Hotspot	PPA	Rationale
Muiron Islands	Emergent	2	Y	Y	+ Shoreline accumulation + Short time to contact + HEV rank 2
Ningaloo Coast North	Emergent	2	Y	N	+ Prolonged time to contact

** Discretionary hotspots are further described in the EP, Section 7.6.5.3*

Table 6-10 lists the key sensitivities and associated locations within the protection priority areas identified for both the subsea and surface loss of well control worst-case spill scenarios. **Table** 6-11 presents the priorities for protection for the diesel scenario. The ranking of these sensitivities (also referred to as receptors) are listed, which is consistent with the rankings in Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Assessment for Zone 1: Kimberley (Advisian, 2018) and Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Assessment for Zone 2: Pilbara (Advisian, 2017). Using a combination of sensitivities, and their associated rankings; together with the modelled maximum total volumes ashore and minimum time to shoreline contact, an initial response priority is provided in **Table 6-10** and **Table** 6-11**.** This information is designed to aid decision making in the preliminary stages of the response operation, so that initial resources are used for best effect.

Table 6-10: Initial response priorities- MEFF subsea and surface loss of well control (Mutineer-Exeter crude)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[11]	DoT Ranking (Dissolved oil)	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Imperieuse Reef MP	Turtles Green turtles (Vulnerable) and hawksbill turtles (Vulnerable) known to be present – not regionally significant habitat	2	1	N/A	N/A	Subsea LOWC: 501.8 Surface LOWC: 497.8	Subsea LOWC: 8.5 Surface LOWC: 8.2	Medium
	Marine mammals Humpback whale migration	2	1	N/A	Peak between June –Aug			Low
	Birds Wide range of seabirds observed	2	1	N/A	N/A			Medium
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			Medium
	Socioeconomic Tourism – charter boats, diving and snorkelling Recreational fishing (limited numbers due to distance from coast)	1	1	N/A	Tourism: Sep to Dec			Low

[11] Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Assessment for Zone 2: Pilbara (DoT, 2017).

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[11]	DoT Ranking (Dissolved oil)	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Clerke Reef MP	Turtles Green turtles (Vulnerable) and hawksbill turtles (Vulnerable) known to be present – not regionally significant habitat	2	1	N/A	N/A	Subsea LOWC: 192.6 Surface LOWC: 183.6	Subsea LOWC: 12.4 Surface LOWC: 12.6	Medium
	Marine mammals Humpback whale migration	2	1	N/A	Peak between June –Aug			Low
	Birds Second largest breeding colony on red-tailed tropicbirds (Migratory) in Australia Wide range of seabirds observed	2	1	Bedwell Island	Nesting: Sept to Feb			Medium
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[11]	DoT Ranking (Dissolved oil)	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Socioeconomic Tourism – charter boats, diving and snorkelling Recreational fishing (limited numbers due to distance from coast)	1	1	N/A	Tourism: Sep to Dec			Low
Barrow Island	Mangroves	3	3	Bandicoot Bay	N/A	Subsea LOWC: 29.2 Surface LOWC: 33.3	Subsea LOWC: 16.9 Surface LOWC: 17.5	Medium
	Turtles Regionally and nationally significant green (western side) and flatback turtle (eastern side) nesting beaches, Turtle Bay north beach, North and west coasts- John Wayne Beach, loggerheads and hawksbill	4	3	Green turtles on the western side of Barrow Island and flatback turtle nesting on the eastern side. Turtle Bay north beach, North and west coasts and John Wayne Beach have loggerhead and hawksbill turtle nesting	Year round, peaking Oct to Jan			High

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[11]	DoT Ranking (Dissolved oil)	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Birds Migratory birds (important habitat); Double Island has important bird nesting sites (shearwaters and sea eagles)	2	1	Double Islands, migratory birds at Bandicoot Bay and widespread on Barrow Island	Nesting: Sep to Feb			Low
	Coral and other subsea benthic primary producers	3	4	Eastern side – Biggada Reef	Coral spawning: Mar & Oct			Medium
	Socio-economic Significant for recreational fishing and charter boat tourism, Nominated place (National heritage), Industry – Reverse Osmosis Plant and port operations Petroleum Activities such as Barrow Island petroleum production	5	5	Reverse Osmosis plant and port on eastern side of island (Port of Barrow Island)	N/A			Medium

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[11]	DoT Ranking (Dissolved oil)	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Montebello Islands	Mangroves	3	3	Widespread and present in lagoons. Important stands in Stephenson Channel	N/A	Subsea LOWC: 16.6 Surface LOWC: 20.2	Subsea LOWC: 13.9 Surface LOWC: 14.4	Medium
	Turtles Loggerhead (Endangered) and green (Vulnerable) (significant rookeries); hawksbill (Vulnerable), flatback (Vulnerable) turtles	4	3	Northwest and Eastern Trimouille Islands (hawksbill) Western Reef and Southern Bay at Northwest Island (green)	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan			Medium
	Marine mammals Pygmy blue whale (Vulnerable) and humpback whale migration area	3	2	N/A	Pygmy blue whale migration: Apr to Aug Humpback whale peak migration between June – Aug			Low

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[11]	DoT Ranking (Dissolved oil)	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
	Birds Migratory and threatened seabirds – at least 14 species Significant nesting, foraging and resting areas	3	2	Widespread	Nesting: Sep to Feb			Medium
	Coral and other subsea benthic primary producers	3	4	Widespread	Coral spawning: Mar & Oct			Low
	Socio-economic Pearling (inactive/pearling zones) Very significant for recreational fishing and charter boat tourism (Marine Management Area) Social amenities and other tourism Nominated place (national heritage)	3	2	Widespread	Year-round			Low

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[11]	DoT Ranking (Dissolved oil)	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Muiron Islands	<u>Turtles</u> Turtle nesting – major loggerhead (Endangered) site, significant Green turtle (Vulnerable) nesting site, low density Hawksbill nesting (Vulnerable), occasional Flatback (Vulnerable) presence	4	3	Loggerhead – South Island	Turtle nesting and breeding Nov to Mar with peak in late Dec/early Jan	Subsea LOWC: 2.4 Surface LOWC: 4.6	Subsea LOWC: 13.5 Surface LOWC: 14.1	High
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning Mar & Oct			Medium
	Seabird nesting	2	1	Widespread	Nesting: Sep–Feb			Low
	Humpback whale migration	3	2	N/A	Peak between June –Aug			Medium
	Exmouth gulf prawn fishery (Muiron is western boundary); significant for recreational fishing and charter boat tourism	1	2		Prawn fishery – April to November Tourism and recreation: year-round			Low

Santos

Table 6-11: Initial response priorities- vessel collision (marine diesel oil)

Protection Priority Area	Key sensitivities	DoT Ranking (Floating oil)[12]	DoT Ranking (Dissolved oil)	Key locations	Relevant key periods	Maximum total accumulated oil ashore (tonnes) >100 g/m²	Minimum arrival time accumulated oil ashore >100 g/m² (days)	Initial response priority
Imperieuse Reef MP	Turtles Green turtles (Vulnerable) and hawksbill turtles (Vulnerable) known to be present – not regionally significant habitat	2	1	N/A	N/A	MDO spill: 12.4	MDO spill: 11.7	Medium
	Marine mammals Humpback whale migration	2	1	N/A	Peak between June –Aug			Low
	Birds Wide range of seabirds observed	2	1	N/A	N/A			Medium
	Coral and other subsea benthic primary producers	3	4	N/A	Coral spawning: Mar & Oct			Medium
	Socioeconomic Tourism – charter boats, diving and snorkelling Recreational fishing (limited numbers due to distance from coast)	1	1	N/A	Tourism: Sep to Dec			Low

[12] Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Assessment for Zone 2: Pilbara (DoT, 2017).

6.6.1 Tactical Response Plans for Priority Protection Areas

Santos Tactical Response Plans (TRPs) are in place for certain receptors (**Table 6-12**), identifying suitable response strategies, equipment requirements, relevant environmental information, and access and permit requirements. TRPs are to be used by the IMT for first strike and ongoing activities and to assist in informing the appropriate responses for inclusion in an IAP.

Not all PPA's require TRPs in place. The requirement for a TRP considers the predicted time to contact to a PPA from accumulated or floating hydrocarbons in <10 days (above the response planning thresholds defined in **Section 6.2**). Ten days allows two days to get services procured; six days to draft the TRP; and two days to implement. The Sensitivity Ranking (HEV and DoT), and accessibility (i.e. on mainland compared to a remote island location) are also considered.

A TRP will also be considered should the impact from hydrocarbon be considerable (high accumulation, large floating oil contact). Where TRPs are unavailable for areas likely to be contacted, refer to other sources of information such as aerial photography, Oil Spill Response Atlas, Pilbara Region Oiled Wildlife Response Plan and WAMOPRA. Additionally, TRPs for contacted receptors will be sought from other operators where possible.

Table 6-12: Tactical Response Plans for Priority Protection Areas

PPA	TRP Evaluation	Existing TRP
Imperieuse Reef MP	A TRP already exists for Imperieuse Reef	Yes
Clerke Reef	A TRP already exists for Clerke Reef	Yes
Muiron Islands	A TRP already exists for Muiron Islands	Yes
Montebello Islands	A TRP already exists for: + Montebello 1: Claret Bay + Montebello 2: Sherry Lagoon entrance + Montebello 3: Hock Bay + Montebello 4: Stephenson Channel, north + Montebello 5: Hermite – Delta Island channel + Montebello 6: Champagne Bay – Chippendal Channel + Montebello 7: North Channel and Kelvin Channel	Yes
Barrow Island	NWS OSCP Volume 2: Environmental Resource Atlas-Barrow is covered	Yes

6.7 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 6.6** 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 between Santos and WA DoT, consultation will be required during the NEBA process such that there is consistency in the sensitivities prioritised for response across the Control Agencies.

A strategic NEBA has been developed for all response strategies identified as applicable to both the LOWC and vessel spill scenarios, with the benefit or potential impact to each sensitivity identified (refer to **Table 6-13** to **Table 6-14)**.

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 (**Table 6-10** and **Table** 6-11).
- 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.

Table 6-13: Strategic net environmental benefit analysis matrix – MEFF plug and abandonment LOWC scenarios

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersant	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Imperieuse Reef MP											
Turtle habitat – green, hawksbill											
Coral and other subsea benthic primary producers								N/A	N/A	N/A	
Marine mammals – humpback whale migration											
Seabirds											
Tourism – charter boats, diving, snorkelling, recreational fishing											
Clerke Reef MP											
Turtle habitat – green, hawksbill											
Coral and other subsea benthic primary producers								N/A	N/A	N/A	
Marine mammals – humpback whale migration											
Seabirds – significant breeding for migratory species at Bedwell Island											
Tourism – charter boats, diving, snorkelling, recreational fishing											

Santos

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersant	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Barrow Island											
Turtle nesting – particularly flatback (western side) and green turtles (eastern side)											
Mangroves and mudflats (shorebird foraging) – Bandicoot Bay										N/A	
Coral and other subsea benthic primary producers – incl. Biggada Reef								N/A	N/A	N/A	
Seabird nesting – incl. Double Island											
Migratory shorebirds – particularly Bandicoot Bay											
Aboriginal listed sites incl. pearling camps											
Montebello Islands											
Turtle nesting – North West and Eastern Trimouille Islands (hawksbill); Western Reef, Southern Bay and North West Island (green)											
Mangroves – particularly Stephenson Channel										N/A	
Coral and other subsea benthic primary producers								N/A	N/A	N/A	
Seabird nesting											

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Containment and Recovery	Mechanical Dispersion	Surface Dispersant	Sub Sea Dispersant Injection	Shoreline Protection & Deflection	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Migratory shorebirds											
Humpback/pygmy blue whale migration											
Fishing/charter boat tourism											
Muiron Islands											
Turtle nesting – major loggerhead site, significant Green turtle nesting site											
Coral and other subsea benthic primary producers								N/A	N/A	N/A	
Mangroves										N/A	
Seabird nesting											
Humpback whale migration											
Tourism – significant fishing/charter boat tourism											
Legend											
		Beneficial impact.									
		Possible beneficial impact depending on the situation (e.g., time frames and metocean conditions to dilute entrained oil).									
		Negative impact.									
N/A		Not applicable for the environmental value or not applicable for hydrocarbon type.									

Table 6-14: Strategic net environmental benefit analysis matrix- vessel collision (marine diesel oil)

Priority for Protection Area	No Controls	Source Control	Monitor and Evaluate	Mechanical Dispersion	Shoreline Clean-Up	Oiled Wildlife Response	Scientific Monitoring
Imperieuse Reef MP							
Turtle habitat – green, hawksbill							
Coral and other subsea benthic primary producers					N/A	N/A	
Marine mammals – humpback whale migration							
Seabirds							
Tourism – charter boats, diving, snorkelling, recreational fishing							

Legend	
	Beneficial impact.
	Possible beneficial impact depending on the situation (e.g. time frames and metocean conditions to dilute entrained oil).
	Negative impact.
N/A	Not applicable for the environmental value or not applicable for hydrocarbon type.

6.8 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 2/3 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 State 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 2/3 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 WA DoT (MEER unit).

State water notifications to WA DoT will apply to spills in State waters or spills originating in Commonwealth waters and moving to State waters.

The Incident Response Telephone Directory (SO-00-ZF-00025.020) 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-00025.020) 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	*Petroleum and Greenhouse Gas Storage Act 2006* Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations 2009 (as amended 2014)	A spill associated with the activity in Commonwealth waters 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 Commonwealth waters 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	*Environment Protection and Biodiversity Conservation Act 1999*	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
Parks Australia (24-hour Marine Compliance Duty Officer)	Verbal notification as soon as practicable	*Environment Protection and Biodiversity Conservation Act 1999*	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: + Titleholder's details

Agency or Authority	Type of notification/ timing	Legislation/guidance	Reporting requirements	Responsible person/group	Forms
					+ 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 environment that may be affected (EMBA) Consider a courtesy call if not in exposure zone	Notification by Environment Unit Leader (or delegate)	Not applicable
If spill is heading towards WA waters					
Department of Mines, Industry Regulation and Safety (DMIRS) (Petroleum Environment Duty Officer)	Verbal phone call within two hours of incident being identified Follow up written notification within three days	Guidance Note on Environmental Non-compliance and Incident Reporting	All actual or impending spills in State waters	Notification by Environment Unit Leader (or delegate)	Environmental and Reportable Incident/ Non-compliance Reporting Form http://www.dmp.wa.gov.au/Environment/Environment-reports-and-6133.aspx

Agency or Authority	Type of notification/ timing	Legislation/guidance	Reporting requirements	Responsible person/group	Forms
WA Department of Transport (WA DoT)[2] (MEER Duty Officer)	Verbal notification within two hours Follow up with Pollution Report (**Appendix C**) as soon as practicable after verbal notification If requested, submit Situation Report (**Appendix D**) within 24 hours of request	Emergency Management Regulations 2006 State Hazard Plan: Maritime Environmental Emergencies Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements	Santos to notify of actual or impending Marine Pollution Incidents (MOP) that are in, or may impact, State waters Emergency Management Regulations 2006 define MOP as an actual or impending spillage, release or escape of oil or an oily mixture that is capable of causing loss of life, injury to a person or damage to the health of a person, property or the environment[1]	Notification by Environment Unit Leader (or delegate) MEER Duty Officer contacted per Incident Telephone Directory	WA DoT POLREP (**Appendix C**): https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-PollutionReport.pdf WA DoT SITREP (**Appendix D**): https://www.transport.wa.gov.au/mediaFiles/marine/MAC-F-SituationReport.pdf
Department of Biodiversity Conservation and Attractions (State Duty Officer)	Verbal notification within two hours	Western Australian Oiled Wildlife Response Plan	Notify if spill has the potential to impact or has impacted wildlife in State waters (to activate the Oiled Wildlife Adviser)	Notification by Environment Unit Leader (or delegate)	Not applicable
Department of Primary Industry and Regional Development (DPIRD) Fisheries	Verbal phone call notification within 24 hours of incident	As per consultation with DPIRD Fisheries	Reporting of marine oil pollution[1] Notify if spill has the potential to impact or has impacted fisheries in State waters	Notification by 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 7 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 State waters, WA DoT MEER.

Santos

Table 7-2: List of spill response support notifications

Organisation	Indicative timeframe	Type of communi-cation	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)
Duty Officers/ Incident Commanders (Woodside, BHP, Chevron, Jadestone)	Within two hours of incident having been identified	Verbal	Mutual aid resources (through AMOSC mutual aid arrangement)	Phone call.	Incident Commander (or delegate)

Organisation	Indicative timeframe	Type of communi-cation	Resources available	Activation instructions	Santos person responsible for activating
Exmouth 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)
North West Alliance – Waste	As required for offshore and shoreline clean-up activities	Verbal	Santos has contract arrangements in place with North West Alliance 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)
Monitoring Service Provider	Scientific Monitoring Plan initiation criteria are met (**Appendix N**)	Verbal and written	Santos' Monitoring Service Provider has been contracted by Santos to provide Standby Services for Scientific Monitoring Plans (SMPs) 1 to 11. This includes provision of personnel and equipment. The Monitoring Service Provider annually reviews the SMPs for continual improvement	**Step 1.** Obtain approval from Incident Commander to activate Monitoring Service Provider for Scientific Monitoring. **Step 2.** Verbally notify Monitoring Service Provider followed by the submission of an Activation Form (Environment Unit Leader Folder) via email. **Step 3.** Provide additional details as requested by the Monitoring Service Provider Monitoring Coordinator on call-back. **Step 4**. Monitoring Service Provider initiates Scientific Monitoring Activation and Response Process.	Environment Unit Leader (or delegate)
Dispersant Operational Monitoring Provider	When application of dispersant is activated (**Section 13.7**).	Verbal and Activation Form	Santos' Dispersant Operational Monitoring Provider has been contracted to provide operational dispersant monitoring, including the provision of personnel and equipment.	Phone call to the Dispersant Operational Monitoring Provider – Operational Stand-by Response (refer to **Appendix O**)	Environment Unit Leader (or delegate)

Organisation	Indicative timeframe	Type of communi-cation	Resources available	Activation instructions	Santos person responsible for activating
Intertek Geotech (WA) Environmental Services and Ecotoxicology	When characterisation of oil is activated (**Section 10.6**)	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 required, as part of contracting arrangements with RPS Group	Contact RPS Group Duty Officer.	Environment Unit Leader (or delegate)
Wild Well Control (WWC)	Within four hours of a loss of well control incident having been identified	Loss of well control only Verbal	Well intervention services. Under contract.	**Step 1**. Following Santos management confirmation of a loss of well control (LOWC), Source Control Branch Director is to call the Wild Well Control 24-hour emergency hotline	Source Control Branch Director

Organisation	Indicative timeframe	Type of communi-cation	Resources available	Activation instructions	Santos person responsible for activating
				number to notify WWC of the incident. **Step 2**. As soon as practical after initial notification and once the scale of the subsea loss of containment is confirmed, an emergency mobilisation authorisation form (saved in ECM) must be filled out, signed off by the authorised Santos Manager sent through to WWC. The form is located on the Santos Intranet Procedures Index under Emergency Procedures (http://ausintranet.enerylimited.com/dept_data/Procedure_data/index.htm). Email as directed by WWC point of contract provided by the emergency hotline attendant.	

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**.

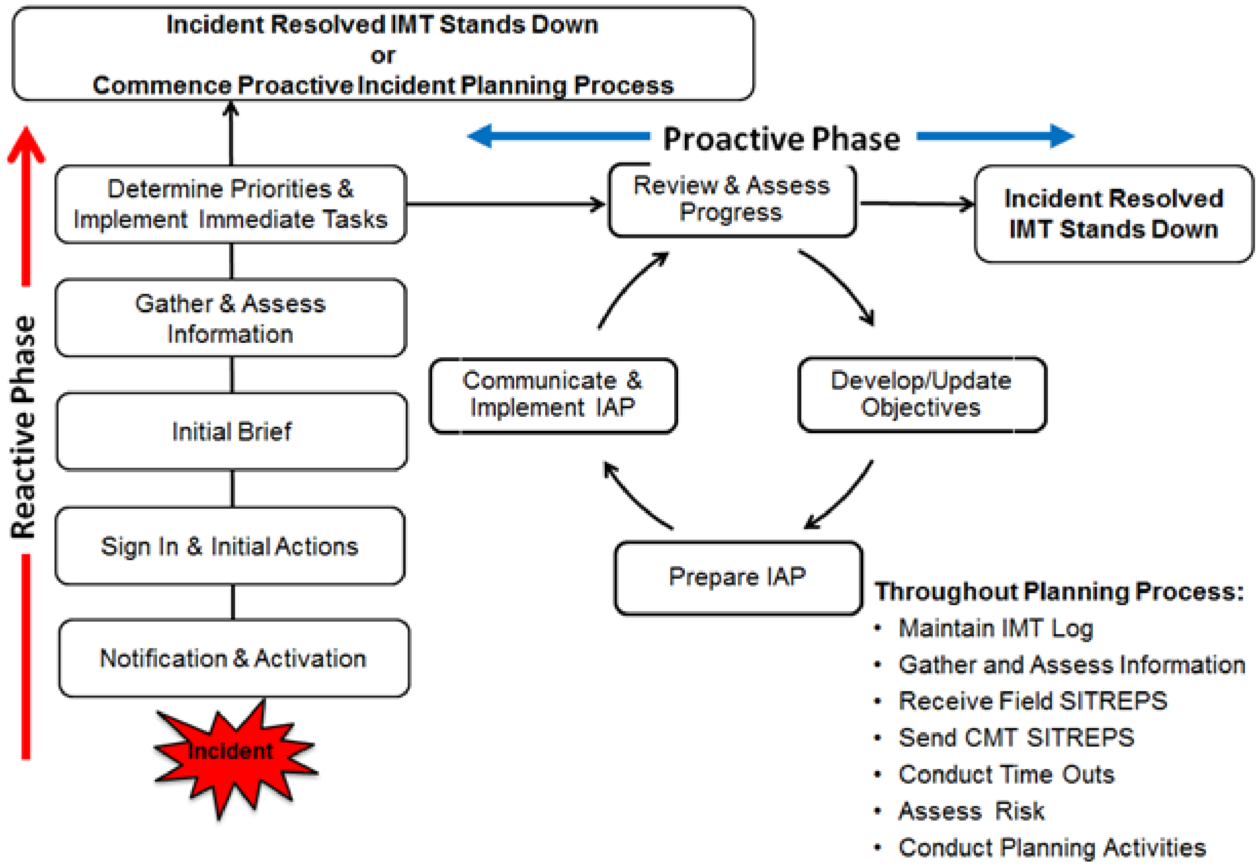


Figure 8-1: Incident action plan process

8.1 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 (performances standards) that must be followed to ensure the initial response meets regulatory requirements and environmental performance outcomes.

For each 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 the activity-specific OPEP Addendums. 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.

8.2 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 identification 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.

8.3 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	If operational monitoring shows that shoreline contact of Protection Priority 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 2/3 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.

For the ongoing response to a LOWC incident, the Santos Offshore Source Control Planning and Response Guideline (DR-00-ZF-20001) is to be consulted as the overarching source of information for implementing a relief well.

The sections below provide an outline of source control activities noting that the Vessel SOPEP and Source Control Planning and Response Guideline (DR-00-ZF-20001), 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	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✓	✗
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 MDO is released from a vessel due to a tank rupture, the relevant vessel-specific procedures will be applied. For support 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 9-7** 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	The vessel's SOPEP, as applicable under MARPOL, or procedure for responding to a ruptured tank will be followed, as applicable.	Notwithstanding vessel-specific procedures for source control, the following activities would be evaluated immediately for implementation, providing it is safe to do so: + 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.	Vessel Master	☐

9.2 Loss of well control

Table 9-3 provides the environmental performance outcome, initiation criteria and termination criteria for controlling the source of a loss of well control.

Table 9-3: Loss of well control – source 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	LOWC	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✗	✓
Termination criteria	The primary well is contained and killed to prevent any further release of hydrocarbon to the environment	

Santos identified the worst-case credible oil spill scenarios for assessment as:

+ a subsea LOWC with the release of 99,939 STB (15,890 m^3) of Mutineer-Exeter light crude oil characterised by moderate flow rates of oil at approximately 1,300 STB/day (207 m^3/day) over 77 days
+ a surface LOWC with the release of 99,939 STB (15,890 m^3) of Mutineer-Exeter light crude oil characterised by moderate flow rates of oil at approximately 1,300 STB/day (207 m^3/day) over 77 days.

9.2.1 Emergency blowout preventer activation

As part of the plug and abandonment activity, a blow-out preventer (BOP) stack will be installed onto the wellhead whenever there are less than two permanent barriers present, in accordance with API Standard 53: *Well control equipment systems for drilling wells* (API, 2018). The purpose of a BOP is to provide a secondary barrier to hydrocarbons by providing a mechanical means of shutting in the well if primary well control is lost, and hydrocarbons enter the wellbore.

9.2.1.1 Manual activation

If primary well control actions have failed and a loss of well control incident is anticipated, or is occurring, the drilling crew will initiate emergency BOP activation procedures immediately to shut in the well.

The relevant BOP rams will be activated, via the BOP control panel located in the drill shack. There is an additional BOP control panel located remote to the drill shack. BOP rams commonly include:

+ **pipe ram**: seals the wellbore by sealing around drill pipe of a specific size
+ **variable-bore ram**: seals the wellbore by sealing around various sizes of drill pipe
+ **blind ram**: seals the wellbore when there is no tubing across the BOP
+ **blind-shear ram**: seals the wellbore by cutting through and displacing drill pipe/ tubing.

One or more of the BOP rams may be activated depending on the status of the well and the severity of the well control incident. Once a ram is closed it cannot be opened without further hydraulic intervention. Well pressure acts to hold the ram closed. BOP shear rams often have a secondary lock mechanism to further ensure that the well remains closed.

Sealing the wellbore in this manner provides an important safety barrier. It also allows the drill crew time to consider and plan actions to bring the well back under primary control.

9.2.1.2 Automatic activation

In the event of loss of communication between the MODU and the BOP (e.g., the electrical connection between the BOP control panels on the MODU and the BOP on the wellhead is severed or damaged in some way), the BOP is designed to fail-safe close automatically on loss of signal, using stored electrical and hydraulic control power from the BOP battery and accumulators, respectively. In this situation the BOP will seal the well automatically.

9.2.1.3 MODU emergency disconnect

In the event of a serious loss of well control incident where the safety of the MODU and crew are threatened, the MODU emergency disconnect system (EDS) will be activated. This will unlatch the lower marine riser package (LMRP) from the BOP and activate the BOP rams. The EDS is used as a 'last resort' where all other attempts at well control have been unsuccessful and the safety of the MODU and its crew is threatened to an unacceptable level.

9.2.1.4 Failure intervention

In the unlikely event that attempts to activate the BOP from the MODU have failed, and/or the fail-safe close operation of the BOP has malfunctioned, the BOP can be closed via remotely operated vehicle (ROV) hot-stab intervention. Either the ROV on the MODU or an ROV from a separate support vessel can actuate the BOP in this manner. ROV deployment would commence as soon as practicable from the MODU if safe to do so. If an ROV was to be deployed from a support vessel, the IMT would immediately seek to source an ROV and suitable vessel to mobilise to the field and deploy the intervention ROV as soon as practicable. ROV operations would commence to navigate the ROV to the BOP and activate the BOP rams via a hydraulic hot-stab connection on the BOP side panel. This would serve to add hydraulic pressure to the BOP circuit from either the ROV pumps or an external hydraulic source, to enable manual close of the BOP rams to seal the well.

9.2.2 Subsea first response toolkit (SFRT)

If a subsea LOWC was to occur, the site would require a detailed assessment to determine the most suitable intervention methods for the incident. This may be achieved through the use of remotely operated vehicles (ROVs) (supplied by Santos via existing contractual arrangements) and the AMOSC Subsea First Response Toolkit (SFRT). The SFRT includes debris clearance equipment and ancillary tools.

In the event of a loss of well control incident, Santos will mobilise the AMOSC SFRT from Fremantle to Dampier for transhipment to a suitable vessel for transport to and deployment at the incident location. The SFRT is located at Oceaneering's facilities at Jandakot. If required, the equipment would be mobilised via road from Jandakot to Dampier. It is estimated this would take 10 hours to arrange and up to 7 days to load and transport to Dampier, depending on the destination and time of year. A suitable vessel would be acquired by Santos during this timeframe and arrive in Dampier (within 9 days of the call-out). Once the equipment is loaded, the vessel will mobilise to site and be ready to commence operations by day 11–12 from call-out. Specialist personnel to deploy the SFRT will be provided via Santos' contract with Oceaneering and will be available in Dampier within 72 hours (3 days). Vessel specifications are outlined in the Santos Offshore Source Control Planning and Response Guideline (DR-00-ZF-20001).

9.2.3 Relief Well Drilling

Relief well drilling is the primary source control strategy to control a LOWC during plug and abandonment activities.

The Santos Source Control Planning and Response Guideline (DR-00-OZ-20001) outlines the overarching process for planning and mobilising personnel and equipment into the field for the purpose of drilling a relief well.

9.2.3.1 Relief well planning

Relief well planning is embedded into the Santos Drilling & Completions Management Process (DCMP). The following industry accepted guidelines have been adopted to assist relief well planning requirements:

+ SPE Calculation of Worst Case Discharge Rev 1, 2016: This is used as part of the prospect screening review to generate a credible rate for oil spill modelling.
+ United Kingdom Oil and Gas Relief Well Guidelines, Issue 2, 2013: This methodology is used to confirm a well complexity analysis.

MEFF plug and abandonment activities will have a source control plan (SCP) to address all wells. The SCP is a Santos controlled document and is encompassed in the well operations management plan (WOMP).

All SCPs will contain relief well planning information, specifically:

+ MODU positioning assessment for relief well drilling locations
+ relief well tangible equipment requirements and availability
+ relief well trajectory analysis and casing design
+ dynamic well kill hydraulic simulation results.

These reports are static reports developed prior to higher-risk campaign-specific activities (plug and abandonment activities). While they contain planning that would be relevant to drilling a relief well for any well release (e.g. MODU positioning locations), time-variable information, such as MODU availability, is only assessed for the duration of the campaign.

To ensure Santos has current MODU availability, Santos maintains a register of MODU activity within the region and updates this on a monthly basis. The MODU capability register includes information about:

+ MODU name
+ MODU contract status (Operator and contract duration)
+ current location
+ maximum water depth capability
+ MODU type (floating vs jack-up; mooring type; MODU Design/Class)
+ available drilling envelope
+ blowout preventer specifications
+ blowout preventer (BOP) /lower marine riser package (LMRP) connector specifications
+ mud pumps specifications/capability
+ choke and kill line internal diameters
+ storage capability (i.e. MDO, base-oil, brine, drill-water, potable water, bulks)
+ NOPSEMA safety case (yes/no).

The SCP will also include relief well planning that involves a review of the most recent MODU capability register to identify the most suitable MODU for the well. In the event a suitable MODU is not in Australian waters, or is not predicted to be in Australian waters at the time of the activity, further work will be completed to identify a regionally suitable MODU, along with a mobilisation plan that demonstrates construction of a relief well within the time frame outlined in **Table 9-4** is achievable. Once a MODU is allocated as a potential relief well MODU for a project, the MODU capability register will be annotated as such. As such, any change to the register on a month-to-month basis that affects a preferred MODU will trigger a revision to the SCP for that particular well. The review will be completed within 4 weeks of identifying the change.

Santos commits to reviewing the Source Control Plan assumptions for relief well MODU availability and verifying that a suitable relief well MODU is either in Australian Waters, or there is a suitably robust plan in place to mobilise one outside of Australia. The activity will not proceed if there is not a least one relief well MODU option than could execute a relief well within the timeframes committed to in **Table 9-4.** In addition, during the activity, if the preferred relief well MODU/s becomes unavailable, work will commence on an update on the SCP to identify a suitable replacement relief well MODU regionally along with any required pre-work (contracting/logistics plans etc.).

In order to facilitate and expedite the use of regional MODU for relief well drilling an Australian Petroleum Production & Exploration Association (APPEA) Memorandum of Understanding: Mutual Assistance is in place. This agreement provides the mechanism to facilitate the transfer of drilling units and well-site services between operators in Australian and Timor-Leste administered waters in order to respond urgently to emergency source control events.

A Safety Case Revision will be required for the relief well MODU to undertake the activity; this cannot be submitted before the event. The Safety Case Revision will be based on existing documents, including the in-force Safety Case for the relief well MODU, if one is available. A Safety Case Revision would be submitted within 14 days from the well incident, however the critical path time allowed for the actual writing of the document is three days. The remaining estimated time would be used for gathering post-event data, mobilising the workforce and conducting a hazard identification. It is not practicable to reduce the critical path days with additional pre-planning as document revision, final review and approval will still be required after completing the hazard identification.

9.2.3.2 Relief well schedule

An indicative relief well drilling schedule is provided in **Table 9-4**. This is based on control of the well by 11 weeks (77 days). This period is used as a base case well control timeframe by Santos across its wells and is based on indicative mobilisation durations, relief well planning and operations. It could take up to 33 days to have a relief well MODU onsite ready to spud.

Long lead item equipment to enable a relief well to be drilled within this timeframe is held in the Santos inventory or has been confirmed to be available at short notice from vendors or other operators in the region.

This timeline has been assessed as ALARP based on the current controls/measures in place; however, Santos is actively working with industry to evaluate measures to improve on the ALARP response time model through the APPEA Drilling Industry Steering Committee Source Control Response Industry (SCRI) Working Group. The SCRI working group is an APPEA Drilling Industry Steering Committee initiative which has been established to drive collaboration and continuous improvement in source control emergency response planning. The Working Group will explore and act on opportunities to align and strengthen the Titleholders' source control emergency response capability through 'mutual aid' initiatives and drive continuous improvement by implementing fit-for-purpose and effective source control emergency response strategies.

Table 9-4: Schedule for mobile offshore drilling unit arriving on site (from time of notification)

LOWC relief well		
Task	**Duration (days)**	**Controls**
Event reported. Begin sourcing of MODU for relief well drilling operations. Concurrently, stand up relief well drilling team and activate relief well specialists.	2	+ On-site communications + Active IMT, including Operations Section Chief, Source Control Branch Director and Relief Well Team Lead

LOWC relief well		
Task	**Duration (days)**	**Controls**
		+ Stood-up Relief Well Team (as per Santos Offshore Source Control Emergency Response Plan) + Relief Well Drilling specialist services contract (Wild Well Control) + Regional MODU tracking + APPEA MoU: Mutual Assistance
Relief well MODU confirmed. Relief well MODU suspends operations and prepares to mobilise to relief well location. Demobilisation of equipment from previous operator Concurrently, prepare relief well MODU Safety Case Revision and submit to NOPSEMA. Concurrently, prepare relief well design and dynamic kill plan. Prepare relief well WOMP and submit to NOPSEMA.	7	+ Active IMT + Santos Offshore Source Control Emergency Response Plan (DR-00-OZ-20001) + Pre-completed campaign specific Source Control Plan complete with relief well study + Relief Well Drilling specialist services contract (Wild Well Control) + Regional MODU tracking + APPEA MoU: Mutual Assistance + Pre-verified access to relief well long lead equipment (e.g. casing and wellhead) + Drilling services contracted.
Contract relief well MODU. Concurrently, continue preparations for relief well MODU mobilisation. Concurrently, NOPSEMA assessment of relief well MODU SCR and relief well WOMP. Mobilise relief well MODU to location.	24	+ Active IMT + Santos Offshore Source Control Emergency Response Plan (DR-00-OZ-20001) + Relief Well Drilling specialist services contract (Wild Well Control)
Total days before arrival, ready to spud/commence relief well operations	33	-
Drill and construct relief well and execute dynamic well kill operations	44	+ Active IMT + Santos Offshore Source Control Emergency Response Plan (DR-00-OZ-20001) + Relief Well Drilling specialist services contract (Wild Well Control)
Total days from notification of LOWC to well kill	77	-

9.2.4 Capping stack

A Capping Stack provides a temporary means of sealing the well until a permanent well kill can be performed through either a relief well or well re-entry. It is considered a secondary source control measure (refer to **Table 6-8**).

Capping Stack compatibility varies from well to well and can also depend on the extent of the blowout and water depth. Compatibility will also vary according to technical and safety constraints, and damage to an individual well, which would only be known at the time of the spill and assessed via the SFRT and accompanying ROVs.

The installation of a Capping Stack may be applicable for a subsea loss of well control during MEFF plug and abandonment activities using a Semi-submersible MODU where the BOP is present on the seabed. The use of a Subsea First Response Toolkit (SFRT) (**Section 9.2.2**) may be applicable in assisting the installation of a Capping Stack.

A Capping Stack would only be used where there is suitable vertical access over the wellhead and a suitable restricted flow rate was determined. Santos has contracts in place with Wild Well Control (WWC) and would deploy their Singapore-based Capping Stack as the primary option (another Capping Stack is available from Aberdeen). The Singapore-based Capping Stack would be assembled quayside, tested and then transported via barge to a suitable deployment vessel where it would then be transferred, fastened and then commence its transit to the well site.

The deployment vessel will need to meet the following criteria:

+ require an active heave compensator, capability of lifting minimum of 150 Tonne
+ 500–1,000 m^2 of deck space
+ located within a 4-day sail radius of Singapore.

Additional vessel specifications are outlined in the Santos Offshore Source Control Planning and Response Guideline (DR-00-0Z-20001). In addition, the Santos Vessel Requirements for Oil Spill Response document (7710-650-ERP-0001) provides further details on the vessel specification for capping stack deployment, and the process for monitoring vessel availability.

Santos would be responsible for managing the customs and importation issues related to equipment arrival into Australian Waters, obtaining support from WWC. To ensure access to suitable vessels to deploy the Capping Stack to the incident location, prior to and during the activity, Santos will monitor the availability of Capping Stack capable vessels on a monthly basis through shipbroker reports. This also includes the tracking of current vessel Safety Case status.

However, as an adaptive management measure, as part of the DCMP Assurance Review (described in **Section 9.2.3.1**) Santos commits to verifying that a suitable deployment vessel is available and can meet the criteria defined above. In addition, this check will occur monthly. In the event a suitable vessel is not available, work will commence to identify a suitable vessel further afield, along with identifying any pre-work (contracting/logistics plans etc.) that might be needed to mobilise a vessel from further afield.

In addition, Santos has current contracts with vessels that have similar specifications for various scopes of work with approved Australian Safety Cases. These Safety Cases could be used as a basis of a Safety Case revision if one was required, which could create significant time efficiencies. Santos also has in place a contract with a specialist contractor highly experienced in the Safety Case revision process, to leverage their experience, further reducing the timeframes required to develop a Safety Case revision that meets NOPSEMA's requirements.

The location of these vessels can be tracked through Santos' offshore vessel tracking system accessed via the Santos Emergency Response Intranet page.

9.2.4.1 Capping stack schedule

An indicative Capping Stack schedule is provided in **Table 9-5**. This period is based on indicative mobilisation durations and is subject to weather conditions and availability of specialist personnel.

Table 9-5: Capping stack mobilisation schedule

LOWC Capping Stack timeline		
Task	**Duration (days)**	**Controls**
Event reported – source suitable deployment vessel (with approved safety case) (Santos) Concurrently deploy Capping Stack components from warehouse to	4	+ On-site communications + Active IMT on call including Operations/Drilling Team Lead + WellCONTAINED Logistics Plan

LOWC Capping Stack timeline		
Task	**Duration (days)**	**Controls**
quayside (including assembly and testing) (WWC)		+ Monthly monitoring of suitable vessels
Capping Stack lifted on to barge, fastened and then tug operations transit to anchored deployment vessel (WWC)	2	+ Active IMT + Santos Offshore Source Control Emergency Response Plan (DR-00-OZ-20001) + Capping Stack specialist services (Wild Well Control) + Well Contained Logistics Plan + Capping Stack Logistics Methodology
Handover of Capping Stack from WWC to Santos (WWC to continue to support via specialist personnel)		
Capping Stack mobilised to incident location by deployment vessel (Santos with support from vessel broker)	9	+ Stood-up Source Control Team (as per Santos Offshore Source Control Planning and Response Guideline (DR-00-0Z-20001) + Capping Stack specialist services contract (Wild Well Control) + Well Contained Logistics Plan
Total days before arrival, ready to commence Capping Stack operations	15	-
Days to installation of Capping Stack (worst case allowing for potential removal of debris and issues due to damaged wellhead, BOP and/or lower marine riser package)	2 to 28 (estimated)	-

9.3 Source control implementation guidance

Relief well drilling is the primary source control strategy to control a LOWC during MEFF Plug and Abandonment activities.

The Source Control Planning and Response Guideline (DR-00-OZ-20001) outlines the overarching process for planning and mobilising personnel and equipment into the field for source control methods.

A high-level summary of source control Implementation actions is provided in **Table 9-6.**

Table 9-6: Implementation guidance – loss of well control

	Action	Responsibility	Complete
Initial actions	**Relief well**		
	Implement the Source Control Planning and Response Guideline (DR-00-OZ-20001).	Relief Well Team Leader	☐
	Notify Santos Drilling and Completions Team to assemble a Source Control Team and immediately begin preparations.	Relief Well Team Leader	☐
	Notify well control service provider personnel for mobilisation.	Relief Well Team Leader and Source Control Branch Director	☐
	Source MODU through nearby drilling operations if available or procure from nearest operator through mutual aid agreement MoU.	Source Control Branch Director	☐
	Refine, as necessary, the relief well pre-planning work described in **Section 9.2.3.1**, and have prepared in time to procure equipment and personnel before MODU arrival on location.	Source Control Branch Director	☐
	Assess relief well equipment and personnel requirements. Procure and make ready.	Logistics Section Chief	☐
	Deploy equipment and personnel to site to begin spud and drill.	Relief Well Team Leader	☐
	SFRT		
	Activate Subsea First Response Toolkit (SFRT) equipment. Activate Oceaneering personnel for deployment	Designated call-out authority (Incident Commander) Source Control Branch Director	☐
	Contract suitable vessel capable of deploying SFRT equipment	Logistics Section Chief Source Control Branch Director	☐
	Arrange road transport of SFRT equipment from Jandakot to Dampier.	Logistics Section Chief Source Control Branch Director	☐
	Conduct initial ROV survey at the release point to determine the nature of the release, behaviour of the oil, and estimate the oil and gas flow rates.	Operations Section Chief Source Control Branch Director	☐

	Action	Responsibility	Complete
	Capping stack		
	Consider technical and safety constraints and assess the suitability of a Capping Stack for the incident.	Source Control Branch Director	☐
	Implement the Source Control Planning and Response Guideline (DR-00-OZ-20001).	Source Control Branch Director	☐
	Notify Santos Drilling and Completions Team to assemble a Source Control Team and immediately begin preparations.	Source Control Branch Director	☐
	Notify Capping Stack service provider of incident for activation of personnel and equipment as per the Source Control Planning and Response Guideline (DR-00-OZ-20001).	Source Control Branch Director	☐
	Contract suitable vessel capable of deploying Capping Stack via freight contractor.	Logistics Section Chief Source Control Branch Director	☐
Ongoing actions	**Relief well**		
	Design relief well, using relief well pre-planning work, as applicable, and have prepared in time to procure equipment and personnel before MODU arrival on location.	Source Control Branch Director	☐
	Assess relief well equipment and personnel requirements. Procure and make ready.	Logistics Section Chief	☐
	Deploy equipment and personnel to site to begin spud and drill.	Relief Well Team Leader	☐
	Monitor progress of relief well drilling and communicate to IMT.	Relief Well Team Leader	☐
	SFRT		
	Arrange equipment to be loaded on to vessel once in Dampier and authorise transit to field.	Logistics Section Chief Operations Section Chief Source Control Branch Director	☐
	Deploy equipment and personnel to site to begin SFRT operations	Source Control Branch Director	☐

	Action	Responsibility	Complete
	Capping Stack		
	Take into consideration any feedback from ROV surveys in response planning.	Source Control Branch Director	☐
	Deploy equipment and personnel to site to begin capping process.	Source Control Branch Director	☐

Santos

9.4 Environmental performance

Table 9-7 indicates the environmental performance outcomes, controls and performance standards for the Source Control response strategy.

Table 9-7: 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 – relief well drilling	Santos Source Control Planning and Response Guideline (DR-00-OZ-20001)	The Santos Source Control Planning and Response Guideline (DR-00-OZ-20001) is in place and up-to-date during the activity	Santos Source Control Planning and Response Guideline (DR-00-OZ-20001)
	Relief Well MODU Availability Register	A Relief Well MODU Availability Register is maintained during the activity through monthly monitoring	Relief Well MODU Availability Register
	Contract and Equipment Access Agreement with WWC	Contract and Equipment Access Agreement with WWC are maintained providing technical support and equipment	Contract with WWC
	Relief well drilling supplies readily available in Western Australia	Long lead equipment for a relief well drilling will be readily available to Santos	Audit records
	Arrangements for source control emergency response personnel	Arrangements for access to source control personnel are maintained during the activity	Contract/ Memorandums of Understanding for source control personnel
	Suitable relief well MODU confirmed to be available prior to activity	Activity will not proceed if there is not a least one relief well MODU option than could execute a relief well within the timeframes committed to in **Table 9-4**	Relief Well MODU Availability Register Source Control Plan
	Regular monitoring of Relief Well MODU Availability Register to ensure preferred MODU remains available throughout the activity	If the preferred MODU becomes unavailable during the activity, Santos will update the SCP to identify a suitably alternative MODU	Relief Well MODU Availability Register Source Control Plan
Source control – BOP Activation	BOP Unit	BOP rams pressure/function tested as per latest edition of API Standard 53 on deployment, and then at regular intervals throughout the plug and abandonment activity	BOP rams function test records

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**
		BOP battery and accumulators function tested prior to deployment.	BOP battery and accumulators function test records
	EDS	EDS function tested prior to deployment.	EDS function test records
	ROV hot stab capability	Access to ROV capability for BOP hot-stab intervention maintained with MODU ROV contractor throughout the plug and abandonment activity	ROV contractual arrangements
Source control – SFRT	Arrangements to enable access to SFRT equipment and personnel	Maintenance of access to SFRT equipment and personnel	AMOSC SFRT participating member
			OTA Agreement with Oceaneering
	Arrangements in place to monitor availability of vessels capable of transporting SFRT	Vessel availability shall be monitored regularly via Santos' contracted vessel broker	Shipbroker reports
	Maintenance of MSAs with multiple vessel providers	Santos maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers
Source control – Capping Stack	Arrangements to enable access to Capping Stack and trained personnel	Maintenance of access to Capping Stack and personnel	Contract with Capping Stack service provider
	Arrangements in place to monitor availability of vessels capable of transporting Capping Stack	Vessel availability shall be monitored regularly via Santos' contracted vessel broker	Shipbroker reports
	Suitable Capping Stack deployment vessel is confirmed to be available prior to activity	Verify suitable Capping Stack deployment vessel is available as part of DCMP Assurance Review	Shipbroker reports Well-specific Source Control Plan DCMP Assurance Review
	Monthly monitoring of shipbroker reports to ensure suitable Capping Stack deployment vessel is available throughout the activity	If a suitable Capping Stack deployment vessel becomes unavailable, Santos will commence work to identify a suitable alternative vessel	Shipbroker reports
	Arrangements to enable timely mobilisation of Capping Stack	Capping Stack mobilised to site and ready to commence deployment by day 15	Capping Stack mobilisation schedule (**Table 9-5**)
	Maintenance of MSAs with multiple vessel providers	Santos maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers

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**
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 support vessels are conducted as per the vessels SOPEP or SMPEP	Spill exercise close out reports
Response Implementation			
Source control – relief well drilling	Source Control Branch	Source Control Branch mobilised within 24 hours of being notified of well leak incident	Incident log
	Equipment/Services for Relief Well drilling	Equipment/Services for Relief Well drilling sourced within five days of being notified of well leak incident	Incident log
	Well Control Specialists	Well control specialists mobilised within 72 hours of being notified of well leak incident	Incident log
	Relief Well MODU	MODU for relief well drilling to be on site by Day 33 of being notified of well leak incident	Incident log
	Relief Well	Relief well completed within 77 days of being notified of well leak incident	Incident log
	Source Control Planning and Response Guideline (DR-00-OZ-20001)	Relief well drilling implemented in accordance with the Source Control Planning and Response Guideline (DR-00-OZ-20001) during a well release	Incident log
Source control – SFRT	Access to suitable SFRT vessel	Vessel mobilised to Dampier within 9 days of IMT call-out	Incident Log
	Access to personnel for the deployment of the SFRT	Oceaneering to mobilise personnel to Dampier within 9 days of IMT call-out	Incident Log
Source control – Capping Stack	Access to Capping Stack and suitable vessel	Capping Stack to be onsite and ready to commence deployment by day 15 from the start of the release	Incident Log
	Access to trained personnel for the deployment and operation of the Capping Stack and well intervention equipment	Capping Stack trained personnel mobilised to site within 15 days	Incident Log

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**
Source control – vessel collision	As per the vessel SOPEP	Actions to control spill associated with a vessel incident followed in accordance with SOPEP	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 2/3 spill – may be deployed in a Level 1 incident (to be determined by OSC)	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✓	✓
Termination criteria	+ 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 10-41 lists the environmental performance standards and measurement criteria for this strategy.

Santos

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	☐
	Source additional contracted vessels if required for assistance.	Refer to Santos Vessels for Oil Spill Response (7110-650-ERP-0001) for the process for vessel monitoring and guidance on vessel types.	Logistics Section Chief	☐
	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 2/3 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	☐
	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	☐
Ongoing actions	Review surveillance information to validate spill fate and trajectory.	-	Planning Section Chief / GIS	☐
	Use available data to conduct operational NEBA and confirm that pre-identified response options are appropriate.	-	Environment Unit Leader	☐
	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	☐

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 Dampier, Varanus Island, Exmouth or offshore location. Locations verified through AIS Vessel Tracking Software.	Pending availability and location. Expected within 12 hours.

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

<table>
<tr><th colspan="2">Task</th><th>Time from IMT call-out</th></tr>
<tr><td colspan="2">IMT begins sourcing Santos-contracted vessel or VOO for on-water surveillance</td><td><90 minutes</td></tr>
<tr><td colspan="2">VOO on site for surveillance</td><td><24 hours (daylight dependent)</td></tr>
<tr><td colspan="3">Minimum resource requirements</td></tr>
<tr><td colspan="3">One vessel. No specific vessel or crew requirements.</td></tr>
<tr><td colspan="3">Approximate steam time</td></tr>
<tr><td>Deployment location</td><td>Approximate distance to operational area[13] (nautical miles)</td><td>Approximate steam time[14] (hours)</td></tr>
<tr><td>Dampier</td><td>78</td><td>7.5</td></tr>
<tr><td>Exmouth</td><td>210</td><td>21</td></tr>
</table>

[13] As measured to geometric centre point of operational area

[14] At average rate of 10 knots

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 2/3 spill	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✓	✓
Termination criteria	+ 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 2/3 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 **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 10-41 lists the environmental performance standards and measurement criteria for this strategy.

Table 10-6: Implementation guidance – aerial surveillance

Action		Consideration	Responsibility	Complete
Initial actions	Contact contracted aviation provider – provide details of incident and request mobilisation to spill site for initial surveillance.	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. 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. There should be an attempt to obtain the following data during initial surveillance: + 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 (windows, patches etc.) + wildlife, habitat or other sensitive receptors observed + basic metocean conditions (e.g. sea state, wind, current) + photographic/video images.	Operations Section Chief Logistics Section Chief	☐
	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	☐
	Develop flight plan (frequency and flight path) to meet IMT expectations and considering other aviation ops. Expected	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	☐

	Action	Consideration	Responsibility	Complete
	that two overpasses per day of the spill area are completed.			
	Pre-flight briefing.	-	Aerial Observers Contracted aircraft provider/ pilots	☐
	Aerial Observers to commence surveillance	Consider procedure for interacting with marine fauna.	Operations Section Chief	☐
	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	☐
	Record presence and type of fauna by completing the Aerial Surveillance Marine Fauna Sighting Record Sheet (**Appendix H**).	-	Aerial Observer	☐
	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	☐
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	☐
	Mobilise additional aircraft and trained observers to the spill location to undertake ongoing surveillance activities	-	Logistics Section Chief	☐
	Update Common Operating Picture with surveillance information and provide updates to spill trajectory modelling provider	-	Planning Section Chief GIS Team Leader	☐

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	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 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 (Dampier)	<24 hours (daylight dependent)
Minimum resource requirements	
+ Santos contracted helicopter and pilots (based in Dampier) + Santos trained Aerial Observers	

Approximate flight time		
Airport	**Approximate distance[15] (nm)**	**Approximate flight time[16] (hours: minutes)**
Dampier	78	0:40
Exmouth (Learmonth)	225	1:50

[15] As measured to geometric centre point of operational area
[16] At average flight speed of 120 knots

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

<table>
<tr><td>Environmental performance outcome</td><td colspan="2">Implement monitor and evaluate tactics in order to provide situational awareness to inform IMT decision-making</td></tr>
<tr><td>Initiation criteria</td><td colspan="2">Notification of a Level 2 or 3 spill
May be deployed for a Level 1 spill if deemed beneficial by the OSC</td></tr>
<tr><td rowspan="2">Applicable hydrocarbons</td><td>MDO</td><td>MEFF Crude</td></tr>
<tr><td>✓</td><td>✓</td></tr>
<tr><td>Termination criteria</td><td colspan="2">+ 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</td></tr>
</table>

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 10-41** lists the environmental performance standards and measurement criteria for this strategy.

Santos

Table 10-10: Implementation guidance – tracking buoys

	Action	Consideration	Responsibility	Complete
Initial actions	Organise vessel to mobilise two tracking buoys from MODU/ LWIV.	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	☐
	Deploy two tracking buoys at leading edge of slick.	Note deployment details and weather conditions in incident log.	Vessel Master	☐
	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	☐
	Use tracking buoy data to maintain Common Operating Picture.	Data tracked online.	Planning Section Chief / GIS	☐
	Relay information to spill fate modelling supplier for calibration of trajectory modelling.	-	Planning Section Chief / GIS	☐
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	☐
	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	☐
	Direct the deployment of the Tracker Buoys – for continuous releases over multiple days use a rolling deployment/collection of buoys to provide better coverage of plume direction.	-	Operations Section Chief	☐
	Deploy tracking buoys.	-	Vessel Master	☐
	Monitor movement of tracking buoys.	-	Planning Section Chief /GIS	☐
	Relay information to spill trajectory modelling supplier for calibration of trajectory modelling.	-	Planning Section Chief /GIS	☐

Table 10-11: Tracking buoy resource capability

Equipment type/personnel required	Organisation	Quantity available	Location	Mobilisation timeframe
Tracking buoys	Santos	2	MODU/ LWIV	<2 hours for incident
		4	Dampier	Dampier – <10 hours to site pending vessel availability
		4	VI	VI buoys – 48–72 hours to site pending vessel availability
		2	Ningaloo Vision	<48 hours pending vessel availability
		4	Harriet Alpha supporting vessels	<48 hours 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 (refer to **Table 10-12**)
		4	Geelong	

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

	Perth	Dampier
Geelong	40 hours / 3,395 km	70 hours / 4,840 km
Perth	NA	19 hours / 1,530 km
Exmouth	15 hours / 1,250 km	7 hours / 555 km
Broome	27 hours / 2,240 km	11 hours / 855 km

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

Task	Time from IMT call-out
Tracking buoys deployed from MODU/ LWIV	<2 hours
OR	
Tracking buoys deployed from Dampier using vessels of opportunity	<10 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 or 3 spill	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✓	✓
Termination criteria	+ 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.

Table 10-41 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	☐
	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	☐
	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	☐
	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	☐
	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	☐
	If chemical dispersants are considered applicable strategy for spill scenario, request modelling provider to model how dispersant addition effects the distribution and concentration of floating oil, subsea oil and shoreline loading.	Planning and Operations to provide inputs for modelled simulation based on potential/planned dispersant operations. Outputs from dispersant addition modelling to inform NEBA.	Planning Section Chief Operations Section Chief	☐
	Identify location and sensitivities at risk based on the trajectory modelling and inform IMT. Conduct operational NEBA on proposed response strategies.	-	Environment Unit Leader	☐

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	☐
	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	☐

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	
+ 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 or 3 spill	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✓	✓
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 10-41 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	☐
	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	☐
	Assess suitability and order imagery.	-	Planning Section Chief	☐
	Integrate satellite imagery into Common Operating Picture and provide to trajectory modelling provider for model validation.	-	GIS Team Leader Planning Section Chief	☐

	Action	Consideration	Responsibility	Complete
Ongoing actions	Review surveillance information to validate spill fate and trajectory.	-	Planning Section Chief	☐
	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	☐

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)

10.6 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 or 3 spill	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✓	✓
Termination criteria	+ 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	

10.6.1 Overview

MDO is a common fuel type with known properties and Mutineer-Exeter light crude is a hydrocarbon that has been previously assayed, the general physical and chemical characteristics of these hydrocarbons 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.

10.6.2 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 10-41 lists the environmental performance standards and measurement criteria for this strategy.

10.6.3 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 mobilised 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.

Onsite dispersant testing

Using AMOSC dispersant shake test kits, samples of oil are to be tested by onsite vessels/crew for dispersant efficacy using the included dispersants by way of a simple shake test of efficacy. Photos of sample jars and observations are to be reported back to the IMT for evaluation. These tests are not a substitute for laboratory testing and test spraying but provide an early indication of efficacy on the oil and the relative effectiveness of the dispersants included within the test kits.

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	☐
	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	☐
	Vessel directed to sampling location.	Sampling of oil at thickest part of slick – typically leading edge.	Operations Section Chief	☐
	Vessel crew to undertake sampling and delivery of samples to Dampier for dispatch to laboratory. Environment Unit Leader to confirm analysis of oil with lab.	Exmouth and/or Dampier Logistics personnel to assist with logistics of sending oil samples to laboratory for analysis.	Operations Section Chief Environment Unit Leader Logistics Section Chief	☐
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	☐

Table 10-23: Initial oil characterisation – resource capability

Equipment type/personnel required	Organisation	Quantity available	Location	Mobilisation timeframe
Dispersant efficacy kits (shake test)	AMOSC/Santos	3	Exmouth, Varanus Island, Dampier	Within 48 hours
Oil sampling kits	Santos/AMOSC	3	Dampier, Exmouth, Varanus Island	Within 48 hours
Bulk oil sampling bottles	Intertek/Santos	As required	Perth	Within 48 hours
Santos Contracted Vessel Providers	Availability dependent upon	Availability dependent upon Santos and Vessel	Pending availability and location. Expected within 24 hours	Santos contracted vessel providers

Equipment type/personnel required	Organisation	Quantity available	Location	Mobilisation timeframe
Vessels of Opportunity identified through AIS vessel tracking system	Santos and Vessel Contractor activities.	Contractor activities. Locations verified through AIS vessel tracking system		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	
+ One vessel; no special requirements; oil sampling can be done concurrently with other tasks + One dispersant efficacy shake test kit + One oil sampling kit	

10.7 Operational water quality monitoring

10.7.1 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 or 3 spill	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✓	✓
Termination criteria	+ 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 18**).

10.7.2 Implementation guidance

Refer to **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 10-41** 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	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: + 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; and in the case of incidents where dispersants are approved for use, may inform the water sampling locations for Special Monitoring of Applied Response Technologies (SMART) Protocol and subsea dispersant efficacy monitoring (using API (2020) Technical Report 1152) methods. + Where surface oil is present in shallow water (<5 m) sampling should involve a depth profile from the seabed to surface waters. + For a subsea release or 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 (NATA) accredited laboratory in Perth for hydrocarbon suite analysis including polycyclic aromatic hydrocarbons.
Analysis and reporting	+ 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.

Considerations for operational water quality sampling and analysis	
	+ 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.	Refer to **Appendix O** for activation guidance	Environment Unit Leader	☐
	Obtain spill trajectory modelling and provide to Monitoring Service Provider.	-	Environment Unit Leader Planning Section Chief GIS Support	☐
	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	☐
	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	☐

Action		Consideration	Responsibility	Complete
	Monitoring Service Provider to assemble team/s and water quality monitoring equipment.	-	Monitoring Service Provider	☐
	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	☐
	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	☐
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	☐

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	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	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	Vessels mobilised from Exmouth, Dampier, Varanus Island or offshore location. 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	
+ 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).	

10.7.3 Continuous fluorometry surveys

Table 10-30 provides the environmental performance outcome, initiation criteria, termination criteria and other key aspects for this strategy.

Table 10-30: Continuous fluorometry surveys – 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 2/3 spill	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✓	✓
Termination criteria	+ Continuous fluorometry surveys will continue for 24 hours following control of the source provided oil is no longer detectable, OR + As directed by the relevant Control Agency.	

In addition to operational water sampling and sensor deployment at discrete locations, a continuous fluorometry survey(s) may be run across the expected slick/plume extent, as well as vertically through the water column. This allows a far greater area of coverage than discrete sampling, aiding in the mapping of entrained and dissolved oil movement.

Continuous fluorometry surveys are also used to evaluate the effectiveness of dispersant application by detecting changes in the distribution of oil before and after the application of dispersants whether that be on surface on subsea.

Subsurface gliders containing fluorometers built into the body of the glider may be used for this monitoring and would be preferential for monitoring a continuous subsea release (subsea LOWC from all locations). This will allow continuous monitoring of entrained oil covering a large area and will provide near real-time three-dimensional data on the distribution of entrained oil to enable decision-making within the IMT. Similarly, other sources of monitoring data (e.g. spill fate modelling) can be used in near real-time to inform the path of the subsurface glider. Subsurface gliders are particularly suited to subsea releases where oil may be distributed below surface layers.

Fluorometers towed behind vessels will be used as an alternative or complementary approach for a subsea release and would be preferred for surface spills and to monitor oil distribution through the water column.

10.7.4 Implementation guidance

Table 10-31 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 10-32** provides a summary of resources that may be used to implement this strategy. **Table 10-33** details the minimum first-strike requirements to be mobilised on activation. The Incident Commander is ultimately responsible for the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

Table 10-41 lists the environmental performance standards and measurement criteria for this strategy.

Table 10-31: Continuous fluorometry surveys – implementation guidance

Action		Consideration	Responsibility	Complete
Initial actions	Activate Monitoring Service Provider and engage to provide fluorometry services (personnel and equipment) as part of Operational Water Sampling and Analysis – refer **Table 10-27** for actions.	-	Monitoring Service Provider Environment Unit Leader	☐
	Activate OSRL monitoring and determine availability of subsea gliders and towed fluorometry equipment.	OSRL can provide specialist technical advice on operation of towed fluorometers. Consider: Engaging OSRL for review and input into monitoring action plan for towed fluorometry.	Incident Commander Environment Unit Leader	☐
	Determine suitability of subsea gliders for monitoring.	Subsurface gliders containing fluorometers built into the body of the glider may be used for this monitoring and would be preferential for monitoring a continuous subsea release (well leak scenario).	Environment Unit Leader	☐
	If gliders and pilot/s available and suitable for incident, engage provider to develop Monitoring Action Plan.	Arrange a joint meeting with spill modelling provider and OSRL/glider operator to develop monitoring design and ongoing data transfer protocols to meet objective of model validation.	Environment Unit Leader	☐
	Source vessels and other logistics to support monitoring.	-	Logistics Section Chief Operations Section Chief	☐
	Conduct monitoring as per monitoring action plan with deployment area guided by other operational monitoring studies.	The scope of monitoring will be dictated by the response strategies being employed. Where dispersant application is being undertaken, fluorometry surveys will have to be coordinated with application activities so subsea oil distribution can be assessed before and after dispersant addition to determine effectiveness. Appendix F of CSIRO oil spill monitoring handbook (CSIRO, 2016) provide standard operating procedures using fluorometry equipment.	Operations Section Chief Planning Section Chief Environment Unit Leader	☐

Action		Consideration	Responsibility	Complete
Ongoing actions	Provide daily data reports and spatial outputs IMT.	-	Monitoring Provider	☐
	Monitoring results to be incorporated into Common Operating Picture.	-	Planning Section Chief GIS Support	☐

Table 10-32: Continuous fluorometry surveys – resource capability

Equipment type/personnel required	Organisation	Quantity available	Location	Mobilisation timeframe
Towed fluorometers	OSRL	Towed Fluorometers: 7 Turner C3 fluorometers globally	4 in Southampton, 2 in Singapore and 1 in Fort Lauderdale	<72 hours
Glider mounted fluorometers	OSRL	Subsea glider: Qty. subject to availability from OSRL contractor – one engineer from OSRL contractor to deploy and operate the Glider	Gliders based in Australia (Perth, Sydney, Brisbane) OSRL towed fluorometers out of Singapore, Southampton and Fort Lauderdale	<72 hours dependent upon availability
Vertical particle size analyser – Sequoia LISST 100x	Monitoring Service Provider	1	Perth	<72 hours
Water quality monitoring personnel to operate towed fluorometers	Monitoring Service Provider	Approx. 6 (based on capability reports)	Perth-based	<72 hours
Glider (remote) pilot/s and deployment crew	Third-party provider via OSRL	Subsea glider: Qty. subject to availability from OSRL contractor – one engineer from OSRL contractor to deploy and operate the glider	Perth-based pilot and deployment crew	<72 hours dependent upon availability

Table 10-33: Operational water quality sampling and analysis – first-strike response timeline

Task	Time from IMT call-out
IMT activates OSRL and Monitoring Service Provider.	<4 hours
Monitoring Service Provider water quality monitoring personnel deployed to site.	<72 hours
Towed fluorometers deployed to site.	<72 hours
Glider and pilot/s and deployment crew deployed (if gliders available and appropriate).	<72 hours (if gliders available and appropriate)
Minimum resource requirements	
+ Water quality monitoring vessel/s – refer Santos Offshore ER Intranet for vessel specification. + Water quality monitoring team (through monitoring service provider). + OSRL towed fluorometer (Turner C3) + Particle size analyser.	

10.8 Shoreline clean-up assessment

Table 10-34 provides the Environmental Performance Outcome, initiation criteria, termination criteria and other key aspects for this strategy.

Table 10-34: 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 or 3 spills – may be deployed in a Level 1 incident (to be determined by OSC)	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✓	✓
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.

DoT are the designated Control Agency for shoreline response in WA. The designated 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**).

DCCEEW are the designated Jurisdictional Authority for all spills that contact the shorelines within Ashmore Reef AMP and Cartier Island AMP identified in this OPEP; the Santos IMT (as Control Agency for this island as they are in Commonwealth waters) will liaise with DCCEEW to direct resources for the purposes of shoreline assessment and clean-up activities.

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
- Pilbara Region Oiled Wildlife Response Plan (DBCA & AMOSC, 2014)
- WA Marine Oil Pollution Risk Assessment Web Map Application (rankings and general information on protection priorities)

Safety note: *Cartier Island and the surrounding marine area within a 10 km radius was a gazetted Defence Practice Area up to 20 July 2011. Although no longer used, there is a substantial risk that UXOs remain in the area. Landing or anchoring anywhere within the Cartier Island Commonwealth Marine Reserve is strictly prohibited. Therefore, shoreline clean-up assessment of these islands should be conducted via UAVs for Cartier Island. Onshore clean-up assessment is likely to be suitable for Ashmore Island.*

10.8.1 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. In the event of a spill with the potential for shoreline contact in WA waters, DoT, will control shoreline assessments and ultimately personnel supplied through Santos will follow the direction of DoT; this may differ from that included below.

DoT provides guidance on shoreline assessments within their WA Oil Spill Contingency Plan.

Table 10-35 presents considerations for planning and conducting the assessments.

The implementation guide for Shoreline Clean-up and Assessment is found in **Table 10-36**.

Table 10-37 provides a list of resources that may be used to implement this strategy and **Table 10-38** details the minimum first-strike mobilisation requirements for Santos on activation.

Table 10-41 lists the Environmental Performance Standards and Measurement Criteria for this strategy.

Table 10-35*: Shoreline clean-up assessment considerations*

Considerations for Shoreline Clean-up Assessment	
Survey design	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): + 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. A shoreline clean-up assessment may include the following tasks: + Assessment of shoreline character, habitats and fauna, including: o shoreline structured biotic habitats o distribution of fauna o shoreline and processes (e.g. wave, tidal flows) o shoreline substrate (e.g. mud, sand, pebble, rock) o shoreline form (e.g. width, shape and gradient) o access/safety constraints. + Assessment of shoreline oiling (if present): o surface distribution and cover o subsurface distribution

<table>
<tr><th colspan="2">Considerations for Shoreline Clean-up Assessment</th></tr>
<tr><td></td><td>
oil type, thickness, concentration and physical character
sampling of oil for laboratory analysis.
+ Recommendations for response:
applicable strategies based on oil type and habitat
potential access, safety and environmental constraints
likely resourcing (personnel and equipment) requirements.
+ Towards the end of a response, SCAT may be deployed for post treatment shoreline survey and sign-off/completion, including:
post-clean-up inspections to confirm if end points have been achieved or if they require further treatment
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 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 DoT as the HMA and Control Agency for coastal/shoreline pollution in WA. 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 using:
+ 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, wetland, other
+ 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.
</td></tr>
<tr><td>Analysis and reporting</td><td>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.</td></tr>
</table>

Santos

Table 10-36: Shoreline clean-up assessment – implementation guidance

	Action	Consideration	Responsibility	Complete
Initial Actions	Ensure initial notifications to WA DoT have been made.	Refer to **Section 7** for reporting requirements.	Environment Unit Leader	☐
	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	☐
	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 10-37**. 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	☐
	Conduct assessment of shoreline character, habitats and fauna.	Refer to **Table 10-35**. Refer to the WA DoT Shoreline Assessment Form for spills contact WA shorelines	AMOSC Core group and Control Agency	☐
	Conduct assessment of shoreline oiling (if present).	Refer to **Table 10-35**.	AMOSC Core group and Control Agency	☐
	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 10-35**.	AMOSC Core group and Control Agency	☐

Table 10-37: 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 Santos core group 84 (minimum) 16	Perth, Geelong, Fremantle, Dampier, Varanus Island and other Australian locations	<24 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 10-38: 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	
+ 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.	

10.8.2 Resourcing requirements

Shoreline clean-up assessment teams will comprise two to three members per team and are assumed to be able to cover 10 km per team per day. Teams may be able to exceed this distance, especially if remote sensing techniques (e.g. UAVs) are employed to cover shorelines that have access limitations, which includes many receptor locations in the EMBA.

Santos has used both stochastic and deterministic modelling data for shoreline contact to plan for the worst-case shoreline and habitat assessment personnel requirements. **Table 10-39** presents all receptors contacted at >100 g/m² using the stochastic modelling results for the surface LOWC (the surface LOWC had the greatest overall contact and length of oiled shoreline) along with the SCAT planning considerations and estimated number of SCAT teams required. It should be noted that not all of the receptors listed in **Table 10-39** will be contacted by one single spill. These results are presenting the range of possible worst-case timeframes to contact and length contacted based on all runs that make up the stochastic model. Santos will use initial operational monitoring data (e.g. trajectory modelling and aerial surveillance) to determine where resources should be allocated. This may include directing resources to conduct SCAT at locations not identified as protection priority areas, to determine if protection and clean-up activities may be required at these receptors.

Initially, shoreline clean-up assessment may be conducted via reconnaissance surveys and later confirmed via ground and/or vessel surveys.

Deterministic run #150 (subsea LOWC) (**Table 10-40**) was selected to guide resourcing estimates for SCAT given it has the maximum length (km) of shoreline oiled at >100 g/m^2 and the shortest time for oil accumulation >100 g/m^2. Based on run #150 (subsea LOWC) (**Table 10-40**), the worst-case personnel requirements are for 36 to 63 personnel; 18 to 21 teams with two to three personnel each (1 Team Leader and 1-2 Team Members).

Table 10-39: Resource requirements for shoreline clean-up assessment for all locations contacted >100 g/m^2 based on stochastic results for surface LOWC (GHD, 2022)

<table>
<tr><th>Location</th><th>Minimum arrival time shoreline oil accumulation >100 g/m² (days)</th><th>Maximum length of shoreline oiled (km) >100 g/m²</th><th>Planning considerations</th><th>Estimated No. of teams required</th></tr>
<tr><td>Kimberley Coast PMZ</td><td>91.1</td><td>34.0</td><td rowspan="6">Much of these coastlines are inaccessible to ground surveys. Survey teams would initially conduct reconnaissance surveys followed by targeted monitoring surveys to focus areas. Targeted monitoring surveys may be completed via vessel, and where possible, ground surveys.</td><td>2</td></tr>
<tr><td>Camden Sound</td><td>59.8</td><td>80.7</td><td>4</td></tr>
<tr><td>King Sound</td><td>45.1</td><td>68.0</td><td>4</td></tr>
<tr><td>Southern Islands Coast</td><td>15.5</td><td>8.5</td><td>1</td></tr>
<tr><td>Northern Islands Coast</td><td>92.9</td><td>4.2</td><td>1</td></tr>
<tr><td>Dampier Archipelago</td><td>54.4</td><td>4.2</td><td>1</td></tr>
<tr><td>Cartier Island AMP</td><td>67.1</td><td>0.6</td><td rowspan="2">Initial assessment can be conducted via UAVs. These islands are close to each other so sharing resources is preferable.</td><td rowspan="2">1</td></tr>
<tr><td>Ashmore Reef AMP</td><td>49.4</td><td>4.0</td></tr>
<tr><td>Seringapatam Reef</td><td>39.7</td><td>12.7</td><td></td><td>1-2</td></tr>
</table>

Location	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum length of shoreline oiled (km) >100 g/m²	Planning considerations	Estimated No. of teams required
Scott Reef North	44.8	12.7	Mainly intertidal habitat, so use of vessels and UAVs would be more suited to conditions. In close proximity to each other so sharing of resources is feasible.	
Scott Reef South*	39.0	51.0		
Adele Island	54.9	3.2	Much of the island is accessible for ground surveys	1
Clerke Reef MP*	12.6	34.0	These islands are located close to each other so sharing resources is preferable.	1-2
Imperieuse Reef MP*	8.2	46.7		
Port Hedland-Eighty Mile Beach	42.8	4.2	Mainland location, moderately good access.	1
Montebello Islands	14.4	25.5	Offshore Islands with varied access. Facilities exist at Thevenard and Barrow Islands.	2-3
Lowendal Islands	46.8	4.2		1
Barrow Island	17.5	42.5		4
Thevenard Islands	28.1	4.2		1
Browse Island	65.6	0.5		1
Muiron Islands	14.1	8.5		1
Ningaloo Coast North	25.2	21.2	Mainland locations, moderately good access.	2
Broome North Coast	28.9	97.7		10
Broome – Roebuck	32.3	12.7		1-2
Port Hedland-Eighty Mile Beach	42.8	4.2		1
Bedout Island	27.0	1.1	Island surrounded by intertidal habitat. Shallow vessels required.	1
Christmas Island	51.6	17.0	Much of the island is accessible for ground surveys.	2

** Predominantly intertidal receptor apart from small dry emergent areas and therefore length of shoreline oiled likely to be less than model output*

Note: SCAT numbers not to be added up from this table as spill will not contact all receptors modelled (as these are stochastic results). Number of personnel required will be based on direction of spill and timeframes to contact.

Table 10-40: Resource requirements for shoreline clean-up assessment for protection priority areas based on subsea LOWC deterministic run #150 (GHD, 2022)

Location	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum length of shoreline oiled (km) >100 g/m²	Estimated No. of teams required
Kimberley Coast PMZ	105.9	34.0	3-4
Ashmore Reef AMP	108.4	1.0	1
Browse Island	67.2	0.5	1
Camden Sound	90.6	63.7	6
Seringapatam Reef	101.7	12.7	1-2
Scott Reef North	102.1	12.7	
Scott Reef South*	83.7	38.2	
Adele Island	83.2	3.2	1
King Sound	87.6	42.5	4
Clerke Reef MP*	16.9	29.7	1-2
Imperieuse Reef MP*	8.5	38.2	
Total estimated SCAT teams required			**18–21**

**Predominantly intertidal receptor apart from small dry emergent areas and therefore length of shoreline oiled likely to be less than model output*

10.9 Environmental performance

Table 10-41: 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

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**
	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
	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	Completed vessel statement of conformance
		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	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**
		area by observation aircraft provided	
		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 16 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
		Access to additional spill modelling capability to ensure redundancy.	Membership in place with OSRL
	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	Satellite imagery and analysis accessed through third party provider activated through AMOSC and/or OSRL	AMOSC Participating Member contract, OSRL Associate Member contract

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		
	Satellite imagery	Data incorporated into Common Operating Picture and provided to spill modelling provider	Incident log; Incident Action Plan
Monitor and Evaluate – oil characterisation and operational water quality monitoring	**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
	Entrained oil monitoring equipment and services	Maintenance of arrangements to enable access to fluorometry services throughout activity	Arrangement with provider of fluorometry equipment
	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 Dampier	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
		If applicable (not MDO), oil samples sent to laboratory for dispersant amenability	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'	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**
		tests) within 24 hours of receiving all results	
	Operational water quality 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
		Fluorometry surveys mobilised within 72 hours of initiation	Incident log
		Daily report including fluorometry results provided to IMT	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 10-37** and **Table 10-38.** Maintain capability throughout activity through AMOSC Core Group, DoT State Response Team, AMSA National Response Team and OSRL	AMOSC Participating Member Contract, MoU for access to National Plan resources through AMSA, OSRL Associate Contract and TRG arrangements
	Response Implementation		
	Shoreline assessment	SCAT trained personnel are mobilised as per the numbers and deployment schedules provided in **Table 10-38**	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 OSRO responders for SCAT Team Leader positions to the Control Agency	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**
		If required ongoing SCAT teams will be available to meet the requirements specified in **Table 10-40**	
		SCAT reports provided to the IMT daily detailing the assessed areas to maximise effective utilisation of resources	Incident Log
	Just-In-Time training	Training providers and personnel providers contacted during week 1 to initiate training	Incident Log
	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 (i.e., DoT)	Vessel specification documentation contained in IAP.
	SCAT Field Co-ordinator assessment/selection of vehicle appropriate to shoreline conditions	SCAT Field Co-ordinator 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 (i.e., DoT), 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 (i.e., DoT) 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 (i.e., DoT), action plans for shoreline operations include operational restrictions on vehicle and personnel movement	IAP demonstrates requirement is met

11. Containment and Recovery Plan

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

Table 11-1: Containment and recovery – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement containment and recovery tactics to reduce the volume of surface hydrocarbons to reduce contact with protection priorities	
Initiation criteria	Notification of a condensate spill	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✗	✓ 2
Termination criteria	+ NEBA is no longer being achieved, and + Agreement is reached with Jurisdictional Authorities to terminate the response	

11.1 Overview

Containment and recovery involves using booms and skimming equipment to create physical barriers on the water surface to contain and recover the oil, to remove risk of oil contacting environmental, social and cultural sensitivities. This strategy is often used in the offshore environment in close proximity to the hydrocarbon source. Once contained, an attempt to recover the hydrocarbons from the surface waters can be undertaken using a skimmer.

Spill modelling of the surface LOWC scenario predicted very limited opportunity for the application of containment and recovery with the surface slick predicted to only exceed 50 g/m^2 for less than two hours outside of the 18 km exclusion zone (GHD, 20022). For the subsea LOWC scenario there were no instances where the surface slick was predicted to exceed 50 g/m^2. Containment and recovery is therefore a secondary response strategy which may be considered at the time of a spill based on the criteria outlined in **Table 11-2.** Further definition of BAOACs is provided in **Table 13-2**.

Table 11-2: Containment and recovery application criteria

Criteria	Recommended	Not Recommended
Spill characteristics	+ Patchy slick + Extended operations + Surface concentrations >50 g/m² (BAOAC of 4) at a minimum, 200 g/m² (BAOAC of 4/5) is optimal	+ Situation dependent + Surface thickness <50 g/m² (BAOAC <4)
Hydrocarbon type	+ Group 3 hydrocarbons and above + Persistent components of Group 1 and 2 hydrocarbons may be suitable	+ Minor to moderate spills of Group 1 and 2 hydrocarbons are likely to weather rapidly. High volatiles of these hydrocarbons may be a safety risk to personnel
Operating environment	+ Waves <1 m for nearshore containment and recovery systems (Santos Expandi Boom) + Waves <1.8 m for offshore systems + Winds <20 knots	+ Wave heights exceed 1.8 m + Current >0.75 knots

11.2 Implementation guidance

Table 11-3 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 11-4** 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 containment and recovery operations are listed in **Table 11-5**. The Incident Commander is ultimately responsible for the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

11.3 Resourcing Requirements

For planning purposes, a J-Sweep configuration (as shown in **Figure 11-1**) using two vessels (one deployment vessel and one towing vessel) is assumed for each containment and recovery unit. Each unit requires:

- 1 x Vessel Master
- 1 x Supervisor
- 4 x deployment crew
- 1 x 200 m offshore boom reel
- 1 x offshore skimmer
- If required (if vessel does not have integral recovered oil storage tanks): Waste storage of 33 m^3 per day (made up of 2 x 4 m^3 offshore ISO tanks stowed on deck, and 1 x 25 m^3 inflatable storage bladder towed alongside the deployment vessel).

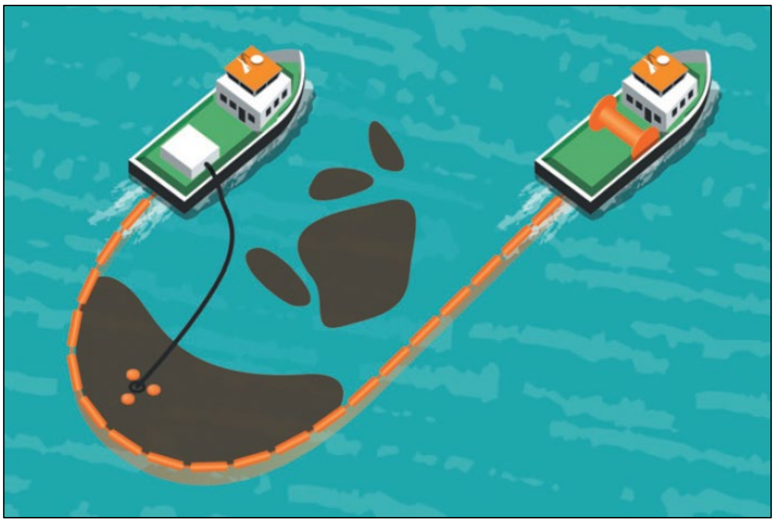


Figure 11-1: 'J' Configuration for Containment & Recovery Operations; 1 x Containment and Recovery Unit (IPIECA-IOGP, 2016a)

The deployment vessel will be tasked to carry out the deployment of boom, skimmer and towable temporary storage bladder (if required), using the towing vessel for support. The use of vessels of an appropriate specification is essential to ensure successful containment and recovery operations. The required specifications for deployment and towing vessels are defined in the Santos Vessel Requirements for Oil Spill Response document (7710-650-ERP-0001).

For the purposes of resource planning for the MEFF plug and abandonment activity, it has been assumed that only one containment and recovery unit may be tasked (if at all), given the very limited opportunity to apply containment and recovery as predicted by the oil spill modelling (refer to **Section 6.4.1**). The personnel resourcing numbers are provided in **Table R-1** (Cumulative Response Capability Assessment) as part of the cumulative resourcing assessment in **Appendix R**.

Table 11-3: Implementation guidance – containment and recovery

	Action	Consideration	Responsibility	Complete
Initial Actions	**Containment and recovery**			
	Identify and activate containment and recovery equipment stockpiles based on incident location. Initial equipment mobilisation from Karratha, Exmouth and Dampier.	Refer to **Table 11-4** for location of containment and recovery resources. Initial deployment from Karratha, Dampier or Exmouth pending vessel availability. Up to date stockpile information accessed through Santos' Emergency Response Intranet Site.	Logistics Section Chief Supply Unit Leader Operations Section Chief	☐
	Identify suitable deployment vessels/crew. Mobilise resources port location – Karratha, Exmouth and Dampier.	Refer to **Table 11-4** for location of containment and recovery resources. Initial deployment from Karratha, Dampier or Exmouth pending vessel availability. Preference will be for vessels and crew that are exercised in regular Santos booming exercises.	Logistics Section Chief Supply Unit Leader Operations Section Chief	☐
	Assess the spill trajectory modelling, other operational monitoring data to identify operational area for containment and recovery (C&R) deployments.	Refer to **Table 11-2 for** guidance.	Operations Section Chief Planning Section Chief	☐
	Confirm conditions are suitable for containment and recovery activities	Refer to **Table 11-2** for guidance.	Operations Section Chief Planning Section Chief	☐
	Mobilise deployment personnel to nominated marine base(s)	Each vessel conducting containment and recovery is to be manned with a trained AMOSC, Santos or OSRL Oil Spill Responder, who is the Team Leader tasked with controlling the operations and implementing them in a safe and responsible method. The Team Leader has the responsibility of evaluating the effectiveness of the containment and recovery operations and communicating the information to the IMT Operations Section Chief.	Operations Section Chief Logistics Section Chief	☐

Action		Consideration	Responsibility	Complete
	Coordinate aerial surveillance support to vessels to ensure they are being directed to priority locations for containment and recovery activities within operational zones.	Focus on containment and recovery activities to areas of slick of a sufficient thickness whereby containment and recovery activities will be effective. Refer to **Table 11-2** for guidance	Planning Section Chief Operations Section Chief	☐
	Direct containment and recovery operations to designated operational zones.	The base case restrictions for containment and recovery is no operations within 18 km of well site, as per the natural dispersion exclusion zone defined by the modelling (GHD, 2022) (refer to **Section 6.4**).	Operations Section Chief	☐
	Decanting (if selected)			
	Obtain decanting approval from AMSA (Commonwealth waters) or DoT (WA waters).	Under both MARPOL and POWBONS, decanting must be approved by the relevant Jurisdictional Authority where the discharge will occur. Approval should be sought to discharge water that has separated from oil into the apex of the already deployed containment boom system (with operational skimmer). This will increase the oil strong capacity of storage tanks.	Environment Unit Leader	☐
	Ensure personnel onboard the vessels are familiar with decanting procedure approved by the relevant authority AMSA (Commonwealth waters) or DoT (WA waters).	-	Operations Section Chief	☐
	Commence decanting operations, ensuring that any discharged water is directed into the apex of the already deployed containment boom system (with operational skimmer).	-	Vessel Master/s	☐
	Ensure there is sufficient temporary storage for oily wastewater onboard vessel.	-	Operations Team Leader	☐

Action		Consideration	Responsibility	Complete
Ongoing Actions	**Containment and recovery**			
	Coordinate the dispatch of operationally ready (all equipment and personnel on board) vessels via the IAP.	Equipment will be maintained and replaced if necessary through existing stockpiles.	Operations Section Chief	☐
	Maintain operational zones and provide updates to Vessel Masters on most suitable locations for containment and recovery operations.	Continue to utilise aerial surveillance data to inform the location of operational zones.	Operations Section Chief	☐
	Develop waste transfer process to secondary vessels/barge to enhance C&R vessel operational time, reduce port visits for waste unloading and reduce contamination.	Consider location and size/ type of waste collection vessel/barge and suitability of equipment and waste receptacles for dynamic lifts. Consider waste transfer to Dampier port rather than Exmouth which is a small multi-use port facility.	Operations Section Chief Planning Section Chief Logistics Section Chief	☐
	Decanting (if selected)			
	Record volumes of all water decanted.	This information must be supplied to the relevant Jurisdictional Authority.	Vessel Master/s	☐
	Manage any solid wastes generated.	-	Vessel Master/s	☐

Table 11-4: Containment and recovery – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Santos Expandi Boom (inshore/calm seas deployment) c/w accessories and powerpacks	Santos	Dampier container (two 200 m booms + accessories) VI Containers four 200 m boom and accessories	Dampier, Varanus Island	Within 12 hours (for Dampier or VI based deployment)
Santos Disc/Brush Skimmers (Desmi DBD16) (inshore/calm seas deployment) c/w hoses/powerpacks	Santos	Two (one each: Dampier and VI)	Dampier, Varanus Island	Within 12 hours (for Dampier or VI based deployment)

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
AMOSC Offshore containment and Recovery Boom AMOSC Offshore Skimmers	AMOSC	2 x 200 m Offshore Boom on Hyd. Reel 15 x Ro Boom (200 m) 1 x Current Buster Boom System 1 x Speed Sweep system 6 x LWS 500 Weir Skimmer GT 185 Weir Skimmer	Broome – 2 (Offshore Boom) Exmouth – 2; Fremantle – 6 Geelong – 7 Geelong – 1 Geelong – 1 Fremantle – 3; Geelong –3 Exmouth – 1	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 (refer **Table 10-12**)
AMSA Offshore containment and Recovery Boom AMSA Offshore Skimmers	AMSA	8 x RO Boom (200 m) 4 x Vikoma Hi Sprint Boom – four 8 x LWS 500 Weir Skimmer 2 x DESMI Termite Skimmer	Karratha – 4; Fremantle – 4 Karratha – 2; Fremantle – 2 Fremantle – 4; Karratha – 4 Fremantle – 1; Karratha – 1	Access to National Plan equipment through AMOSC. Equipment. Logistics varies according to stockpile location (refer **Table 10-12**)
Industry Mutual Aid offshore containment and recovery boom Industry Mutual Aid oil skimmers	Industry Mutual Aid	2 x 200 m Offshore Boom (Chevron) 2 x 200 m Offshore Boom (Woodside) 2 x Weir Skimmers (Woodside) 1 x Weir Skimmer (Jadestone) 2 x Weir Skimmer (Chevron) 1 x Weir Skimmer (INPEX)	WA	Access to Industry Mutual Aid through AMOSPlan and facilitated by AMOSC

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
OSRL offshore containment and recovery boom OSRL offshore oil skimmers	OSRL (Guaranteed access to 50% by type of equipment available. Additional access considered on a case-by-case basis.)	37 x Ro Boom (200 m) 2 x Hi Sprint Boom (300 m) 100 x Ocean Boom (30 m) 50 x Offshore recovery skimmers	Singapore, UK, Bahrain, Fort Lauderdale	Response Activation and Mobilisation of OSRL Duty Manager, available within 10 mins of first call. Equipment logistics varies according to stockpile location
AMOSC offshore waste storage	AMOSC	4 Lancer Barges (25 m^3 each) 6 Deck Bladders (25 m^3 each)	Fremantle –2; Geelong – 2 Fremantle –3; Geelong – 3	Response via duty officer within 15 mins of first call – AMOSC personnel available within 1 hour of initial activation call. Logistics varies according to stockpile location (refer **Table 10-12**)
AMSA offshore waste storage	AMSA	8 x Vikoma Flexidam (10 m^3 each) 5 x Canflex Sea Slug (10 m^3 each) 4 x Vikoma Frost Barge (25 m^3 each) 2 x Covertex tow tank (20 m^3 each)	Fremantle –4; Karratha –4 Fremantle –3; Karratha – 2 Fremantle –2; Karratha – 2 Karratha – 2	Access to National Plan equipment through AMOSC. Logistics varies according to stockpile location (refer **Table 10-12**)
Liquid Waste Tanks	Via North West Alliance contract OEG Contract	As per **Table 17-3** ISO Tanks (4 m^3)	Perth, Karratha WA	<24 hours <24 hours. Offshore rated ISO Tanks are readily available through existing contract arrangements through OEG

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
OSRL offshore temporary waste storage	OSRL (Guaranteed access to 50% by type of equipment available. Additional access considered on a case-by-case basis.)	14 x Storage Barges (50 m^3 each) 21 x Storage Barges (25 m^3 each) 9 x Waste Containment Tanks (10 m^3 each) 2 x Sea Slug (10 m^3 each)	Singapore, UK, Bahrain, Fort Lauderdale	Response Activation and Mobilisation of OSRL Duty Manager, available within 10 mins of first call. Equipment logistics varies according to stockpile location.
Offshore containment and recovery deployment vessels, towing vessels and barges/tanker for waste oil storage and transfer	Santos contracted vessel providers. Preference for vessels used in Santos deployment exercises	Varies – check through vessel contractors/Santos vessel tracking system. Santos Vessel Requirements for Oil Spill Response document (7710-650-ERP-0001) provides the required vessel specifications.	Australia, Singapore	Varies subject to location/ availability.
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 Aus. facilities – ten Port Bonython (SA) – two	From <12 hours (NW-based personnel) From <24 hours (Perth personnel)
	AMOSC Core Group (Industry)	As per monthly availability (minimum 84)	Office and facility location across Australia	Location dependent. Confirmed at time of activation.

Table 11-5: Containment and recovery- first strike response timeline

Task	Time from IMT call-out
IMT confirms applicability of strategy and begins sourcing C&R resources for applicable spills	<4 hours
Santos Core Group mobilised to deployment port location	<24 hours
C&R equipment (offshore boom/skimmers) mobilised to deployment port	<24 hours
Waste storage equipment mobilised to port	<24 hours
Suitable C&R vessels mobilised to port	<24 hours
C&R trained personnel mobilised to deployment port	<24–48 hours
C&R operation deployed to spill site (weather/daylight dependent)	<60–72 hours (weather/daylight dependent)
Minimum Resources Per Containment and Recovery Unit	
+ Two suitable C&R vessels (one deployment vessel + one tow vessel) + 200 m of offshore boom + One offshore skimmer + Waste storage (comprising a combination of towable bladder, IBCs, Iso-tanks, inbuilt vessel storage tanks allowing for 33 m³ liquid waste volume storage) + One trained responder + Four deployment crew + Personal protective equipment	

11.4 Decanting

Decanting is an important tool needed to make efficient use of waste management resources which are often a limiting factor in containment and recovery.

The reduction of overall waste in some circumstances can create an environmental benefit which outweighs the minimal impact caused by the release of water with very low concentrations of oil.

The *Pollution of Waters by Oils and Noxious Substances (POWBONS) Act 1986*; section 8 allows for decanting for combating specific pollution incidents. Additionally, Annex 1 of MARPOL (Regulation 9) allows for decanting for combating specific pollution events to minimise the damage from pollution. Under both MARPOL and POWBONS decanting must be approved by the relevant Jurisdictional Authority. In WA State waters this is DoT (as the Hazard Management Agency under the Emergency Management Act 2005) and in Commonwealth waters this is AMSA. Approval will be sought if decanting is required.

If decanting approval is not obtained through AMSA/DoT, the complete collected oil and water will remain in the collection tanks, and all will be treated as collected waste. In this event, the duration of containment and recovery operations may be reduced due to restricted available sullage.

11.5 Environmental performance

Table 11-6 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 11-6: Environmental performance – containment and recovery

Environmental Performance Outcome	Implement containment and recovery tactics to reduce hydrocarbon contact to surface and shoreline priority protection areas		
Response Strategy	**Control Measures**	**Performance Standard**	**Measurement Criteria**
Offshore Containment and Recovery	**Response Preparedness**		
	Access to containment and recovery equipment and personnel through AMOSC, AMSA National Plan, OSRL and TRG	Maintenance of access to containment and recovery equipment and personnel through AMOSC, AMSA National Plan, OSRL and TRG throughout activity as specified in **Table 11-4**	MoU for access to National Plan resources through AMSA
			AMOSC Participating Member Contract
			OSRL Associate Member Contract
			TRG arrangements
	Offshore waste transfer concept of operations in place	Offshore waste transfer concept of operations to help maximise waste storage availability for C&R vessels.	Waste transfer concept of operations (within Santos Vessel Requirements for Oil Spill Response [7710-650-ERP-0001])
	Maintenance of MSAs with multiple vessel providers	Santos maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers
	Offshore containment and recovery vessels	Maintenance of vessel specification for offshore containment and recovery vessels	Vessel specification
	Planning and arrangements to enable fast access to containment and recovery resources	Santos trained personnel and Santos owned equipment to mobilise to the spill site on the first day post spill.	Equipment manifests Training records MSAs with multiple vessel providers
	Response Implementation		
	First strike resources	Minimum first strike resource requirements mobilised in accordance with **Table 11-5**	Incident Log
	Response requirements for extended operations.	Maintain and operate the containment and recovery systems specified in **Table 11-6.**	Incident Log
	Aerial surveillance reports (to direct operations to areas with greatest oil concentration)	Aerial surveillance reports communicated to C&R Team Leaders	Incident Log

Environmental Performance Outcome	Implement containment and recovery tactics to reduce hydrocarbon contact to surface and shoreline priority protection areas		
Response Strategy	**Control Measures**	**Performance Standard**	**Measurement Criteria**
	Decanting to free up liquid oil waste container storage)	Application for offshore decanting is made to AMSA (Commonwealth waters) or DoT (State waters). When approved decanting of water occurs back into boomed area.	Incident Log
	Spill response activities selected and reviewed on basis of a Net Environmental Benefit Analysis	Prepare operational NEBA to determine if containment and recovery is likely to result in a net environmental benefit	Incident Log
		Operational NEBA for containment and recovery is conducted each operational period and considers oil thickness and weather constraints to effectiveness.	IAP/Incident Log

12. Mechanical dispersion

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

Table 12-1: 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	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✓	✓
Termination criteria	+ 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	

12.1 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.

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. 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.

Santos

Table 12-2: 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	☐
	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	☐
	Notify vessel-based responders to trial mechanical dispersion.	-	Operations Section Chief	☐
	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	☐

Table 12-3: 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 Dampier and/or NW locations. Locations verified through AIS Vessel Tracking Software.	Varies subject to availability and location.

12.3 Environmental performance

Table 12-4 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 12-4: 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

13. Chemical Dispersant Application Plan

Table 13-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 13-1: Chemical dispersant application – environmental performance outcome, initiation criteria and termination criteria

Environmental Performance Outcome	Implement dispersant application to enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities	
Initiation criteria	Notification of a Level 2/3 condensate spills	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✗	✓
Termination criteria	+ Application of chemical dispersants will cease when dispersant efficacy is no longer providing a net environmental benefit as assessed through the NEBA process, and + Agreement is reached with Jurisdictional Authorities to terminate the response	

13.1 Overview

Surface application of dispersants and SSDI (subsea release only) are considered to be secondary response strategies for Mutineer-Exeter crude (refer to **Section 6.5**). Modelling predicts that the natural weathering of Mutineer-Exeter crude means a slick would rarely reach the minimum surface thickness required (50 g/m^2) for effective dispersant application.

Dispersants are chemicals that are sprayed onto floating oil slicks by vessels and/or aircraft; or injected subsea directly to the source of the spill (e.g. uncontrolled well loss site). Dispersants are designed to separate the oil into small droplets and assist with dispersion in the water column to speed up the process of natural biodegradation. Chemical dispersants can be used to:

+ decrease the concentration and volume of surface oil reaching sensitive receptors
+ increase the rate of natural biodegradation
+ reduce the quantity of waste created.

The operational NEBA process will consider potential impacts of both oil and dispersant on sensitive receptors, taking into account information gained from monitor and evaluate activities. This will inform decisions on dispersant use throughout the response, including application location(s), the volumes and rates at which dispersant is applied, and when to limit or cease dispersant use.

13.2 Surface chemical dispersants

Surface chemical dispersants are most effective on hydrocarbons that are at a thickness of 50 to 100 g/m^2 on the sea surface. EMSA (2010) recommends thin layers of spilled hydrocarbons should not be treated with dispersant. This includes BAOACs 1 to 3 (EMSA, 2010) (**Table 13-2**). IPIECA (2015a) recommends that the thickest areas of oil should be targeted for effective surface dispersant application.

13.2.1 Dispersant application area

The base case for surface dispersant application is that no application is to occur:

+ within a Habitat Protection Zone or National Park Zone of an Australian Marine Park (application permitted in the Multiple Use Zone)
+ within State Marine Parks

+ within State Waters
+ within 10 km of water depths <10 m LAT
+ within exclusion zones of offshore facilities
+ within 18 km of well site[17].

Table 13-2: Bonn Agreement oil agreement appearance codes

Code	Description	Layer Thickness (μm)	Litres per km²
1	Silvery sheen	0.04 to 0.30	40 to 300
2	Rainbow sheen	0.30 to 5.00	300 to 5,000
3	Metallic	5 to 50	5,000 to 50,000
4	Discontinuous true oil colour	50 to 200	50,000 to 200,000
5	Continuous true oil colour	More than 200	More than 200,000

13.3 Vessel-based dispersant operations

For the purposes of resource planning for the MEFF plug and abandonment activity, it has been assumed that only one vessel dispersant system may be tasked (if at all), given the very limited opportunity to apply dispersants as predicted by the oil spill modelling (refer to **section 6.4.1**). The personnel resourcing numbers for vessel dispersant application are provided in **Table R-2** (vessel dispersant application – field resourcing requirements) as part of the cumulative resourcing assessment in **Appendix R**.

Table 13-3 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this tactic. **Table 13-4** 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 vessel dispersant operations are listed in **Table 13-5**. The Incident Commander is ultimately responsible for the response, and may therefore determine that some tasks be varied, should not be implemented or be reassigned.

[17] Santos confirmed during modelling that leaving an 18 km buffer around the LOWC location allows for a significant proportion of Mutineer-Exeter Crude to evaporate (GHD, 2022). The size of the exclusion zone was determined based on the distance surface oil would travel with a typical current speed of 0.2 m/s and allowing an average travel time of 24 hours to allow the majority of natural evaporation to occur (GHD, 2022).

Santos

Table 13-3: Implementation guidance – vessel dispersant application

	Action	Consideration	Responsibility	Complete
Initial Actions	Confirm operational NEBA supports surface chemical dispersant application.	Oil type suits dispersant application. Surveillance to confirm oil spill thickness supports use of dispersants from vessels (e.g. BAOAC 4 to 5). Liaise with third party providers (e.g. AMOSC) as part of operational NEBA. Evaluate oil spill trajectory modelling when available.	Planning Section Chief Environment Unit Leader	☐
	Source vessel/s for dispersant application and mobilise to nearest port for loading equipment and personnel (Exmouth or Dampier).	Vessel specification for dispersant vessels provided in ER Intranet – First Strike Resources, and within Santos Vessel Requirements for Oil Spill Response document (7710-650-ERP-0001).	Logistics Section Chief	☐
	Mobilise dispersant operations Team Leaders and Team Members (Santos Core Group and/or AMOSC staff/ Industry Core Group) to designated port.	Each vessel undertaking dispersant application (is to be manned with personnel trained in dispersant application (e.g. AMOSC staff, Santos or Industry Core Group member) who is the Team Leader tasked with controlling the operations and implementing in a safe and responsible method. For prolonged dispersant operations, OSRL responders via Singapore may also be used.	Logistics Section Chief	☐
	Mobilise vessel-based dispersant application equipment and dispersant shake test kits from the Santos storage locations in Exmouth (Exmouth Freight & Logistics) or Dampier Supply Base (two systems at each location) to the designated deployment port.	Exmouth Freight & Logistics to assist with local logistics and vessel loading of vessel spray systems and dispersant movement in Exmouth.	Logistics Section Chief	☐
	Mobilise AMOSC (Exmouth)/ AMSA (Karratha) dispersant stock to nominated vessel deployment location Exmouth and/or Dampier ports.	Check up to date dispersant stockpile inventories can be accessed via ER Intranet – First Strike Resources.	Logistics Section Chief	☐
	Use aerial surveillance to determine priority areas for dispersant application an define operational area for response.	Aerial surveillance reports of oil location and thickness.	Planning Section Chief Operations Section Chief	☐

Action		Consideration	Responsibility	Complete
	Identify safety requirements and controls associated with spraying dispersants and working over oil.	-	Safety Officer	☐
	First vessel onsite test spray oil – confirm effectiveness.	Effectiveness to be recorded with photos.	Operations Section Chief	☐
	Confirm operational NEBA supports surface chemical dispersant application.	Use forecast modelling, operational monitoring data and dispersant efficacy results in operational NEBA.	Operations Section Chief Environment Unit Leader Planning Section Chief	☐
	If dispersant application is shown to be effective and approved for ongoing use by the Incident Commander, continue vessel operations and defining operational area.	Use real-time or most recent visual surveillance observation data to develop operational zones for vessel dispersant operations. The base case restrictions for dispersant application are – no application: + Within a Habitat Protection Zone or National Park Zone of an Australian Marine Park (application considered in the Multiple Use Zone) + Within State Marine Parks + Within State Waters + Within 10 km of water depths <10 m LAT + Within exclusion zones of offshore facilities + Not within 18 km of well site (as per the exclusion zone defined within the modelling - refer to **section 6.4**) The above applies unless justified otherwise by the Operational NEBA, noting that no application in Australian Marine Park (outside multi-use zone) or State waters without relevant authority approval (refer to **Section 4.6.4** for the process on obtaining consent for dispersant use in WA State waters).	Operations Section Chief Incident Commander Environment Unit Leader Planning Section Chief	☐
Ongoing Actions	Reassess dispersant use, utilising the NEBA process for each operational period. Cease application if no net environmental benefit.	-	Operations Section Chief Incident Commander Environment Unit Leader	☐

Action		Consideration	Responsibility	Complete
			Planning Section Chief	
	Continue to mobilise additional chemical dispersant stocks from AMOSC and AMSA.	-	Logistics Section Chief	☐
	Maintain operational zones and provide updates to Vessel Masters on most suitable locations for application.	-	Operations Section Chief Environment Unit Leader Planning Section Chief	☐

Table 13-4: Vessel dispersant application – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Santos Vessel Dispersant Spray Systems	Santos owned	2 x containers (each c/w 3 x systems – dual arm, single arm & Afedo head)	Exmouth (Exmouth Freight & Logistics) Dampier (Toll Supply Yard)	Within 12 hours mobilised to port
AMOSC Vessel Dispersant Spray System	AMOSC	1) Afedo Spray systems 2) Vikospray 3) Boom vane 4) Global Dispersant spray system	1) Broome – 2; Exmouth – 1; Fremantle – 5; Geelong – 4 2) Exmouth – 1; Geelong – 3; Fremantle - 1 3) Fremantle – 1; Geelong – 1 4) Fremantle – 1	Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call; for equipment mobilisation timeframes refer to **Table 10-12**
AMSA Vessel Dispersant Spray System	AMSA	Ayles Fernie Boat Spray	Darwin – 2; Karratha – 2; Fremantle – 2	Access to National Plan equipment through AMOSC.
Dispersant	AMOSC	Refer to **Table 13-11**		Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call; for equipment mobilisation timeframes refer to **Table 10-12**
	AMSA	Refer to **Table 13-11**		Access to National Plan equipment through AMOSC.

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Dispersant spray system vessels	Santos contracted vessel providers Preference for vessels used in Santos deployment exercises	Varies – check through vessel contractors/ Santos vessel tracking system	Exmouth, Dampier, NW locations	Varies subject to location/ availability
Personnel (field responders)	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 Aus. facilities – 10 Port Bonython (South Aus.) – 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

Table 13-5: Vessel based dispersant application – first strike response timeline

Task	Time from IMT call-out
IMT confirms applicability of strategy and begins sourcing vessel dispersant resources for applicable spills	<3 hours
Suitable Dispersant Vessels mobilised to nearest deployment port (Dampier)	<12 hours
Santos Offshore Core Group mobilised to deployment port (Dampier)	<12 hours
Vessel spray system equipment mobilised to deployment port	<12 hours
Dispersants mobilised to port	<12 hours
Vessel spray operation commenced at spill site (weather/daylight dependent)	<36 hours (weather/daylight dependent)
Minimum Resource Requirements	
+ Suitable dispersant application vessel – refer Santos Offshore ER Intranet for vessel specification + One vessel dispersant spray system + Dispersant (10 m^3) + Two Santos Core Group or Industry Core Group responders + Personal protective equipment	

13.4 Aerial dispersant operations

For the purposes of resource planning for the MEFF plug and abandonment activity, it has been assumed that only 1 aerial dispersant spray system from AMOSC may be tasked (if at all), given the very limited opportunity to apply dispersants as predicted by the oil spill modelling (refer to **Section 6.4.1**). The personnel resourcing numbers for aerial dispersant application are provided in **Table R-3** (FWADC aerial dispersant application – field resourcing requirements) as part of the cumulative resourcing assessment in **Appendix R**.

Table 13-6 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 13-7** 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 dispersant operations are listed in **Table 13-8**. 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 13-6: Implementation guidance – aerial dispersant application

	Action	Consideration	Responsibility	Complete
Initial Actions	Confirm operational NEBA supports surface chemical dispersant application.	Oil type suits dispersant application. Surveillance to confirm oil spill thickness supports use of dispersants (e.g. BAOAC 4 to 5). Liaise with third party providers (e.g. AMOSC) as part of operational NEBA. Evaluate oil spill trajectory modelling when available.	Planning Section Chief Environment Unit Leader	☐
	Mobilise initial resources for aerial application. After initial AMOSC notifications are complete, contact AMOSC Duty Officer and confirm requirements for the following resources: Access to and mobilisation of required AMOSC dispersant stocks and associated equipment into designated airstrip (AMOSC will arrange through their contracted transport provider). Activation of the Fixed Wing Aerial Dispersant Capability (FWADC) (AMOSC will activate this on behalf of Santos). Provision of trained spill responders to support operations (AMOSC Staff and Core Group).	Refer Joint Standard Operating Procedures for FWADC. AMOSC will deploy appropriate aircraft to a designated airstrip close to the spill location (e.g. Dampier, Port Hedland, Learmonth Airports), and arrange for pilots, Air-Attack Supervisors, observation aircraft (one per two attack aircraft) and trained observers.	Logistics Section Chief Operations Section Chief Aviation Superintendent	☐
	Finalise Fixed Wing Air Operations Plan and Air Operations Plan in consultation with AMOSC, AMSA, Aerotech First Response and other stakeholders.	Ensure flight schedule in Air Operations Plan considers requirements for other activities such as aerial surveillance sorties.	Operations Section Chief Aviation Superintendent Planning Section Chief	☐
	Using real-time or most recent visual surveillance observation data, develop operational zones for aerial dispersant operations.	Focus on applying dispersant to areas of slick that threaten priority receptors and are of a sufficient thickness whereby chemical dispersants will be effective. The base case restrictions for dispersant application are – no application:	Operations Section Chief Planning Section Chief	☐

	Action	Consideration	Responsibility	Complete
		+ within a Habitat Protection Zone or National Park Zone of an Australian Marine Park (application considered in the Multiple Use Zone) + within State Marine Parks + within State Waters + within 10 km of water depths <10 m LAT + within exclusion zones of offshore facilities + not within 18 km of well site (as per the exclusion zone defined within the modelling - refer to **Section 6.4**). The above applies unless justified otherwise by the Operational NEBA, noting that no application in Australian Marine Park (outside Multi-use zone) or State waters without relevant authority approval (refer to **Section 4.6.4** for the process on obtaining consent for dispersant use in WA State waters).		
	Conduct aerial dispersant spraying reporting effectiveness to IMT.	-	Operations Section Chief Planning Section Chief	☐
Ongoing Actions	Conduct operational NEBA during each operational period to reassess effectiveness of application rates and dispersant efficacy.	-	Environment Unit Leader Planning Section Chief	☐
	Maintain operational zones and provide updates to pilots on most suitable locations for aerial application.	-	Operations Section Chief Planning Section Chief	☐

Table 13-7: Aerial chemical dispersants application – resource capability

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
Aerotech First Response fixed wing aircraft, pilots and ground crew	AMOSC – Fixed Wing Aerial Dispersant Contract	Six under FWADC contract Additional aircraft potentially available through Aerotech First Response	Operations from designated airbase Aircraft initially mobilised from 6 bases around Australia: + Jandakot (WA) + Batchelor (NT) + Parafield (SA) + Scone (NSW) + Ballarat (Vic) + Emerald (QLD)	Six air contractors to have wheels up in four hours from locations around Australia. Mobilisation times depend on the flight time from the location of the aircraft Supporting equipment mobilisation (dispersants etc) as per equip mob timeframes (**Table 10-12**)
Hercules C130 aircraft	OSRL	One plane	Senai, Malaysia	Wheels up in six hours Flight time from Senai to Port Hedland is eight hours (including one technical stop at Bali/Makassar)
Air attack (and surveillance and reconnaissance (SAR)) helicopter	Santos contracted helicopter provider/s	Two (contracted) + additional subject to availability	Karratha (primary base), Learmonth, Onslow	Wheels up within one hour for Emergency Response
Dispersant	AMOSC	Refer to **Table 13-11**		Response via duty officer within 15 minutes of first call – AMOSC personnel available within one hour of initial activation call; for equipment mobilisation timeframes refer to **Table 10-12**
	AMSA	Refer to **Table 13-11**		Access to National Plan equipment through AMOSC
FWADC operational personnel incl. Air Attack Supervisor and Dispersant Coordinator	AMOSC and subcontractors via Fixed	AMOSC staff + contractors, as per AMOSC FWADOps Plan (AMOSC, 2020).	AMOSC Fremantle AMOSC Geelong	Response via duty officer within 15 minutes of first call; timeframe for availability of AMOSC personnel

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
	Wing Aerial Dispersant Contract			dependent on location of spill and transport to site
SAR vessel (can be double use vessel)	Santos contracted vessel providers.	Varies – check through vessel contractors/ Santos vessel tracking system	Exmouth, Dampier, NW locations	Varies subject to location/ availability

Table 13-8: Aerial dispersant operations – first strike response timeline

Task	Time from IMT call-out
IMT confirms applicability of strategy and activates Fixed Wing Aerial Dispersant Capability (FWADC)	<3 hours
AMOSC to mobilise Fixed Wing aircraft to nominated airbase	<12 hours
AMOSC to mobilise dispersants to nominated airbase	<24 hours
AMOSC to mobilise all FWADC capability personnel to nominated airbase	<48 hours
AMOSC/Santos to mobilise helicopter to nominated airbase to support air-attack surveillance	<48 hours
AMOSC/Santos to mobilise vessel to nominated port to provide SAR support	<48 hours
First FWADC test spray	<48 hours (weather/daylight dependent)
Minimum Resource Requirements	
+ one fixed wing aircraft (Aerotech First Response) + one helicopter + SAR Vessel + WA AMOSC dispersant stocks to deployment airbase (refer to **Table 13-11**) + AMOSC contracted FWADC capability personnel: o Pilots o Air Attack Supervisor o Aerial Observer o FOB Commander o Airbase Manager	

Task	Time from IMT call-out
○ Safety Officer ○ Dispersant Coordinator ○ Dispersant Loading Crew ○ Log/ Admin	

13.5 Subsea dispersant injection operations

SSDI has been observed to break-up oil droplets, forcing greater entrainment of the oil into the water column below the sea surface (Adams *et al.*, 2013). SSDI has additional benefits over surface dispersant application including its ability to reduce volatile organic compounds in the vicinity of a spill, making the area safer for responders. It typically requires smaller volumes of dispersant to be used as it has a higher encounter rate with the hydrocarbons than surface application. SSDI can also be used day and night; whereas surface application via vessel or aircraft can only occur during daylight hours.

The effectiveness of SSDI is influenced by dispersant efficacy on the hydrocarbon, how close to the release the dispersants may be added and the dispersant to oil ratio (DOR). It is assumed the DOR would commence at 1:100 and would be modified based on the results of the effectiveness monitoring. Research conducted by Brandvik *et al*., 2014 indicated that DORs of 1:50 to 1:100 may be sufficient to cause substantial additional dispersion, particularly if the dispersant is injected close to or into the release point.

Personnel resources for SSDI are provided in **Table R-1** (Cumulative Response Capability Assessment) in **Appendix R**.

13.5.1 Implementation guidance

Table 13-9 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. Mobilisation times for the minimum resources that are required to commence initial SSDI operations are listed in **Table 13-10**. 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 13-9: Implementation guidance – subsea dispersant injection

	Action	Consideration	Responsibility	Complete
Initial Actions	Confirm operational NEBA supports subsea chemical dispersant injection.	As described in **Section 6.5,** subsea dispersant application has been identified as secondary strategy for subsea LOWC scenarios only. The operational NEBA will identify if this strategy is activated. Use forecast modelling and any operational monitoring results in operational NEBA.	Operations Section Chief Incident Commander Environment Unit Leader Planning Section Chief	☐
	If viable and if the Operational NEBA supports SSDI, activate Subsea First Response Toolkit (SFRT) equipment and activate Oceaneering personnel for deployment.	As described in **Section 6.5,** SSDI is considered a secondary response strategy for a subsea LOWC for this activity. Separate contracts in place for SFRT (AMOSC) and Oceaneering.	Designated call-out authority (Incident Commander) Source Control Branch	☐
	Refer to **Section 9.2.2** for implementation guidance associated with the SFRT.			
	If viable, conduct initial ROV survey at the release point to determine the nature of the release, behaviour of the oil, estimate the oil and gas flow rates and determine DOR for injection.	Information to be used to help determine injection method/s.	Operations Section Chief Source Control Branch Director	☐
	If viable, commence dispersant subsea injection adjusting DOR based on real-time monitoring.	-	Operations Section Chief Source Control Branch Director	☐
	Continue operational monitoring (including operational water quality monitoring and surveillance) near the release point to help determine dispersant effectiveness.	Use guidance provided in API Technical Report 1152 (API, 2013) to determine dispersant efficacy. Surveillance should have commenced prior to any dispersant being added to the release so that changes and efficacy can be determined. Once baseline data has been collated, commence injection to help determine DOR and modify accordingly.	Source Control Branch Director Operations Section Chief	☐
	If dispersant application is shown to be effective and approved by the Incident Commander, continue operations.	-	Source Control Branch Director Operations Section Chief	☐

	Action	Consideration	Responsibility	Complete
			Incident Commander	
Ongoing Actions	Reassess dispersant use, utilising the NEBA process for each operational period. Cease application if no net environmental benefit.	Continue to use forecast modelling, operational monitoring data and dispersant efficacy results in operational NEBA.	Source Control Team Leader Operations Team Leader Incident Commander Planning Team Leader Environmental Team Leader	☐

Table 13-10: Subsea dispersant injection – first strike response timeline

Task	Time from IMT call-out
IMT Source Control Branch activated	<24 hours
If viable response strategy, suitable SFRT-dispersant injection vessel/s mobilised to Dampier	<10 days
If viable response strategy, Oceaneering to mobilise personnel to Dampier	<10 days
If viable response strategy, AMOSC to mobilise SFRT and dedicated dispersant to Dampier	<10 days
If viable response strategy, load equipment, steam to site and commence SSDI	<12 days
Minimum Resource Requirements	
+ Suitable vessel and crew + SFRT + Dispersant (with SFRT) + Oceaneering personnel	

13.6 Dispersant selection process

13.6.1 Dispersant use

Dispersants should only be used when the risks associated with their use to the environment as a whole have been analysed, and it has been determined that there would be a net environmental benefit from their use. The type of dispersant that will be effective is influenced by the oil type and metocean conditions (Hook and Lee, 2015).

Most of the knowledge on the biological impacts of dispersants has been developed via laboratory experiments (Quigg *et al*., 2021) rather than from in-situ use. This is also the case for those dispersants listed as approved in the National Plan for Maritime Environmental Emergencies Register of Oil Spill Control Agents (OSCA). Before a dispersant can be considered for use by AMSA, its toxicological impact must be tested on a diverse range of aquatic taxa, including algae, invertebrates and fish (Hook and Lee, 2015). This screening process ensures that these compounds have comparatively low toxicity (according to US Environmental Protection Agency criteria; Hemmer et al., 2011) and that they are much less toxic than oil (Hook and Lee, 2015).

Of the dispersants listed on the OSCA Register, only Corexit 9500A and 9527 (the latter is only on the transitional acceptance list) have been used in response to a large-scale spill and during subsea application, which was during the Macondo oil spill (Gulf of Mexico) in 2010. Six types of dispersant were used on the Montara oil spill in the Timor Sea in 2009, including Slickgone NS, Corexit 9500, Corexit 9527, Slickgone LTSW, Ardrox 6120 and Tergo R40 (AMSA, 2010). However, the total volumes sprayed equated to 150 m^3 (AMSA, 2010), as opposed to the 7,000 m^3 (4,100 m^3 surface application and 2,900 m^3 subsea application of just Corexit 9500A and 9527) (Quigg *et al*. 2021) used during the Macondo spill.

A detailed assessment of oil fate and mass balance was completed by French-McCay *et al*. (2021) on the Macondo spill. This indicated on average, that there was 9% less floating oil during the duration of the release due to subsea dispersant application. This assessment also showed subsea application was increasingly effective over the course of the spill in reducing VOC exposures in the immediate area of the wellhead by up to 27% (French-McCay *et al*. 2021), making source control operations safer for responders.

However, water depth may be a limitation to the effectiveness of SSDI for VOC control; shallower depths may not be sufficient to enable VOCs to be reduced to a point which ensures a safe operating environment on the surface (OSRL, 2019). Some research suggests this may be around 500 m (Adams & Socolofsky, 2005, in: IPIECA, 2015) however there is currently no definitive recommended minimum water depth for SSDI use. Water depth at the MEFF field is 130-160 m, compared to 1,500 m where SSDI was used during the Macondo spill.

Despite the considerable amount of research, modelling and experimental work done to study the effects of subsea dispersant application, there is conflicting evidence as to the efficacy of the use of subsea dispersants (Quigg *et al*., 2021). However, NASEM (2020) found no compelling evidence that at low to moderate oil concentrations that chemically dispersed oil was any more toxic than oil alone. However, at high concentrations the combination of oil and dispersant appeared more toxic (Quigg *et al*., 2021), suggesting caution should be applied when considering dispersant application rates and volumes. This also shows the importance of ongoing dispersant effectiveness monitoring (**Section 13.7**) and its application through the operational NEBA process.

13.6.2 Dispersant selection

Chemical dispersants listed as approved in the National Plan for Maritime Environmental Emergencies Register of Oil Spill Control Agents (OSCA) are to be prioritised for use. OSCA listed dispersants are readily available to Santos through AMOSC, OSRL and AMSA. These include Slickgone NS, Slickgone EW, Corexit EC9500A, Corexit 9527 (transitional acceptance) and Finasol 52. As described in **Sections 13.8** and **13.9**, there are sufficient stockpiles of these dispersants in Australia to service the entire duration of surface or subsea application.

During a response, chemical dispersant shall be tested on the released oil at a laboratory as part of the initial oil characterisation (refer **Section 10.6**) as well as through field testing using vessel-based spray systems/ dispersant shake test kits. The State ESC can also advise on the location of AMSA National Plan Dispersant Effectiveness Test Kits, which could be utilised in addition to Santos' dispersant efficacy testing resources.

13.7 Dispersant effectiveness monitoring

To assess the effectiveness of dispersant application, Santos will use the SMART monitoring protocol (NOAA, 2006) to measure the efficacy of surface dispersants and the Industry Recommended Subsea Dispersant Monitoring Plan (API, 2020) to determine the efficacy of subsea dispersant application. These techniques assist in characterising the nature and extent of subsea or near surface dispersed oil, aid in the validation and accuracy of plume trajectory models and allow for rapid quantification of data to enable the IMT to make decisions about continuation of dispersant application. The IMT assesses the effectiveness of continued dispersant use against an operational NEBA assessment. This capability is provided by Santos' Dispersant Operational Monitoring Provider (refer to **Appendix O**).

The SMART protocol for surface dispersants allows for the acquisition of more robust data using fluorometry. This protocol includes the following tiers (which may be conducted at the same time):

+ **Tier I: Visual Monitoring** – requires the use of trained or experienced personnel to conduct visual monitoring of dispersant efficacy after a dispersant has been applied to the spill in-situ. This monitoring is usually performed after the shake jar test. If the shake jar test shows the dispersant to be effective, then a 'test spray' is performed and observed using this protocol, before full-scale deployment of dispersant spraying occurs. Tier I gives rapid (but qualitative) results and is used as the initial monitoring method until additional resources and equipment are deployed to conduct Tier II and III monitoring. It should be noted that visual monitoring does not provide any details on particle sizes (required to understand the stability of the suspension) nor does it indicate the overall loadings of oils into the water column (an indicator of both efficacy and the likelihood of toxic impacts). Visual observations may be taken by vessel and/or aircraft and will be used to assess whether dispersant application is successful in dispersing hydrocarbons. The effectiveness of the aerial based chemical dispersion strategy is communicated to the Operations Section Chief via the Air-Attack Supervisors. As per industry standard practice, initial dispersant use decision making for surface application (Day 1 – Day 4) will be supported using these visual monitoring techniques and thereafter on-water monitoring techniques, such as fluorometry will be deployed.
+ **Tiers II and III:** On-water monitoring – requires the use of trained or experienced personnel to conduct on-water monitoring using CTD meter, fluorometer and water quality samples (collected as per operational water quality monitoring (**Section 10.7**).

Subsea dispersant injection monitoring includes the following phases:

+ **Phase 1:** Confirmation of dispersant effectiveness near the discharge point and reduction in surface VOCs. This is conducted visually via ROVs and aerial imaging; and via VOC monitoring.
+ **Phase 2**: Characterisation of oil droplet size near plume and dispersed oil concentrations at depth in the water column. This is conducted using a particle size analyser close to the release site and water column monitoring (as per operational water quality monitoring (**Section 10.7)**
+ **Phase 3**: Detailed chemical characterisation of water samples. This involves characterisation of collected water samples using accredited contract laboratories. The transfer and shipping would be handled using the logistical pathways utilised for operational water quality monitoring (**Section 10.7**).

SSDI application is considered a secondary strategy to surface dispersant application (refer to **Section 6**). and is primarily included to attempt reduction of VOC exposure to response personnel working close to the well site. SSDI would be considered where VOC levels in the vicinity of the wellsite are shown through monitoring to be unacceptable.

Prior to any application of subsea dispersants, an initial ROV survey would be conducted at the release point to determine the nature of the release. This information will inform an assessment of the feasibility of subsea chemical dispersion, initial choice of dispersant injection methods (e.g., number of nozzles, nozzle sizes) and DOR. In addition, as per Industry Recommended Subsea Dispersant Monitoring Plan (API, 2020), subsea dispersant effectiveness monitoring should commence prior to the application of any dispersant, to ensure baseline data is captured.

13.8 Surface dispersant supply and logistics requirements

A surface LOWC from MEFF Plug and Abandonment activities has a low flow rate and as noted in **Section 6.5** and **13.1**, it is predicted a slick would rarely achieve the minimum surface thickness required (50 g/m^2) for effective dispersant application.

However, for the purposes of a capability assessment, it has been highly conservatively assumed that the entire daily flow rate of ~207 m^3 would be available for treatment. Modelling (GHD, 2022) predicts the daily volume of oil remaining following evaporation (55%) and submersion (5%) after 24 hours at a wind speed of 5 m/s is ~83 m^3. To treat this volume of surface oil at a DOR of 1:25 would require 3 m^3 dispersant per day, or 228 m^3 over a spill duration of ~76 days (assuming 36-48 hours for mobilisation of surface dispersant application). The dispersant stockpiles in Australia would be sufficient to supply dispersant for the duration of operations.

Dispersant stockpiles are made available via AMOSC membership or AMSA agreement with most supplies within Australia being available within 48 to 55 hours. Santos can supply all required road logistics to meet these timeframes through its contracted logistics provider. Santos can also provide air logistics for all other stockpiles throughout Australia and internationally.

Dispersant availability is checked bi-annually against Santos' worst-case requirements across all operational, project and drilling activities.

Table 13-11: Dispersant supply stock locations and volumes

Source	Stock Location	Volume (m³)	Type	Total Volume (m³)
AMSA	Adelaide	10	Slick Gone EW	355
		10	Slick Gone NS	
	Brisbane	10	Slick Gone EW	
		10	Slick Gone NS	
	Townsville	10	Slick Gone EW	
		15	Slick Gone NS	
	Karratha	10	Slick Gone EW	
		10	Slick Gone NS	
	Darwin	10	Slick Gone EW	
		10	Slick Gone NS	
	Devonport	10	Slick Gone EW	
		10	Slick Gone NS	
	Fremantle	48	Slick Gone NS	
		52	Slick Gone EW	
	Horne Island	10	Slick Gone NS	
	Melbourne	10	Slick Gone EW	
		10	Slick Gone NS	
	Sydney	45	Slick Gone NS	

Source	Stock Location	Volume (m³)	Type	Total Volume (m³)
		55	Slick Gone EW	
AMOSC	Exmouth	75	Slick Gone NS	511 (surface) 761 (subsea)
	Fremantle	8	Slick Gone NS	
		27	Corexit 9500	
		500 (SFRT stockpile* 50%)	Slick Gone NS	
	Geelong	75	Slick Gone NS	
		62	Corexit 9500	
	Broome	14	ARDROX 6120	
Santos	Port Bonython	4	Slickgone NS	9
		5	Corexit 9527	
OSRL (Santos has access up to 50% of SLA stockpile)	Various (Singapore, UK, Bahrain, USA)	50% of SLA = 366	Slick Gone NS Slick Gone EW Slickgone LTSW Finasol OSR 52 Corexit 9500	366
Total				1,241 (surface) 1,491 (subsea)
OSRL Global Dispersant Stockpile (GDS)	Various (Singapore, UK, France, South Africa, USA, Brazil)	5,000	Slick Gone NS Finasol OSR 52 Corexit 9500	5,000
Total (including additional OSRL GDS stocks)				6,241 (surface) 6,491 (subsea)

** As per the AMOSPlan, there is a provision made by the SFRT Steering Committee to provide up to 250 m³ of dispersant into a surface spill response, given certain provisions are met in the first instance by AMOSC (AMOSC, 2021).*

13.9 Subsea dispersant injection logistics requirements

If a subsea LOWC was to occur, the site would require a detailed assessment to determine the most suitable intervention methods for the incident. This may be achieved through the use of ROVs (supplied by Santos) and the Subsea First Response Toolkit (refer to **Section 9.2.2**), which is stationed in Fremantle and Jandakot and managed by AMOSC. The SFRT includes debris clearance equipment and subsea dispersant equipment, including a dedicated dispersant stockpile (500 m³ of Dasic Slickgone NS) and ancillary equipment (e.g., pumps, flying leads, coiled tubing head, dispersant wands). Santos can access a suitable vessel for transportation of the subsea dispersant injection system, dispersants and ancillary equipment including ROVs through its contracted vessel providers.

The volumes of dispersant required will depend on the DOR used at the injection point. It has been assumed that the release would require a DOR of 1:100. To achieve a DOR of 1:100 for a flow rate of 207 m^3/day from a MEFF subsea LOWC scenario, a dispersant pump rate of ~1.4 L/min (or ~2 m^3/day) is required.

The AMOSC SFRT Package can deliver up to 110 L/min (158 m^3/day), and along with the dispersant stocks specified in **Table 13-11**, is therefore capable of meeting the demand for SSDI for this activity, if it is determined to be a viable strategy.

13.10 Environmental performance

Table 13-12 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 13-12: Environmental performance –dispersant application

Environmental Performance Outcome	Implement chemical dispersant application to enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities.		
Response Strategy	**Control Measures**	**Performance Standard**	**Measurement Criteria**
Chemical Dispersant Application – surface	**Response Preparedness**		
	Arrangements to enable access to dispersants, equipment and personnel	Maintenance of access to dispersant, application equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity as specified in **Table 13-4** and **Table 13-7**	MoU for access to National Plan resources through AMSA
			AMOSC Participating Member Contract
			OSRL Associate Member Contract and Global Dispersant Supply Supplementary Agreement
	Maintenance of MSAs with multiple vessel providers	Santos maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers
	Dispersant application vessels	Maintenance of vessel specification for dispersant application vessels	Vessel specification
	Response Implementation		
	Mobilisation of minimum resource requirements for initial response operations	Minimum requirements mobilised in accordance with **Table 13-5** and **Table 13-8**	Incident log
	Chemical Dispersant Application Plan	Only chemical dispersants that are listed as approved on the National Plan Oil Spill Control Agent (OSCA) list are to be used	Incident Log
		Santos will have access to dispersants specified in **Table 13-11**	Incident Log
		Santos will conduct surface dispersant efficacy monitoring in accordance with SMART Monitoring Protocol (NOAA, 2006)	Incident Log
		Analysis of dispersant amenability provided to IMT within 24 hours of oil delivery to laboratory	Incident Log
		If amenable to surface dispersants, and required oil volume can be collected, oil and dispersant samples to be sent immediately	Incident Log

Environmental Performance Outcome	Implement chemical dispersant application to enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities.		
Response Strategy	**Control Measures**	**Performance Standard**	**Measurement Criteria**
		for laboratory ecotoxicity testing of oil and chemically dispersed oil	
		If dispersant application is approved by the Incident Commander for aerial application, a test spray run via the National Plan Fixed Wing Aerial Dispersant Contract will be conducted to assess dispersant effectiveness	Incident Log IAP
		If dispersant application is approved by the Incident Commander for vessel application, a test spray will be conducted to assess dispersant effectiveness	Incident Log IAP
		Prepare operational NEBA to determine if chemical dispersant application is likely to result in a net environmental benefit. NEBA will consider: + forecast spill modelling of oil comparing simulations with and without effect of chemical dispersants + laboratory dispersant efficacy testing results + operational monitoring results (surveillance and shoreline assessment) showing distribution of floating, stranded oil and location of sensitive fauna and habitats + operational water quality monitoring results showing distribution and concentration of subsea oil (once available) + scientific monitoring water sampling results (SMP1) (once available) + consultation with Control Agency and/or key stakeholders	Incident Log IAP
		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

Environmental Performance Outcome	Implement chemical dispersant application to enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities.		
Response Strategy	**Control Measures**	**Performance Standard**	**Measurement Criteria**
		Surface Dispersant Application Area will be defined as part of the IAP. The base case for dispersant application is that no dispersants to be applied: + within a Habitat Protection Zone or National Park Zone of an Australian Marine Park (application permitted in the Multiple Use Zone) + within State Marine Parks + within State Waters + within 10 km of water depths <10 m LAT + within exclusion zones of offshore facilities + within 18 km of well site (exclusion zone as defined by the oil spill modelling)	IAP
		Surface dispersant will only be applied in the Dispersant Application Area and target oil above BAOAC 4 and 5	IAP Incident Log
Chemical Dispersant application – subsea	**Response Preparedness**		
	Arrangements to enable access to dispersants, equipment and personnel	Maintenance of access to dispersant, application equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity	MoU for access to National Plan resources through AMSA
			AMOSC Participating Member Contract
			AMOSC SFRT Participant
			OTA Agreement with Oceaneering
			OSRL Associate Member Contract and Global Dispersant Supply Supplementary Agreement
	Arrangements in place to monitor availability of vessels capable of transporting SFRT	Vessel availability shall be monitored regularly via Santos' contracted vessel broker	Shipbroker reports
	Maintenance of MSAs with multiple vessel providers	Santos maintains MSAs with multiple vessel providers	MSAs with multiple vessel providers

Environmental Performance Outcome	Implement chemical dispersant application to enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities.		
Response Strategy	**Control Measures**	**Performance Standard**	**Measurement Criteria**
	Arrangements to enable fast access to subsea application platform and dispersant supply	SFRT and dedicated dispersant stockpile mobilised to site within 10 days	AMOSC SFRT Participant OTA Agreement with Oceaneering Source Control Planning and Response Guideline
	Chemical Dispersant Application Plan	Only chemical dispersants that are listed as approved on the National Plan Oil Spill Control Agent (OSCA) list are to be used	Incident Log
		Analysis of dispersant amenability provided to IMT within 24 hours of oil delivery to Laboratory	Incident Log
		If dispersant application is approved by the Incident Commander for subsea injection, ROV monitoring of the site will commence to help determine injection method/s	Incident Log IAP
		If dispersant application is approved by the Incident Commander for subsea injection, operational monitoring of dispersant efficacy will be conducted	Incident Log IAP
		Prepare operational NEBA to determine if chemical dispersant application is likely to result in a net environmental benefit. NEBA will consider: + forecast spill modelling of oil comparing simulations with and without effect of chemical dispersants + laboratory dispersant efficacy testing results + operational monitoring results (surveillance and shoreline assessment) showing distribution of floating, stranded oil and location of sensitive fauna and habitats + operational water quality monitoring results showing distribution and concentration of subsea oil (once available) + scientific monitoring water sampling results (SMP1) (once available) + consultation with DoT	Incident Log IAP
		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

14. Shoreline protection and deflection plan

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

Table 14-1: 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	+ Level 2 or Level 3 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	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	×	✓
Termination criteria	+ 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	

14.1 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 10.8**).

DCCEEW are the designated Jurisdictional Authority for all spills that contact the shorelines of Ashmore Reef and Cartier Island AMPs identified in this OPEP; the Santos IMT (as Control Agency for these islands as they are in Commonwealth waters) will liaise with DCCEEW to direct resources for the purposes of shoreline clean-up activities.

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.
+ 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.

14.2 Implementation guidance

Table 14-2 provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 14-3** 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 14-4**. 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 14-2: 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	☐
	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	☐
	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 10.8**).	Pre-existing TRPs exist for the Priority Protection Areas for this activity, further described in **Section 6.6.1.** TRPs are available on the Santos ER Intranet page[18].	Environment Unit Leader	☐
	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: + 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) + timeframes to undertake deployment + access locations from land or sea	Operations Section Chief Planning Section Chief Environment Unit Leader	☐

[18] Where TRPs are unavailable for areas likely to be contacted, refer to other sources of information such as aerial photography, Oil Spill Response Atlas, Pilbara Region Oiled Wildlife Response Plan and WAMOPRA.

	Action	Consideration	Responsibility	Complete
		+ 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	☐
	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	☐
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	☐
	Report to the Operations Section Chief on the effectiveness of the tactics employed.	-	Shoreline Response Programme Manager – AMOSC core group responder	☐
	Response teams to conduct daily inspections and maintenance of equipment.	Shoreline protection efforts will be maintained through the forward operation(s) facilities set-up at mainland locations under direction of the Control Agency. Response crews will be rotated on a roster basis, with new personnel procured on an as needs basis from existing human resource suppliers.	Shoreline Response Programme Manager	☐

Table 14-3: Shoreline protection and deflection – resource capability

Equipment Type/ Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
AMSA nearshore boom/skimmer equipment	AMSA	Canadyne inflatable Structureflex inflatable Versatech zoom inflatable Slickbar – solid buoyancy Structureflex – solid buoyancy Structureflex – land sea	Karratha – 5 Karratha – 10; Fremantle – 15 Karratha – 5; Fremantle – 13 Karratha – 2 Karratha – 3; Fremantle – 10 Karratha – 30; Fremantle – 30, other locations around Australia	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 × 25 m lengths) Zoom Boom (199 x 25 m lengths) HDB Boom (2 x 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**
Santos owned nearshore boom/skimming equipment	Santos	Beach Guardian (8 x 25 m lengths) Zoom Boom (16 x 25 m lengths) 2 x Desmi DBD16 brush skimmer	Varanus Island (VI) VI One each: Dampier and VI	Within 12 hours for deployment by vessel from VI

Equipment Type/ Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
OSRL nearshore boom/skimming equipment (Note: further boom is available, the listed items shown as an example). Guaranteed access to 50% of stockpile by equipment type. Access to more than 50% on a case-by-case basis.	OSRL	Air-skirt boom 10 m: 228 Air-skirt boom 20 m: 658 Air-skirt boom 200 m: 4 Beach sealing boom 10 m: 154 Beach sealing boom 15 m: 65 Beach sealing boom 20 m: 113 Inshore recovery skimmers: 126 Range of ancillaries to support above equipment	OSRL global stockpiles at base locations: + UK + Singapore + Bahrain + Fort Lauderdale	Response from OSRL Duty Manager within 10 minutes. Equipment logistics varies according to stockpile location.
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	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 14-4: 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	<60–72 hours (weather/daylight dependent)
Minimum Resource Requirements	
NB: Resource requirements for protection and deflection will be situation/receptor specific. TRPs are held by Santos and DoT and have been developed for various NWS locations and are available on the Santos ER Intranet page; TRPs exist for the Priority Protection Areas for this activity, further described in **Section 6.6.1** [19]. Indicative first-strike resources for a single site protection area are: + 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	

14.3 Worst-case resourcing requirements

Protection and deflection resourcing requirements have been determined from deterministic modelling for affected shorelines. Deterministic run #105 (subsea LOWC) was selected to guide resourcing estimates for protection and deflection given it was the simulation that represented the maximum length of accumulated shoreline loading >100 g/m^2 from all simulations. It was also the simulation with the shortest time to the arrival of accumulated shoreline loading >100 g/m^2 (subsea LOWC).

This deterministic run does not include all possible spill scenarios; a single spill may contact other receptors and at different volumes, as presented in **Section 6.3**. However, the selection of this run will provide the worst-case shoreline loading scenario on which to base protection and deflection response preparedness arrangements.

Resource requirements for protection and deflection will be situation/receptor specific. TRPs are held by Santos and DoT and have been developed for all of the PPA's (refer to **Section 6.6.1**).

[19] Where TRPs are unavailable for areas likely to be contacted, refer to other sources of information such as aerial photography, Oil Spill Response Atlas, Pilbara Region Oiled Wildlife Response Plan and WAMOPRA

Table 14-5: Shoreline protection and deflection resource requirements (based on deterministic simulation #105 [GHD, 2022])

Location	Minimum arrival time shoreline oil accumulation >100 g/m² (days)	Maximum length of shoreline oiled (km) >100 g/m²	Estimated No. of required protection and deflection teams to set up and monitor (and remarks)
Kimberley Coast PMZ	105.9	34.0	2 teams
Camden Sound	90.6	63.7	3-4 teams
King Sound	87.6	42.5	3 teams
Ashmore Reef AMP	108.4	1.0	1 team (small length of shoreline predicted to be impacted; one team considered sufficient to protect emergent receptors)
Seringapatam Reef	101.7	12.7	1 team (minimal emergent features; keep response personnel to minimum to reduce disturbance of surrounding habitat and fauna)
Scott Reef North	102.1	12.7	
Scott Reef South	83.7	38.2	
Adele Island	83.2	3.2	1 team (small island with sensitive receptors; keep response personnel to minimum to reduce disturbance of surrounding habitat and fauna)
Clerke Reef MP	16.9	29.7	1 team (Cunningham and Bedwell Islands are small islands with sensitive receptors; keep response personnel to minimum to reduce disturbance of surrounding habitat and fauna)
Imperieuse Reef MP	8.5	38.2	
Browse Island	67.2	0.5	1 team (small island with sensitive receptors; keep response personnel to minimum to reduce disturbance of surrounding habitat and fauna)
Total estimated Protection and Deflection Teams required			**13-14 teams**

Capability allows for mobilisation of protection and deflection resources (refer to **Table 14-3**) by day 2-3 if required (**Table 14-4**). However, the shortest timeframe to shoreline accumulation >100 g/m^2 is not predicted until day 8 at Imperieuse Reef and day 16 at Clerke Reef. From the deterministic modelling all other island and mainland receptors have contact times between 67 days and 108 days. This allows sufficient time to organise, mobilise and deploy protection and deflection personnel and equipment prior to hydrocarbon contact, guided by the ongoing operational monitoring.

A typical shoreline protection and deflection team would consist of 12 personnel as a minimum, comprised of the following:

- 1 x Incident Commander/Site Supervisor;
- 1 x Shallow draft vessel skipper;
- 1 x Shallow draft vessel deck-hand; and
- 9 x Protection and deflection operatives.

One team (a total of 12 personnel) would be required to cover these two initial contact locations.

The resourcing requirements will be determined based on feedback from SCAT activities, on operational NEBA, and in consultation with DoT as the Control Agency. Shoreline effort will likely consist of a combination of protection and deflection and clean-up, with resources often working together and/or in parallel.

14.4 Environmental performance

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

Table 14-6: 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, OSRL and TRG.	Maintenance of access to protection and deflection equipment and personnel through AMOSC, AMSA National Plan and OSRL throughout activity as per **Table 14-3**.	MoU for access to National Plan resources through AMSA
			AMOSC Participating Member Contract
			OSRL Associate Member Contract
			TRG arrangements
	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 14-4** 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

15. Shoreline clean-up plan

Table 15-1: 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	+ Level 2 or Level 3 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	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✓ 2	✓ 1
Termination criteria	+ As directed by DoT	

15.1 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 10.8**) 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. DCCEEW are the designated Jurisdictional Authority for all spills that contact the shorelines of Ashmore Reef AMP and Cartier Island MP identified in this OPEP; the Santos IMT (as Control Agency for this island as it is in Commonwealth waters) will liaise with DCCEEW to direct resources for the purposes of shoreline clean-up activities.

Spill modelling indicates if a worst-case spill were to occur as a result of MEFF plug and abandonment activities, shoreline contact would occur and therefore clean-up of shorelines is likely to be required.

MDO is likely to be difficult to remove given its light nature and high weathering potential. It can be readily washed from sediments by wave and tidal flushing. The likely waste products from a diesel spill shoreline response would be contaminated sand and debris.

Mutineer-Exeter Light Crude is considered a Group 2 oil (light) hydrocarbon (AMSA, 2015), with low asphaltene, and a moderate wax content. Modelling of the analogue Vale 2013 under moderate wind speeds of 5 m/s, resulted in approximately 60% of the surface slick evaporating after 5 days, while a further ~18% is dispersed into the water column and the surface slick makes up the remaining ~22%. Vale 2013 has a high tendency for emulsion formation, with peak water contents in the surface slick stabilising at 76% after 72 hours for low winds (1 m/s), while this occurs much more rapidly (within 6–12 hours) under moderate (5 m/s) and high (10 m/s) wind speeds (**Appendix A**).

Shoreline clean-up techniques include:

- Shoreline Clean-up Assessment – uses assessment processes (refer to **Section 10.8**) 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
- 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.

15.2 Implementation guidance

Table 15-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy. **Table 15-2** provides guidance to the IMT on the actions and responsibilities that should be considered when selecting this strategy. **Table 15-3** 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 15-4**. 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 15-2: 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.**			
Initial Actions	Initiate Shoreline Clean-up Assessment (if not already activated).	Refer to **Section 10.8** 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	☐
Initial Actions	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	☐
Initial Actions	If operational NEBA supports shoreline clean-up, prepare a Shoreline Clean-up Plan for inclusion in the IAP.	Shoreline Clean-up Plan may include: + 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	Environment Unit Leader Planning Section Chief Operations Section Chief	☐

	Action	Consideration	Responsibility	Complete
		+ 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. Refer to IPIECA guide: A Guide to Oiled Shoreline Clean-up Techniques (IPIECA-IOGP, 2016b) for additional guidance on shoreline clean-up planning and implementation.		
	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 Deputy Logistics Officer (DoT IMT)	☐
	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. 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 Deputy Logistics Officer (DoT IMT)	☐
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	☐
	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	-	Operations Section Chief Planning Section Chief	☐

	Action	Consideration	Responsibility	Complete
	and activated through the Supply Unit Leader and Logistics Section Chief.			
	Monitor progress of clean-up efforts and report to the Control Agency.	-	Operations Section Chief On-Scene Commander Deputy OSC (Control Agency FOB)	☐

Table 15-3: 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**)
	Santos	One shoreline clean-up container	Varanus Island	Within 12 hours for deployment from VI
	Hardware suppliers	As available	Karratha, Exmouth, 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 14-3**)	-	-

Equipment Type/Personnel Required	Organisation	Quantity Available	Location	Mobilisation Timeframe
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**
	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 17**)	Karratha, Broome, Perth	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 15-4: 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.	<60–72 hours (weather/daylight dependent)
Minimum Resource Requirements	
NB: Resource requirements for shoreline clean-up will be situation/receptor specific. If developed for the area/receptor, TRPs will outline suggested resource requirements and shoreline assessments (as part of operational monitoring strategy) to be conducted prior to clean-up to confirm techniques. TRPs are held by Santos and DoT. For further description on relevant TRPs for this activity, refer to **Section 6.6.1.** Indicative minimum requirements for one Santos-activated shoreline clean-up team are: + manual clean-up/shoreline flushing equipment kit + waste storage (bags, temporary storage tanks, skips as appropriate) + decontamination/staging equipment kit + personal protective equipment. One clean-up team comprises: + one Team Leader (AMOSC staff, Industry Core Group or Santos Core Group) + 10[20] shoreline clean-up responders (AMOSC Core Group, Santos contracted labour hire personnel).	

15.3 Shoreline clean-up resources

Shoreline clean-up equipment available for use by Santos is a combination of Santos owned, AMOSC, AMSA, DoT and OSRL equipment as well as other industry resources available through the AMOSPlan mutual aid arrangements. Shoreline consumables are available through hardware, PPE and specialist oil/chemical spill suppliers and mobile plant equipment is available through hire outlets in Karratha, Broome, Perth and other regional centres. Where vessel deployments are required, Santos will leverage from existing contracted vessel providers.

Shoreline clean-up personnel available to Santos is a combination of AMOSC Staff, AMOSC Core Group Responders (comprising AMOSC trained Santos and Industry personnel), OSRL responders, State Response Team members and National Response Team members. Personnel for manual clean-up and mobile plant operation can be accessed through Santos' labour hire arrangements.

The level of deployment of equipment and personnel for clean-up will be commensurate to the spatial extent of shoreline contact, the volume of oil arriving and the sensitivity and access constraints of the shoreline in question. Deployment will be under the direction of the relevant Control Agency and the advice of shoreline clean-up specialists from AMOSC Core Group and National/State response

[20] Remote islands and ecologically sensitive locations will have reduced personnel numbers to reduce impacts from clean-up operations (Refer to **Section 15.4**)

teams. Shoreline clean-up assessments (**Section 10.8**) will provide information to guide the clean-up strategy and deployment of resources.

15.4 Worst case resourcing requirements

Shoreline clean-up requirements have been determined for affected shorelines based on deterministic run #127 (subsea LOWC) which resulted in the highest volume of shoreline accumulation (above 100 g/m^2) across all shorelines. Using conservative estimates, clean-up operations would require a maximum of 12 teams (120 personnel) when shoreline accumulation is predicted to peak in weeks 10-12.

Resourcing requirements for shoreline oil operations have been conservatively determined based on a manual clean-up rate of 1 m^3 of oily waste per person per day. A bulking factor of 10 has been applied to manual clean-up activities (IPIECA-IOGP, 2016b). The resourcing estimate considers:

+ the size of a typical shoreline clean-up team (11 persons, consisting of 1 x Shoreline Clean-up Supervisor/ Incident Commander and 10 x operatives)
+ the assumption that teams will work throughout a 16-week response duration (which for the purposes of resourcing is assumed to match the simulation duration of 11 weeks LOWC event, plus 5 weeks of dispersion time, as per the modelling configuration (GHD, 2022).

At some mainland locations with good access, it may be possible to employ mechanical removal techniques (earth moving equipment), which can remove up to 150 m^3 of oily waste per mechanical aid per day. The suitability of mechanical removal at mainland locations should be assessed for each clean-up segment during SCAT assessments (e.g. taking into account seasonality of receptors and clean-up end points).

Daily accumulation data from subsea deterministic run #127 has been used to inform calculations for resourcing requirements as presented in **Table 15-5**. Daily accumulation represents the net volume of oil remaining on the shoreline following any daily oil arrival and daily oil removed through natural processes.

Note that this does not include all possible spill scenarios and that a single spill may contact other receptors and at different volumes, as presented in **Section 6.3**. The information presented in **Table 15-3** is to demonstrate that Santos can obtain the resources to scale up to the worst-case shoreline accumulation volumes. In the event of an incident, Santos would use initial operational monitoring data (e.g., trajectory modelling and aerial surveillance) to determine where the available resources should be allocated for an effective clean-up response.

For deterministic run #127 (subsea LOWC) peak shoreline accumulation is predicted to occur at Imperieuse and Clerke Reefs during week 11 and 12 (**Table 15-5)**. It should be noted that the model treats these reef systems as completely emergent features (intertidal reef + islands) and consequently has likely significantly overestimated the amount of oil that would accumulate on the two small sandy islets of Cunningham and Bedwell Islands (Imperieuse Reef and Clerke Reef, respectively). At high tide the length of shoreline at Cunningham and Bedwell Islands is approximately 500 m and 2.6 km, respectively.

Given the small size and risk of ecological impacts from clean-up activities to the islands and surrounding intertidal reef, each island could only accommodate one shoreline clean-up team (refer to **Section 15.4.3**), which would be subject to an operational NEBA at the time of the spill. For the surrounding intertidal reef at these locations, it is likely that natural flushing and re-floating of the oil would occur with the tide. The applicability of shoreline clean-up techniques for any oil found to persistently adhere to the intertidal reef should be assessed during SCAT assessments and undergo operational NEBA.

15.4.1 Operational and environmental considerations affecting resourcing

Tidal ranges in the EMBA are large (7 to 8 m) and much of the coastline is remote and inaccessible via road, making many shoreline clean-up techniques difficult and their use may result in greater environmental impacts than the oil itself. In addition, the remote nature, potential presence of dangerous fauna (i.e., saltwater crocodiles and Irukandji jellyfish) present significant safety risks to responders working in these environments.

Large scale operations involving large numbers of personnel may cause adverse environmental impacts at many of these sensitive shoreline locations. The constant removal of oil, even via manual removal can result in a removal of substrate (e.g. sand, pebbles). If intrusive clean-up is conducted frequently, over a long period of time and along contiguous lengths of coastline, this may result in geomorphological changes to the shoreline profile and adverse impacts to shoreline invertebrate communities which provide an array of ecosystem services (Michel*, et al*., 2017).

Given the safety constraints and ecological sensitivities of these shorelines, shoreline clean-up operations should be conducted by smaller teams for a longer period of time. Intermittent manual treatment (<20 visits/month) and use of passive recovery booms is likely to be more effective than intrusive methods (e.g. intrusive manual removal >20 visits/month). Although this may take longer to undertake the clean-up, it is considered that the benefits outweigh the impacts as smaller teams are more targeted, recovering more oil and less sand and debris, reducing trampling of oil into the shore profile and minimising ecological impacts on the shorelines and their sensitive species.

The number of shoreline clean-up teams recommended to treat these shorelines (as shown in **Table 15-5**) is not based on extensive, intrusive and contiguous removal of oil and waste along all shorelines, but rather use of smaller teams and at lower frequency of visits. Where shoreline based manual removal is safe and deemed advantageous by shoreline clean-up assessment teams and operational NEBA, this should be conducted via land access (if possible) or via suitable vessels. However, it should be noted that it is generally not feasible to move response equipment into and out of mangroves, tidal flats and delta environments without causing excessive damage. Even foot traffic must be minimised, either by laying down wooden walkways or relying on vessel-based activities as much as possible (API, 2020). Santos has considered the access limitations, safety issues and number of clean-up teams that may be able to operate in each of these environments. A summary of these findings is presented below.

15.4.2 Remote island deployment

For shoreline clean-up of remote islands, the following process could be implemented so as to minimise the secondary impacts of high numbers of spill response personnel on shorelines. If shoreline contact is predicted with locations where TRPs exist, the TRP will be used to plan the deployment. Where TRPs are unavailable for areas likely to be contacted, refer to other sources of information such as aerial photography, Oil Spill Response Atlas, and WAMOPRA.

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 four stages:

1. Drop off six-person clean-up containers (contents list in **Appendix J**) to shoreline contact locations defined by IMT through observation data; or if locations are too sensitive to be using as staging sites, then transfer equipment via landing barge for offsite staging.
2. Deploy 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. Deploy clean-up teams in six person squads 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-tide mark.
4. Deploy the waste pickup landing barges to retrieve collected wastes from the temporary bunding and to complete the shoreline clean-up and final polishing.

Santos

Multiple six-person teams are to be utilised based on the actual volume of oil deposited, which will be determined via shoreline clean-up assessments (**Section 10.8**).

Safety note: *Cartier Island and the surrounding marine area within a 10 km radius was a gazetted Defence Practice Area up to 20 July 2011. Although no longer used, there is a substantial risk that UXOs remain in the area. Landing or anchoring anywhere within the Cartier Island Commonwealth Marine Reserve is strictly prohibited. As mentioned in* ***Section 10.8****, shoreline clean-up assessment of Cartier Island should be conducted via UAVs. Santos will then conduct a NEBA in consultation with Parks Australia to assess the net benefit and safety constraints of conducting onshore clean-up operations on Cartier Island. Onshore clean-up is likely to be suitable for Ashmore Island.*

Table 15-5: Requirements for shoreline clean-up for priority protection areas based on subsea LOWC run #127 (GHD, 2022)

Time (week)	Weekly change in mass of oil ashore (m^3) at PPAs								Maximum weekly loading (m^3)	Potential maximum waste generated (m^3/week) – bulking factor of 10	Number of shoreline clean-up teams recommended (max 10 personnel/ team)*	Maximum volume collected (m^3/ week by teams)
	Camden Sound	Adele Island	King Sound	Lacepede Islands	Broome North Coast	Clerke Reef MP*	Imperieuse Reef MP*	Broome-Roebuck				
1–4	0	0	0	0	0	0	0	0	0	0	0	n/a
5	0	0	0	0	0	5.4	16.0	0	21.4	214	2	140
6	0	0	0	0	0	2.9	7.6	0	10.5	105	2	140
7	0	0	0	3.9	0	0	0.8	0	4.7	47	2-3	140-210
8	0	0	0	1.0	5.1	0	1.6	0	6.7	67	4-5	280-350
9	0	1.5	0	0	6.3	0	0.7	0	8.5	85	6-7	420-490
10	0	0.3	0.9	0.4	13.1	0	1.6	1.8	18.1	181	10-12	700-840
11	0	0.5	3.9	0	10.1	21.7	174.1	0	210.3	2,103	10-12	700-840
12	0	0.1	0.9	0.1	0	19.3	112.6	0.5	133.5	1,335	6	420
13	0	0	0	0.8	0	8.4	47.2	0	56.4	564	3	210
14	0	0	0.8	0	0	6.4	0	0	7.2	72	2**	140
15	0.9	0	0	0	0	3.6	0	0	4.5	45	2**	140
16	0	0	0	0	0	0	0	0	0	0	2**	140

** The model treats Clerke and Imperieuse MPs as completely emergent features (intertidal reef + islands) and consequently has likely significantly overestimated the amount of oil that would wash up on the two small sandy islets of Cunningham and Bedwell Islands. Given the small size and risk of ecological impacts from clean-up activities, it would only be feasible to dispatch one shoreline clean-up team to each location.*

*** Additional teams retained during weeks 14 to 16 to enable additional volumes to be collected from previous week that have not weathered or been removed by clean-up activities at Cunningham Island and Imperieuse Reef MP.*

15.5 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.**

The WA DoT Oil Spill Contingency Plan (2015) also provides guidance on shoreline clean-up techniques.

15.6 Environmental performance

Table 15-6 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 15-6: 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, OSRL and TRG.	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, DoT 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
			TRG arrangements
	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	Labour hire contract
	Response Implementation		
	Mobilisation of minimum requirements for initial response operations	Minimum requirements mobilised in accordance with **Table 15-4** 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

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**
		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
		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 AMOSC Core Group responders, or other appropriately trained responders, for shoreline clean-up team positions to the Control Agency.	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 tracts	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

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**
	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
	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 DoT and DBCA	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

16. Oiled wildlife

Note: the WA DoT is the Control Agency and DBCA is the Jurisdictional Authority and lead agency for oiled wildlife response within WA State waters. Santos and AMSA are the Control Agencies for oiled wildlife response within Commonwealth waters from facility and vessel spills respectively.

Table 16-1 provides the environmental performance outcome, initiation criteria and termination criteria for this strategy.

Table 16-1: Oiled wildlife response – environmental performance outcome, initiation criteria and termination criteria

Environmental performance outcome	Implement tactics in accordance with relevant Santos/ State 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	+ 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

16.1 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 in Section 7.6.5.5 of the EP and post-spill via scientific monitoring (**Section 18**).

Table 16-2 provides guidance on the designated Control Agency and Jurisdictional Authority for OWR in Commonwealth and State waters. 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.

The key plan for OWR in WA is the WA Oiled Wildlife Response Plan (WAOWRP) (DBCA, 2022a). The WAOWRP establishes the framework for preparing and responding to potential or actual wildlife impacts during a spill and sets out the management arrangements for implementing an OWR in conjunction with the SHP-MEE. It is the responsibility of DBCA to administer the WAOWRP under the direction of the DoT (**Table 16-2**). The Santos Oiled Wildlife Response Framework Plan (SO-91-BI-20014) is consistent with and interfaces the WAOWRP and WA Oiled Wildlife Response Manual (WA OWR Manual) (DBCA, 2022b).

If a spill occurs in WA State waters or enters State waters, DBCA is the Jurisdictional Authority for wildlife, and for level 2/3 spills, will also lead the oiled wildlife response under the control of the DoT. DBCA is the State Government agency responsible for administering the *Biodiversity Conservation Act 2016* (*BC Act*), which has provisions for authorising activities that affect wildlife.

For level 1 spills in State waters, Santos will be the Control Agency, including for wildlife response. It is however also an expectation that for level 2/3 petroleum activity spills, Santos will conduct the initial first-strike response actions for wildlife and continue to manage those operations until DBCA is activated as the lead agency for wildlife response and formal handover occurs. Following formal handover, Santos will function as a support organisation for the OWR and will be expected to continue to provide planning and resources as required.

Table 16-2: 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	DCCEEW	AMSA		Western Australia Oiled Wildlife Plan (WAOWRP) Western Australia Oiled Wildlife Response Manual
	Petroleum activities		Titleholder		
Western Australian (WA) state waters (State waters to three nautical miles and some areas around offshore atolls and islands)	Vessel	DBCA	WA DoT[21]		
	Petroleum activities		Titleholder	WA DoT	

16.2 Western Australia Oiled Wildlife Response Manual

The WA OWR Manual (DBCA, 2022b) supports, and should be used in conjunction with, the WAOWRP. The purpose of the WA OWR Manual is to standardise the operating procedures, protocols and processes for an OWR during a spill event in WA waters, and to create alignment between the wildlife response processes and the overall incident response (DBCA, 2022b).

The WA OWR Manual is divided into four sections (DBCA, 2022b):

1. Procedures: The WAOWRP divides the operations of OWR into eight phases of response (**Figure 16-1**), each supported by a standard operating procedure in the Manual. The procedures are the primary source of operational direction for responders under the WAOWRP.
2. Guidelines: these provide information on over-arching principles such as risk assessment, biosecurity, wildlife management strategies, animal welfare and facility design tailored to OWR. Guidelines specifically support the WAOWRP but are adapted from internationally recognised general principles and protocols.
3. Template forms and labels: these are the forms and labels specifically designed to support the procedures in the Manual. They are tailored to the recording requirements and formatting of DBCA as the lead agency in OWR in WA and cover all aspects of OWR recording and data entry.
4. Appendices: charts of information, derived from reputable OWR and wildlife management sources, intended to provide quick reference information on response aspects such as nutrition, drug doses, animal weights and bandaging techniques. These have been adapted to reflect WA species and product availability.

[21] If an OWR is required in WA State waters, the DBCA is responsible for the administration of the Western Australian Oiled Wildlife Response Plan (WAOWRP) under the direction of the DoT.

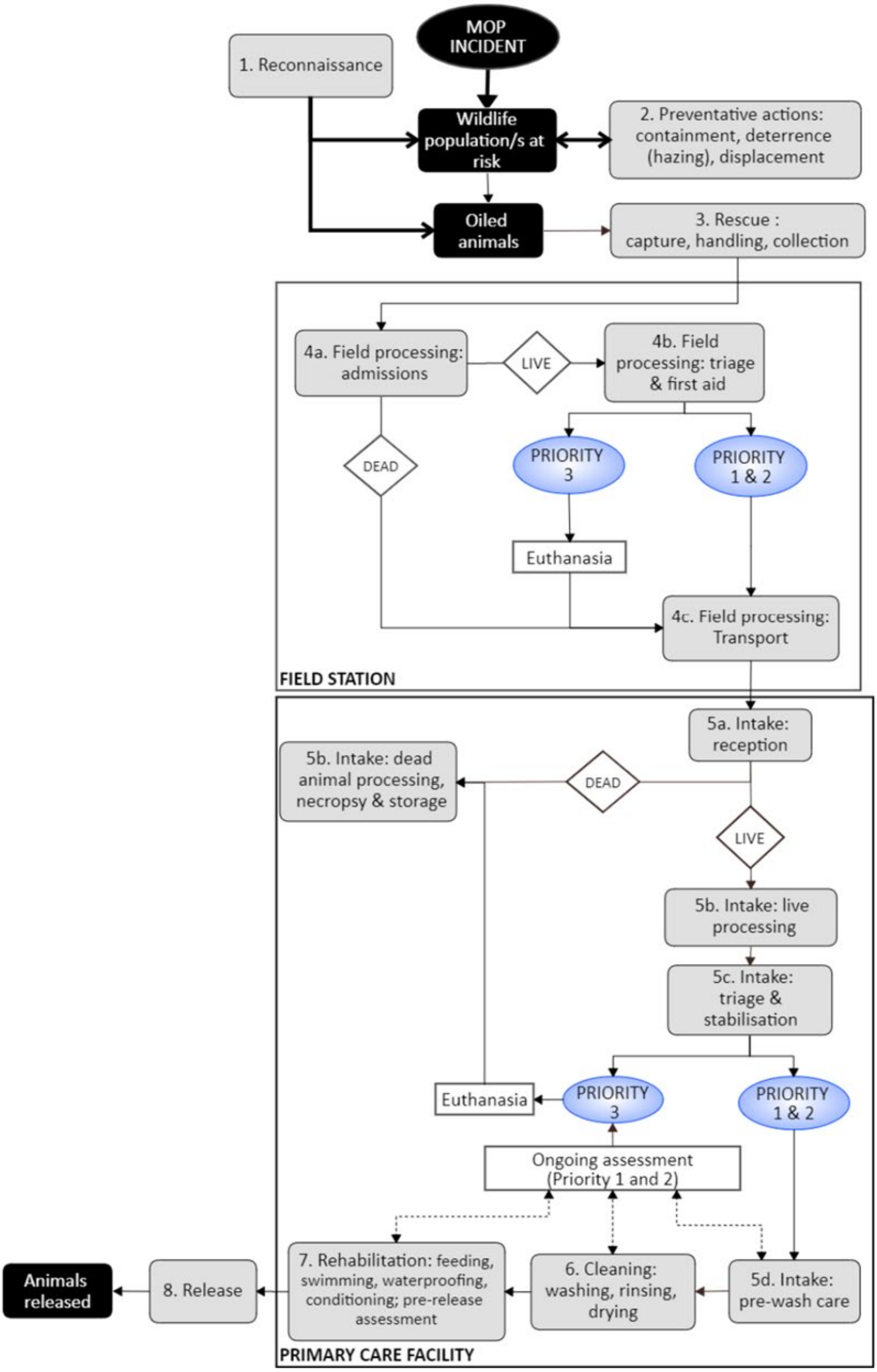


Figure 16-1: Wildlife movement through the operational phases of the OWR (from WAOWRP (DBCA, 2022a))

16.3 Wildlife priority protection areas

For planning purposes, determination of wildlife priority protection areas is based on stochastic modelling of the worst-case spill scenarios, the known presence of wildlife, and in consideration of the following:

+ Presence of high densities of wildlife, threatened species, and/or endemic species with high site fidelity
+ Greatest probability and level of contact from floating oil and/or shoreline accumulation
+ Shortest timeframe to contact.

The wildlife priority protection areas for MEFF plug and abandonment activities are outlined in **Table 16-3** and align with the priority protection sites for spill response described in **Section 6.6** .

Depending on the timing of a potential hydrocarbon spill, certain species could be more impacted because of key seasonal biological activities such as breeding, mating, nesting hatching or migrating.

Table 16-4 provides further detail of key wildlife activities in the Pilbara/Kimberley regions and the corresponding time of year.

Table 16-3: Wildlife priority protection areas

Wildlife priority protection area	Key locations	Reason
Imperieuse and Clerke Reefs	Bedwell Island (Clerke Reef) Cunningham Island (Imperieuse Reef)	+ Bedwell Island is home to one of only 2 nesting colonies of Red-tailed Tropic Birds in WA + Other sea birds known to nest and rest on Bedwell Island + Green and hawksbill turtles frequent these reefs, however little nesting activity has been observed on either Cunningham or Bedwell Islands + Migratory pathway for humpback whales and calves + Oceanic cetacean species including spinner and bottlenose dolphins as well as pilot and false killer whales
Muiron Islands	South Island – Loggerhead turtle	+ Major loggerhead turtle nesting site, significant green turtle nesting site, low density hawksbill turtle nesting site, occasional flatback turtle presence
	-	+ Seabird nesting + Humpback whale migration
Montebello Islands	Northwest and Eastern Trimouille Islands – hawksbill turtle Western Reef and Southern Bay at Northwest Island – green turtle	+ Turtles nesting– significant green turtle nesting; hawksbill, loggerhead and flatback turtles
	-	+ Pygmy blue whale and humpback whale migration area + Dugong foraging + Migratory and threatened seabirds – at least 14 species o Significant nesting, foraging and resting areas

Wildlife priority protection area	Key locations	Reason
Barrow Island	Western side of Barrow Island – green turtles Eastern side of Barrow Island – flatback turtles Turtle Bay north beach, North and west coasts and John Wayne Beach – loggerhead and hawksbill turtle nesting	+ Regionally and nationally significant green turtle (western side) and flatback turtle (eastern side) nesting beaches, Turtle Bay north beach, North and west coasts- John Wayne Beach, loggerheads and hawksbill
	Double Islands – migratory birds Bandicoot Bay and widespread on Barrow Island – migratory birds	+ Migratory birds (important habitat); 10th of top 147 bird sites, Highest population of migratory birds on Barrow Island Nature Reserve (south-south-east of the Island), Double Island has important bird nesting habitat (shearwaters, sea eagles)

Table 16-4: Key wildlife activities in the Pilbara and Kimberley regions and corresponding time of year

Wildlife Type	Activity	Period
Humpback whales	Migration pathway to and from Kimberley calving grounds	Peak between Jun–Aug
Dugong	Breeding Mating	Mar–Aug Aug–Mar
Marine turtles	Nesting Hatching	Sep–Dec Jan–Apr
Shorebirds	Migratory pathway stop over	Sep–Apr

16.4 Magnitude of wildlife impact

Historically OWR tends to predominantly involve avian species, although the OWR for Macondo spill in the Gulf of Mexico, also involved significant numbers of turtles (Stacey *et al*. 2017). During the Macondo OWR only 3 cetaceans were brought into rehabilitation (Wilkin *et al*. 2017) despite the spill contributing to high numbers of dolphin deaths (Venn-Watson *et al.* 2015).

Given the distribution and behaviour of wildlife in the marine environment, a spill which only impacts Commonwealth offshore waters is likely to result in limited opportunities to rescue wildlife. In such instances, continued wildlife reconnaissance, carcass recovery, sampling of carcasses that cannot be retrieved and scientific monitoring are more likely to be the focus of response efforts. In contrast, a spill which results in shoreline accumulation is likely to result in far greater wildlife impacts and opportunities to rescue wildlife.

The stochastic modelling for the worst-case spill scenarios for MEFF plug and abandonment activities predicts that the greatest accumulation of oil will occur at Clerke and Imperieuse Reefs. Although wildlife inhabits the small sandy islets of Bedwell Island (Clerke Reef) and Cunningham Island (Imperieuse Reef), they are not known to occur in high densities and hence large numbers of impacted wildlife are not anticipated at these locations. There is however greater potential for impact at other locations with high densities of wildlife and/or the presence of threatened species and where high shoreline accumulation has been predicted (refer to **Table 6-10** and **Table** 6-11). Using the WAOWRP (DBCA, 2022a) *Guide for Rating the Wildlife Impact of an Oil Spill* (**Table 16-5**), and stochastic modelling for the worst-case spill scenarios (**Section 6.3**), it is predicted that high wildlife impacts have the potential to occur as a result of a worst-case LOWC spill scenario associated with this activity.

Table 16-5: WAOWRP Guide for rating the wildlife impact of an oil spill (DBCA, 2022)

Wildlife Impact Rating	Low	Medium	High
What is the likely duration of the wildlife response?	< 3 days	3-10 days	>10 days
What is the likely total intake of animals?	< 10	11-25	>25
What is the likely daily intake of animals?	0-2	2 to 5	>5
Are threatened species, or species protected by treaty, likely to be impacted, either directly or by pollution of habitat or breeding areas?	No	Yes – possible	Yes – likely
Is there likely to be a requirement for building primary care facility for treatment, cleaning and rehabilitation?	No	Yes – possible	Yes – likely

16.5 Implementation guidance

Table 16-6 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 magnitude of wildlife impact (noting that this may change over time), the timely mobilisation of adequate resources, and initiation of a Wildlife Division 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 16-7**.

In State waters, Santos will conduct the initial first-strike response actions for wildlife and continue to manage those operations until DBCA is activated as the lead agency for wildlife response and formal handover occurs. Following formal handover, Santos will function as a support organisation for the OWR and will be expected to continue to provide planning and resources as required.

Santos

Table 16-6: 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: + location + access + number + species + condition of impacted animals (if available).	Surveillance personnel	☐
	+ 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 State waters also notify DBCA State Duty Officer (who will then activate their respective Oiled Wildlife Advisers).	Obtain approval from IC before activating AMOSC Oiled Wildlife Adviser. DoT will be the Control Agency for OWR in State waters. Under the WAOWRP arrangement, DBCA and AMOSC may request assistance from each other if their internal pool of trained personnel or expertise for wildlife response has been exhausted.	Environment Unit Leader	☐
	Notify DCCEEW 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 (Appendix C).	Environment Unit Leader	☐
	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	☐

Action		Consideration	Responsibility	Complete
	Use information from initial assessments to prepare an Operational NEBA. Use this information to help determine: + Initial magnitude of wildlife impact (low/ medium/ high) refer to **Table 16-5** (the DBCA OWA/ AMOSC OWA will work with Santos to determine the magnitude of impact) + Where wildlife impacts are determined to be medium/high, and where Santos is the Control Agency, a Wildlife Division shall be established (see the Santos Oiled Wildlife Response Framework Plan [SO-91-BI-20014]) + If there are spill response activities that may benefit the OWR + OWR activities likely to result in a net environmental benefit, including: ○ requirement, location and methods for wildlife targeted reconnaissance ○ applicable preventative actions.	Note: Wildlife reconnaissance is a critical component of an oiled wildlife first-strike response. Refer to the following guidance documents for further information: + WA OWR Manual: ○ P1 OWR Procedure: Phase 1 Wildlife Reconnaissance ○ G-1: OWR Strategies by Fauna Group + Santos Oiled Wildlife Response Framework Plan (SO-91-BI-20014): Section 7.3 Any interactions involving nationally listed threatened fauna may require approval from DCCEEW as interactions with such species is controlled by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the *Environment Protection and Biodiversity Conservation Regulations 2000*. In State waters, preventative actions involving wildlife constitute fauna "disturbance" under the *Biodiversity Conservation Act 2016* and require authorisation through DBCA unless undertaken by licensed personnel. No action specifically targeted at wildlife should occur without this authority.	Environment Unit Leader *If Wildlife Division activated:* Santos Oiled Wildlife Response Division Coordinator Santos Oiled Wildlife Response Branch Director	☐
	Prepare a Wildlife Plan for inclusion in the IAP	Refer to the WAOWRP, WA OWR Manual, and Santos Oiled Wildlife Response Framework Plan (SO-91-BI-20014), Section 7.1.	Environment Unit Leader *If Wildlife Division activated:* Santos Oiled Wildlife Response Division Coordinator Santos Oiled Wildlife Response Branch Director	☐

Action	Consideration	Responsibility	Complete
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 Division activated:* Santos Oiled Wildlife Response Division Coordinator Santos Wildlife Reconnaissance Team Leader	☐
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 DBCA.	Consider need for animal rescue, triage, rehabilitation and sampling.	AMOSC OWA Logistics Section Chief *If Wildlife Division activated:* Santos Oiled Wildlife Response Division Coordinator *State waters:* DBCA OWA	☐
Commence mobilisation of equipment (including adequate PPE) and personnel to required location/s.	-	Logistics Section Chief	☐
Contact OSRL to activate Sea Alarm if additional support is likely to be required to sustain an ongoing OWR.	-	Environment Unit Leader	☐

Table 16-7: Oiled wildlife response – first-strike response timeline

<table>
<tr><th>Task</th><th>Time from oiled wildlife contact (predicted or observed)</th></tr>
<tr><td>IMT notifies regulatory authorities and AMOSC of oiled wildlife / potential for contact</td><td><2 hours</td></tr>
<tr><td>Mobilise Santos personnel for oiled wildlife reconnaissance
this will be already occurring through Aerial Observer mobilisation</td><td><24 hours</td></tr>
<tr><td>Mobilisation of AMOSC oiled wildlife equipment and industry OWR team to forward staging area</td><td><48 hours</td></tr>
<tr><td colspan="2">Minimum resource requirements</td></tr>
<tr><td colspan="2">The requirements for oiled wildlife response will be situation specific and dependent upon reconnaissance reports.
<u>First strike resources</u>:
+ Reconnaissance platforms (Refer to Santos Oiled Wildlife Response Framework Plan (SO-91-BI-20014)
+ 6 x trained industry oiled wildlife response team personnel (AMOSC staff & contractors/ AMOSC Industry OWR group)
+ 1 x AMOSC Oiled Wildlife Deterrence Kit
<u>Additional resources:</u>
+ Refer to Santos Oiled Wildlife Response Framework Plan (SO-91-BI-20014)
+ Refer to Appendix M for information on OWR equipment</td></tr>
</table>

16.6 Environmental performance standards

Table 16-8 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 16-8: Environmental performance – oiled wildlife response

<table>
<tr><th>Environmental performance outcome</th><td colspan="3">Implement tactics in accordance with relevant State Oiled Wildlife Response Plans (OWRP) to prevent or reduce impacts, and to humanely treat, house, and release or euthanise wildlife</td></tr>
<tr><th>Response strategy</th><th>Control measures</th><th>Performance standards</th><th>Measurement criteria</th></tr>
<tr><td rowspan="5">Oiled wildlife response</td><td colspan="3">Response preparedness</td></tr>
<tr><td rowspan="3">Maintenance of access to oiled wildlife response equipment and personnel</td><td rowspan="3">Maintenance of access to oiled wildlife response equipment and personnel through Santos, AMOSC, AMSA National Plan and OSRL throughout activity</td><td>MoU for access to National Plan resources through AMSA</td></tr>
<tr><td>AMOSC Participating Member Contract.</td></tr>
<tr><td>OSRL Associate Member Contract.</td></tr>
<tr><td>Santos Oiled Wildlife Response Framework Plan (SO-91-BI-20014)</td><td>Santos Oiled Wildlife Response Framework Plan provides guidance for coordinating an OWR when Santos is the Control Agency and outlined Santos's response arrangements</td><td>Santos Oiled Wildlife Response Framework Plan</td></tr>
</table>

Environmental performance outcome	Implement tactics in accordance with relevant State 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**
	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 on 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 16-7** unless directed otherwise by relevant Control Agency	Incident log
	OWR managed in accordance with the Santos Oiled Wildlife Response Framework Plan (SO-91-BI-20014) in Commonwealth, and the WAOWRP in State waters.	Prepare operational NEBA to determine magnitude of wildlife impact and determine the OWR activities likely to result in a net environmental benefit (particularly in relation to hazing/pre-emptive capture)	Records indicate operational NEBA completed before 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

17. Waste management

Table 17-1 lists the environmental performance outcome, initiation and termination criteria for this strategy.

Table 17-1: 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	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✓	✓
Termination criteria	+ 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	

17.1 Overview

The implementation of some spill response strategies will generate 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.

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 *Environmental Protection (Controlled Waste) Regulations 2004*. Santos' Oil Pollution Waste Management Plan (QE-91-IF-10053) provides detailed guidance to the WSP in the event of a spill.

17.2 Implementation guidance

Table 17-2 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.

Santos

Table 17-2: 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	☐
	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 then to underestimate waste volumes.	Logistics Section Chief Planning Section Chief	☐
	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 DoT and will depend upon the location of shoreline clean-up activities and staging areas and the availability of vehicle access routes. Consideration would be given to positioning receptacles and locating temporary storage sites to ensure secondary contamination of sensitive receptors is avoided or minimised. The approval of temporary storage sites would be given through Department of Water and Environmental Regulation (DWER).	Logistics Section Chief Planning Section Chief Environmental Unit Leader	☐
	For each receival location indicate the anticipated: + 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	☐
	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-10053); and where relevant, the DoT Waste Management	Logistics Section Chief (or delegate) Planning Section Chief	☐

	Action	Consideration	Responsibility	Complete
		Guidelines (WA), the respective Port, Port Operator and/or Ship Owner's waste management plan.	Deputy Waste Management Coordinator (DoT IMT) 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 Deputy Waste Management Coordinator (DoT IMT)	☐
Ongoing actions	Provide ongoing point of contact between IMT & WSP.	If DoT is the Control Agency, the Facilities Support Officer shall be the point of contact between DoT and the WSP.	Logistics Section Chief	☐
Ongoing actions	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 DoT Waste Management Guidelines (WA), the respective Port, Port Operator and/or Ship Owner's waste management plan.	WSP location Responsible Person or Operations Supervisor	☐
Ongoing actions	Ensure records are maintained for all waste management activities, including but not limited to: + waste movements (e.g. types of receptacles, receival 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	☐

17.3 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 DoT Waste Management Guidelines 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 WA Department of Water and Environment Regulation (DWER).

DWER administers the *Environmental Protection Act 1986* (WA) and is the relevant authority for waste management in WA. 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.

17.4 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 worse 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).

17.5 Waste management resources

Santos has access to capacity to deliver storage receptacles, remove, transport and dispose of all waste material from oil spill response activities to predetermined disposal points.

Table 17-3 provides waste service provider capability for waste removal and storage, which is in excess of the waste management requirements for spill response activities associated with this OPEP. The weekly solid waste removal capacity is 8,658 m^3 totalling 138,528 m^3 over the 16 weeks of the shoreline clean-up response (as per **Table 15-5**).

The maximum waste accumulation including bulking factor, further evaluated in shoreline clean-up in **Section 15.4** over 16 weeks is 4,818 m^3 as per **Table 15-5**, which is exceeded by the waste service provider total removal capacity specified in **Table 17-3.**

Table 17-3: North West Alliance vehicle and equipment availability

Plant and Equipment	No.	Capacity	Functionality	Uses per week	Indicative waste stored/shifted per week
Waste removal					
Oily waste					
Skip Lift Truck	12	Lift up to 15 Tonnes	Servicing of skip Bins	7	630
Front Lift Trucks	10	28 m^3 Body	Servicing of Front lift Bins	7	784
Side Loading Truck	10	18 m^3 Body	Servicing of MGB's	7	504
Hook Lift Truck	5	70 Tonne rated	Servicing of hook lift Bins	7	980
Flat Bed Truck	16	15 pallet spaces	Servicing of bins	7	840
Liquid oil					
Liquid waste tankers (triple 'road-train' configuration)	10	75 m^3	Collection of liquid waste at the port of reception (Dampier)	7	5,250
Waste storage					
Oily waste					
MGBs	500	240 litres	Mobile bins	2	48
Offshore 8 pack Lifting Cradle (MGBs)	2	16 x 240 L MGBs	Able to remove 16 x 240 L MGBs simultaneously	continuous	
Lidded Bins	6	1,100 litres	contain various waste streams	2	13
Front Lift Bins	50	3 m^3	various waste streams	2	300
Front Lift Bins	25	4.5 m^3	various waste streams	2	225
Offshore Rated Front Load Bins	100	3 m^3	various waste streams	2	600
Offshore Rated Bins	45	7 m^3	various waste streams	2	630
Marrell Skip Bins	60	6–9 m^3	various waste streams	2	960
Hook Lift Bins	12	15–30 m^3	various waste streams	25	6900
Forklift	4	4 tonne Forklift	All areas	continuous	
Weekly waste storage capacity					**9,628**
Weekly waste removal capacity					**8,658**
Weekly liquid oil removal capacity					**5,250**

17.6 Environmental performance

Table 17-4 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 17-4: Environmental performance – waste management

Environmental performance outcome	Comply with waste treatment, transport and disposal regulations and prevent secondary contamination while reducing, re-using 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
		Provision of liquid oil waste tanks for containment and recovery operations to deployment port, if requested, within 24 hours	Incident log
		Provision of waste bins for oil and oily waste for shoreline clean-up operations to clean-up site or deployment port, if requested, within 24 hours	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

18. Scientific monitoring

Table 18-1: 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**)	
Applicable hydrocarbons	**MDO**	**MEFF Crude**
	✓	✓
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 State and Commonwealth waters.

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

18.1 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**.

18.2 Scope

Santos will implement its SMPs, as applicable, for MEFF plug and abandonment activity oil spills across both State and Commonwealth waters. In the event that control of scientific monitoring in State waters is taken over by DoT under advice from the State Environmental Scientific Coordinator, Santos will follow the direction of DoT and provide all necessary resources (monitoring personnel, equipment and planning) to assist as a supporting agency.

18.3 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.

18.4 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 MEFF plug and abandonment activities (**Table 18-2**). 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 DoT methodology, termination criteria and analysis/reporting requirements may differ.

Table 18-2: Oil spill scientific monitoring plans relevant to MEFF plug and abandonment 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

18.5 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** provides further information on Santos baseline data reviews and outlines a baseline date assessment conducted on high priority areas for scientific monitoring in the event of an oil spill associated with MEFF plug and abandonment activities.

18.6 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 18-2**). These services are provided by Santos' Monitoring Service Provider. **Appendix P** provides further information regarding the Monitoring Service Provider's capability and assurance arrangements.

For whale sharks, scientific monitoring of whale sharks (SMP12) along the Ningaloo Coast and north-west Australian coastline will be undertaken. 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. 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 at, and migrating to-and-from, Ningaloo Reef. 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 MEFF plug and abandonment MEFF activities.

18.7 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 18-3.**

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 18-3: 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	<96 hours (72 hours from monitoring plan approval)

Task	Time from activation
SMP teams and monitoring equipment mobilised to deployment locations	<96 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**. + 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 to **Appendix P**) + Scientific monitoring equipment as detailed in the relevant SMP	

18.8 Environmental performance

Table 18-4 indicates the environmental performance outcomes, controls and performance standards for this response strategy.

Table 18-4: 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 Service Provider throughout activity	Contract with monitoring service provider
	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

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**
		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	MSP 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
	Mobilisation of minimum requirements for initial scientific monitoring operations	Minimum requirements mobilised in accordance with **Table 18-3**	Incident log

19. 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.

20. References

Adams, E. E. & Socolofsky, S. A. (2005), Review of Deep Oil Spill Modelling Activity Supported by the DeepSpill JIP and Offshore Operators Committee. December 2004, revised 2005.

Adams, E.E., Socolofsky, S.A., Boufadel, M. (2013). Comment on ‘‘Evolution of the Macondo Well Blowout: Simulating the Effects of the Circulation and Synthetic Dispersants on the Subsea Oil Transport’’. Environ. Sci. Technol. 47 (20). http:// dx.doi.org/10.1021/es4034099 (11905–11905).

Advisian (2017). Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Protection Priority Assessment for Zone 2: Pilbara – Draft Report. Report No: 301320-09591-EN-REP-0003 – DOT307215. Prepared for Western Australian Department of Transport. Accessed 18th July 2022: https://transport.wa.gov.au/mediaFiles/marine/MAC_P_DOT307215_PilbaraProtectionPriorities.pdf

Advisian (2018). Provision of Western Australian Marine Oil Pollution Risk Assessment – Protection Priorities: Protection Priority Assessment for Zone 1: Kimberley – Draft Report. Report No: 301320-09591-EN-REP-0003– DOT307215. Prepared for Western Australian Department of Transport. Accessed 18th July 2022: https://www.transport.wa.gov.au/mediaFiles/marine/MAC_P_DOT307215_KimberleyProtectionPriorities.pdf

American Petroleum Institute (API) (2018) Standard 53: Well control equipment systems for drilling wells.

API. (2020). Oil Prevention and Response: Shoreline. Accessed 27th July 2021- http://www.oilspillprevention.org/oil-spill-cleanup/shoreline-wetlands-beaches-oil-spill-cle.

Australian Marine Oil Spill Centre (AMOSC) (2021), AMOSPlan Section III 2021 – Australian Industry Cooperative Oil Spill Response Arrangements [Internet, available: <https://amosc.com.au/wp-content/uploads/2021/10/amosplan-2021.pdf>].

Australian Marine Oil Spill Centre (AMOSC) (2020), Fixed Wing Aerial Dispersant Operational Plan (FWADOps Plan), Version 1.0, 10th August 2020.

Australian Maritime Safety Authority (AMSA) (2010). Response to the Montara wellhead platform incident, Report of the incident analysis team March 2010, [Internet, available: <https://www.amsa.gov.au/file/2425/download?token=e-s0BHkQ>].

AMSA (2015). Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities. Prepared by the Australian Maritime Safety Authority, January 2015

AMSA (2017). Australian Government Coordination Arrangements for Maritime Environmental Emergencies. Prepared by the Australian Maritime Safety Authority, October 2017.

AMSA (2020). National Plan for Maritime Environmental Emergencies. Australian Maritime Safety Authority, Canberra, Australian Capital Territory. Accessed 5th November 2021 - https://www.amsa.gov.au/sites/default/files/amsa-496-national-plan.pdf

AMSA (2021), National Response Team Policy (NP-POL-002), 02 March 2021, [Internet, available: <https://www.amsa.gov.au/national-response-team-policy>].

CSIRO (2016). Oil Spill Monitoring Handbook. CSIRO Publishing.

Department of Biodiversity, Conservation and Attractions (DBCA) (2022a). Western Australian Oiled Wildlife Response Plan (WA OWRP) for Maritime Environmental Emergencies. Accessed 14th June 2022 at https://www.dpaw.wa.gov.au/management/marine/marine-wildlife/marine-wildlife-response?showall=&start=2

DBCA (2022b). Western Australian Oiled Wildlife Response Manual. Accessed 14th June 2022 at https://www.dpaw.wa.gov.au/management/marine/marine-wildlife/marine-wildlife-response?showall=&start=2

European Maritime Safety Agency (EMSA) (2010). Manual on the Applicability of Oil Spill Dispersants. Version 2.

French McCay, D., Crowley, D. (2018). Sensitivity Analysis for Oil Fate and Exposure Modelling of a Subsea Blowout – Data Report. Prepared for American Petroleum Institute. API Project 2015-110161.

French-McCay, P., Jayko, K., Li, Z., Spaulding, M., Crowley, D., Mendelsohn, D., Horn, M., Isaji, T., Kim, Y.H., Fontenault, J., Rowe, J. (2021). Oil fate and mass balance for the Deepwater Horizon oil spill, Marine Pollution Bulletin. No. 171. October 2021, 112681

GHD (2022). MEFF Plug and Abandonment Oil Spill Modelling Report, June 2022.

Hemmer, M.J., Barron, M.G. And Greene, R.M. (2011) Comparative toxicity of eight oil dispersants, Louisiana sweet crude oil (LSC), and chemically dispersed LSC to two aquatic test species. Environmental Toxicology and Chemistry, 30 (10), 2,244–52.

Hook, S. and Lee, K. (2015). Risk analysis of chemical oil dispersants on the Australian register. APPEA Journal 2015.

International Petroleum Industry Environmental Conservation Association – International Association of Oil and Gas Producers (IPIECA-IOGP) (2016a), At-sea containment and recovery; Good practice guidelines for incident management and emergency response personnel, IPIECA-IOGP Report 522. [Internet, available: <https://www.ipieca.org/resources/good-practice/at-sea-containment-and-recovery/#:~:text=At%20sea%20containment%20and%20recovery,thickness%2C%20allowing%20for%20mechanical%20removal>].

International Petroleum Industry Environmental Conservation Association – International Association of Oil and Gas Producers (IPIECA-IOGP) (2016b), A Guide to Oiled Shoreline Clean-up Techniques; Good practice guidelines for incident management and emergency response personnel, IPIECA-IOGP Report 521 [Internet, available: <https://www.ipieca.org/resources/good-practice/a-guide-to-oiled-shoreline-clean-up-techniques/>].

ITOPF (2020). ITOPF Members Handbook 2021. Prepared by International Tanker Owners Pollution Federation Ltd. Accessed 5th November 2021 - https://www.itopf.org/knowledge-resources/documents-guides/itopf-handbook/

McKinney, K. and Caplis, J. (2017) Evaluation of Oleophilic Skimmer Performance in Diminishing Oil Slick Thicknesses. International Oil Spill Conference Proceedings: May 2017, Vol. 2017, No. 1, pp. 1366-1381.

Michel, J., S. R. Fegley, J. A. Dahlin, and C. Wood. (2017). Oil spill response-related injuries on sand beaches: when shoreline treatment extends the impacts beyond the oil. Marine Ecology Progress Series 576:203–218.

NASEM (National Academies of Sciences, Engineering, and Medicine). (2020). The Use of Dispersants in Marine Oil Spill Response. The National Academies Press, Washington, DC, 340 pp., Accessed July 19, 2022 – https://www.nap.edu/catalog/25161/the-use-of-dispersants-in-marine-oil-spill-response

National Oceanic Atmospheric Administration (NOAA), US Coastguard, US Environmental Protection Agency (2006). Special Monitoring of Applied Response Technologies (SMART) monitoring protocol, Accessed 19 July 2022- https://response.restoration.noaa.gov/sites/default/files/SMART_protocol.pdf.

NOAA. (2013). Characteristics of Response Strategies: A Guide for Spill Response Planning in Marine Environments. https://response.restoration.noaa.gov/sites/default/files/Characteristics_Response_Strategies.pdf

Oil Spill Response Limited (OSRL) (2019), Technical Information Sheet: Global Dispersant Stockpile. [Internet, available: <https://www.oilspillresponse.com/globalassets/services/member-response-services/global-dispersant-stockpile/tis-gds_19mar2019.pdf>].

Quigg, A., Farrington, J., Gilbert, S., Murawski, S., and John, V. (2021). A Decade of GoMRI Dispersant Science: Lessons Learned and Recommendations for the Future. Oceanography, Vol.34, No.1

RPS. (2019). Inpex VOC & SSDI Modelling: Near-field to far-field investigation stages. Report prepared for INPEX.

Stacy NI, Field CL, Staggs L, MacLean RA and others (2017) Clinicopathological findings in sea turtles assessed during the Deepwater Horizon oil spill response. Endang Species Res 33:25-37. https://doi.org/10.3354/esr00769

Venn-Watson S, Colegrove KM, Litz J, Kinsel M, Terio K, Saliki J, *et al.* (2015) Adrenal Gland and Lung Lesions in Gulf of Mexico Common Bottlenose Dolphins (*Tursiops truncatus*) Found Dead following the Deepwater Horizon Oil Spill. PLoS ONE 10(5): e0126538. https://doi.org/10.1371/journal.pone.0126538

Western Australian (WA) Department of Transport (DoT) (2015). Oil Spill Contingency Plan. Prepared by the WA Department of Transport, January 2015.

WA DoT. (2021). State Hazard Plan – Marine Environmental Emergencies (MEE). Department of Transport, Perth, Western Australia. Accessed 1st February 2022 - https://www.transport.wa.gov.au/mediaFiles/marine/MAC_P_StateHazardPlanMaritimeEnviroEmergMEE.pdf

WA DoT (DoT). (2020). Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements. Accessed 5th November 2021 at https://www.transport.wa.gov.au/mediaFiles/marine/MAC_P_Westplan_MOP_OffshorePetroleumIndGuidance.pdf

Wilkin SM, Rowles TK, Stratton E, Adimey N and others (2017) Marine mammal response operations during the Deepwater Horizon oil spill. Endang Species Res 33:107-118. https://doi.org/10.3354/esr00811

DPaW and AMOSC. (2014). Pilbara Region Oiled Wildlife Response Plan (WA OWRP). Accessed 5th November 2021 at https://www.dpaw.wa.gov.au/images/documents/conservation-management/marine/wildlife/PROWRP_20141103.pdf

Appendix A Hydrocarbon characteristics and behaviour

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-1.** 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. For full details on the properties of MDO, refer to Section 9.5.3 of the MEFF Plug and Abandonment Environment Plan – 9885-236-EMP-0002.

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

+ Diesel 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
+ Diesel residues usually consist of heavy compounds that may persist longer and will tend to disperse as oil droplets into the upper layers of the water column.

Figure A-1 provides the predicted weathering and fates of surface 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-1: 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

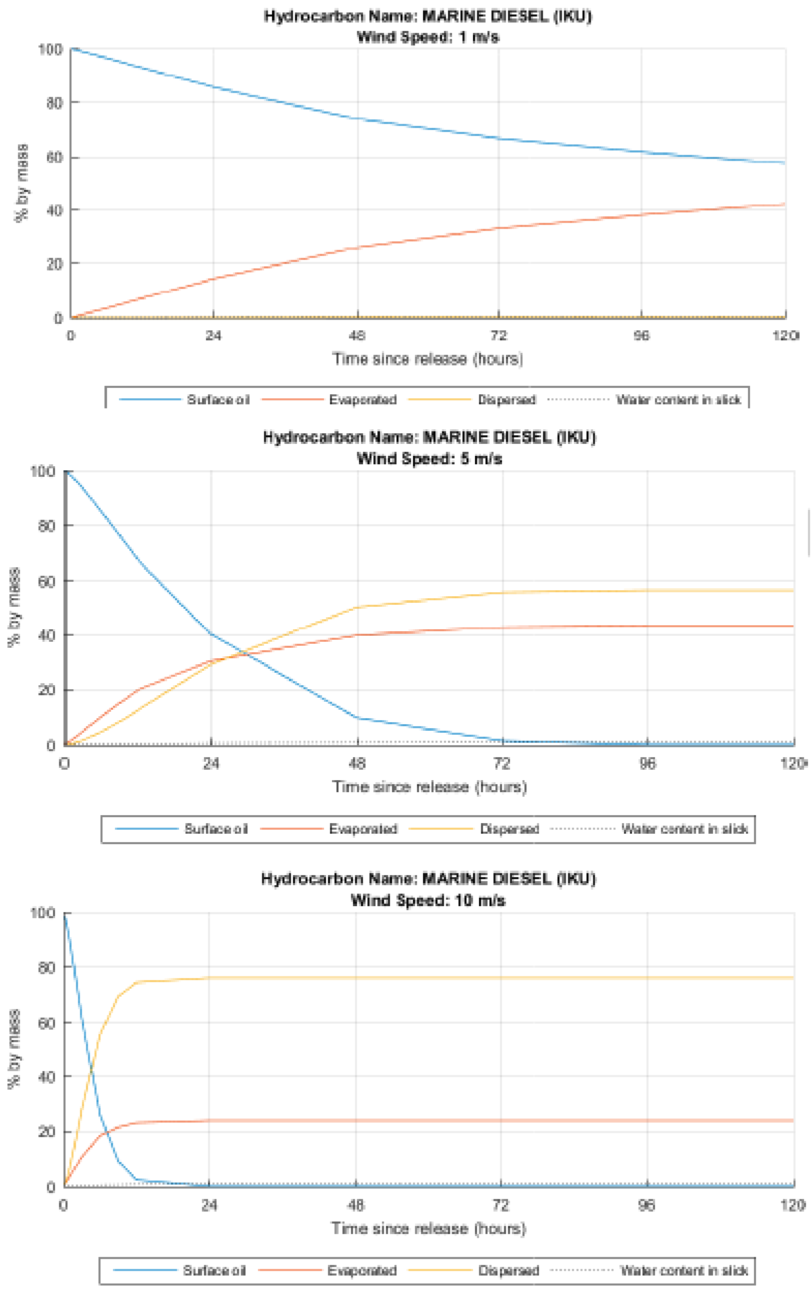


Figure A-1: Predicted weathering and fates of MDO (GHD, 2021)

Mutineer-Exeter Light Crude

Mutineer-Exeter Light Crude is characterised by a low viscosity and is considered a Group 2 oil (light) hydrocarbon, as per the grouping classification presented by AMSA (2015). When the oil appears at the sea surface, the hydrocarbon would rapidly spread and thin out resulting in a large surface area of hydrocarbon available for evaporation.

Oil spill modelling was carried out with SINTEF's Oil Spill Contingency and Response (OSCAR) system (version 12.0) and required the use of a hydrocarbon analogue. SINTEFs hydrocarbon analogue 'Vale' was selected as a suitable match for Mutineer-Exeter Light Crude. The chemical properties of both hydrocarbons is outlined in **Table A-2**.

Evaporation is the primary weathering mechanism for Vale 2013. Under low wind speeds of 1 m/s, approximately 55% of the surface slick is predicted to evaporate after 5 days (120 hours) while wind-driven dispersion into the water column is negligible. Under moderate wind speeds of 5 m/s, approximately 60% of the surface slick evaporates after 5 days, while a further ~18% is dispersed into the water column and the surface slick makes up the remaining ~22%. High wind speeds of 10 m/s are predicted to rapidly (after 48 hours) disperse (45%) and evaporate (55%) the oil with no surface slick remaining.

Vale 2013 has a high tendency for emulsion formation, with peak water contents in the surface slick stabilising at 76% after 72 hours for low winds (1 m/s), while this occurs much more rapidly (within 6–12 hours) under moderate (5 m/s) and high (10 m/s) wind speeds.

Table A-2: Comparison of whole properties of Mutineer-Exeter Crude and SINTEF Vale 2013 (GHD, 2022)

Hydrocarbon type	Specific gravity	Viscosity (cP)	API	Wax content (%)	Pour point °C	Asphaltene (%)
Mutineer-Exeter	0.8091	3.027 (20 °C)	43.4	3	12	0.03
Vale 2013 (Modelling analogue)	0.816	37 (13 °C)	42.0	3.26	−9	0.03

Figure A-2 provides the predicted weathering and fates of surface hydrocarbon for the largest sea surface swept area at the moderate threshold. The graph shows that hydrocarbon on the sea surface is expected to evaporate rapidly (GHD, 2022).

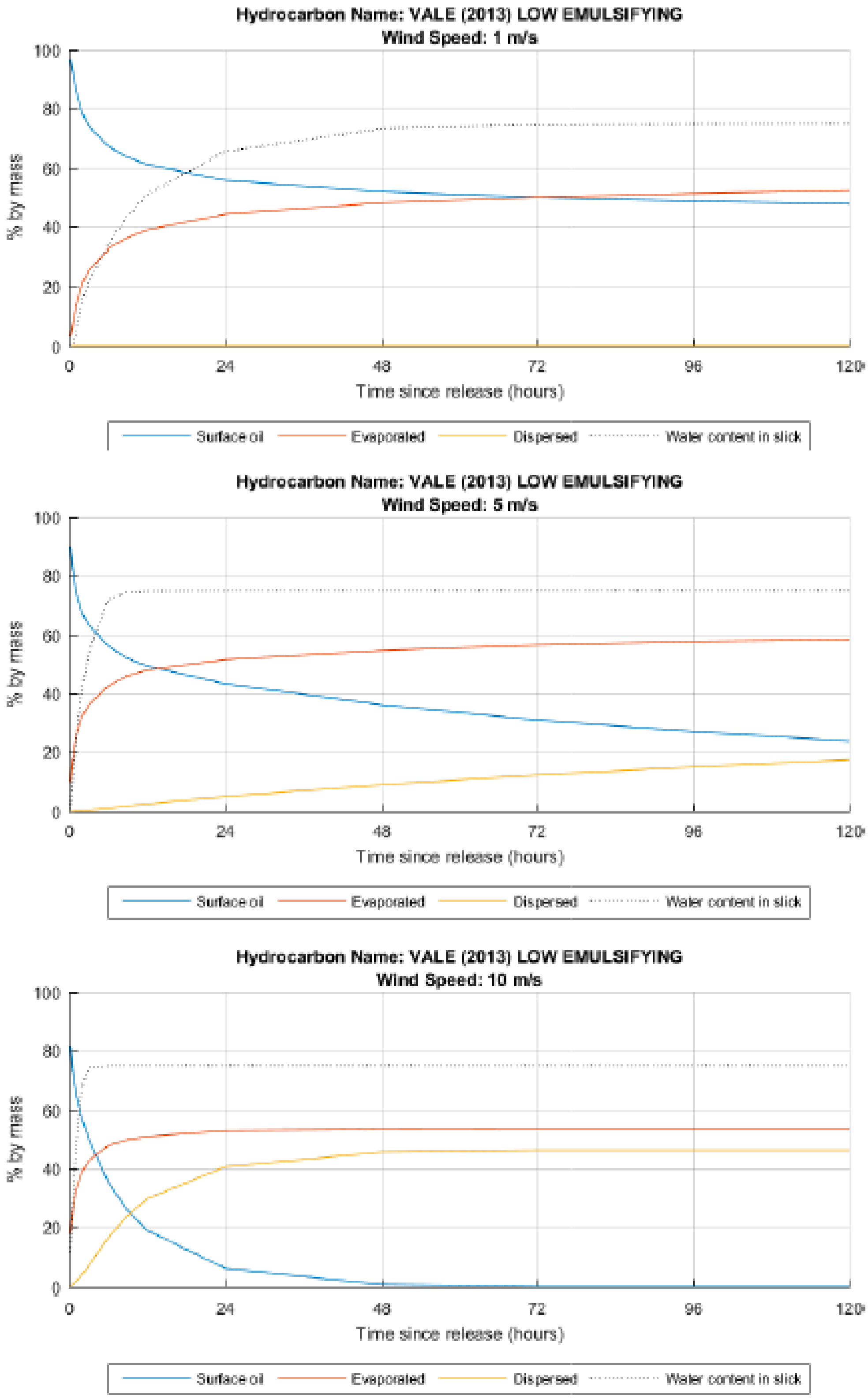


Figure A-2: Simulated weathering of the SINTEF Vale 2013 hydrocarbon for constant wind speeds of 1 m/s (top), 5 m/s (middle), and 10 m/s (bottom) (GHD, 2022)

Appendix B Oil Spill Response ALARP Framework & Assessment

ALARP Assessment Framework

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.

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; and
+ NOPSEMA Oil Pollution Risk Management GN1488 Rev 2 February 2018.

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.**

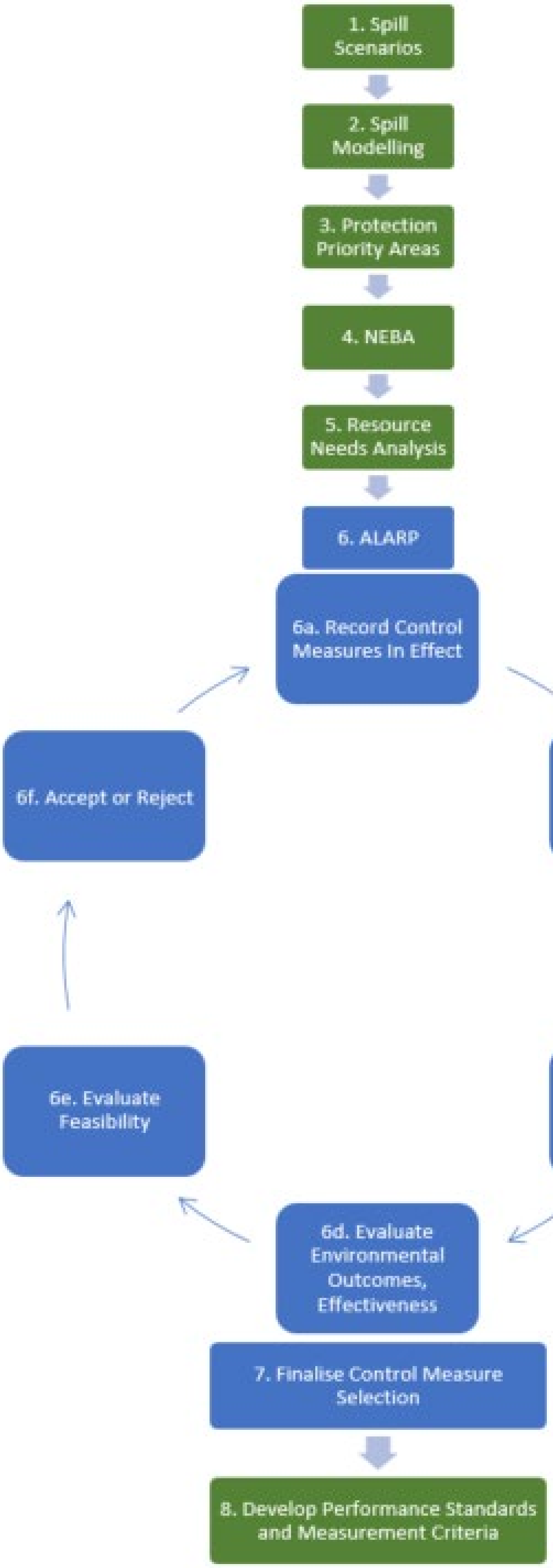


Figure B-1: ALARP Assessment Framework

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**.

+ 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.
+ 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.
+ 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.
+ Evaluate Environmental Outcomes, Effectiveness: The environmental outcomes and effectiveness are assessed for all control measures identified and described through Steps 6a, b, and c.
+ Evaluate Feasibility: Time, cost and effort required for implementation are assessed for all control measures identified and described through Steps 6a, b, and c.
+ 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:

6. Finalised Control Measure Selection: Outputs from the ALARP Assessment shown in Step 6 comprise finalised control measures (in BLUE).
7. 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.

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

Column	Description
	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.
Environmental Outcomes	Assessment of environmental benefits, particularly those over and above those environmental benefits documented in the Control Measure that is in effect. Environmental impacts of the Control Measure are also considered here.
Effectiveness	The effectiveness of a Control Measure in reducing the risk to ALARP is evaluated using the following six criteria. **Functionality** + 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? **Availability** + Probability that the control measure will be available when required and has not failed or is undergoing a maintenance or repair. **Reliability** + 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. **Survivability** + 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. **Dependency** + 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. + Several control measures are reliant on equipment, people and vessels, hence have high dependence. **Compatibility** + 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
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

ALARP Assessment Summaries

ALARP assessment summary
Source Control
The Control Measures in place for emergency BOP activation represent industry best practice and are considered to reduce the timeframe for BOP activation to ALARP in the context of a LOWC incident. The use of a BOP is considered to be an effective source control and the emergency BOP activation procedures ensure timely activation of the BOP. The Control Measures in place for relief well drilling represent industry best practice and are considered to reduce the timeframe for drilling a relief well to as low as reasonably practicable in the context of the risk of an uncontrolled well leak. Potential Control Measures were identified and assessed by the Santos WA Drilling & Completions Department representatives. The drilling of a relief well is considered to be an effective control and relief well planning conducted in the area has demonstrated that a MODU will be on site for relief well drilling by day 33 from the start of a well release. Relief well drilling can be completed within 77 days using MODUs, equipment and specialist personnel that Santos has arrangements to gain access to. Santos has arrangements in place to enable access to a Capping Stack as a secondary source control strategy and would only be used where there is suitable vertical access over the wellhead. These arrangements also include trained personnel for the mobilisation, deployment and operation of the Capping Stack. Limiting factors for the deployment of a Capping Stack involve safety and technical constraints, metocean conditions, location of Capping Stacks and access to a suitable Capping Stack capable vessel. Santos assessed the feasibility of maintaining its own Capping Stack and having suitable deployment vessel/crew on standby to deploy Capping Stack. Given the low likelihood of a blowout event, the significant upfront costs involved and the presence of a more effective primary control strategy (relief well drilling) the costs are considered disproportionate to the level of risk reduction. Eleven additional/alternative/improved Control Measures were identified and assessed. No additional Control Measures were accepted as reasonably practicable. Eleven Control Measures were rejected as grossly disproportionate. Rejected Control Measures were: + Dedicated BOP Intervention vessel equipped with ROV tooling package in field + Purchase and maintain own Capping Stack in Dampier + Incentivise a vendor to set up a Capping Stack Dampier + Purchase and maintain own Capping Stack and have suitable deployment vessel/crew on standby with pre -approved Safety Case to deploy Capping Stack + Transport WWC Capping Stack via air + Use of lightweight Rapid Cap to be mobilised via air from Houston, USA. + Preposition WWC Capping Stack standby crew in Perth + MODU on standby at activity location + Dedicated relief well MODU on contract + Contract source control personnel through a provider in addition to existing arrangements + Wild Well Control on standby in Perth during drilling operations in order to respond immediately to a LOWC Performance Standards and Measurement Criteria that have been developed for the in-effect Control Measures are shown in **Table 9-7**.
Monitor and evaluate
Various, independent inputs from multiple service providers are used to build a detailed Common Operating Picture in the incident. Six additional potential Control Measures were identified and assessed. Two additional Control Measures were accepted as reasonably practicable. The accepted Control Measures were: + Arrangements for staff from an additional oil spill personnel provider

ALARP assessment summary
+ Just-In-Time training to train personnel for spill response roles Four Control Measures were rejected as grossly disproportionate. Rejected Control Measures were: + Purchase of oil spill modelling system and internal personnel trained to use system + Trained aerial observers based in in strategic locations such as Karratha + Ensure trained marine mammal/fauna observers based in Dampier + Trained water monitoring specialists available in Dampier Performance Standards and Measurement Criteria that have been developed for the in-effect and accepted Control Measures are shown in **Table 10-41**.
Subsea Dispersant Injection
A subsea LOWC associated with MEFF plug and abandonment is predicted to result in relatively slow release rates of oil, gas, and water. The low velocity of the subsea plume is likely to result in low entrainment and at the surface under wind speeds of 5 m/s approximately 60% of the surface slick evaporates after 5 days. Therefore, SSDI would be employed as a secondary strategy and only if it was determined to have an overall environmental benefit in consideration of enhancing safety for source control personnel and environmental benefits associated with a reduction in the surface oil versus potential detrimental environmental impacts (such as increased toxicity and reducing the opportunity for evaporation). Control measures are in place for a rapid mobilisation of the SFRT, personnel and dispersants to Dampier, however the key limiting factor for deployment is suitable SFRT capable vessels which may take considerably longer to mobilise (7-10 days). A Control Measure involving the positioning of SFRT vessels on standby at a regional port in order to reduce deployment time was assessed but was found to be disproportionate in terms of costs to the reduction in risk gained. Dispersant available with the AMOSC SFRT package would be sufficient to supply dispersant for the duration of operations. Six additional Control Measures were identified and assessed. No additional Control Measures were accepted as reasonably practicable. Six Control Measures were rejected as grossly disproportionate: + Purchase of Santos SFRT to be located in Exmouth or Dampier + Relocate AMOSC SFRT to Dampier + Subsea bladder dispersant system positioned next to well site + Enable improved vessel access by contracting a suitable, dedicated vessel on standby + Access to additional dispersant stockpile owned by Santos + Rent dispersant stockpiles and place in Dampier Performance Standards and Measurement Criteria that have been developed for the in-effect Control Measures are shown in **Table 13-12**.
Surface Dispersant
Surface dispersant application is a secondary response strategy limited to amendable scenarios at the time of a spill and when deemed environmentally beneficial by an operation NEBA (SIMA). Vessel based dispersant spray systems are available from WA, AMOSC and AMSA in the region (including stockpiles at Exmouth and Dampier) and within WA. These spray systems are not considered a limiting factor to surface dispersant operations; the quantity of equipment available to WA through contractual arrangements and the positioning of equipment in first strike locations is considered adequate for the scale of worst-case surface dispersant operations identified in the OPEP. The timely mobilisation of suitable vessels and personnel required for surface dispersant operations are considered to be the key constraints for this strategy. Santos has defined the specifications for spray vessels and applies this when tracking vessels. A review of control measures associated with personnel identified that no improvements could be made to the availability of personnel without the cost/effort being disproportional to the risk.

ALARP assessment summary
Aerial based dispersant application is available to WA through national and international resources via contractual arrangements. Mobilisation times for these resources are considered to be in line with industry best practice. No potential Control Measures were identified that could improve mobilisation times for aerial dispersant application. Dispersant volumes available within WA and Australia and the mobilisation of these stocks exceed worse case requirements, hence dispersant is not a limiting factor to the operation. Eight potential Control Measures were identified and assessed. One Control Measure was accepted as reasonably practicable. The accepted Control Measure was: + Define spray vessel specifications and input this information to improve vessel tracking Seven Control Measures were rejected as grossly disproportionate. Rejected Control Measures were: + Access to additional spray systems stored in Dampier + Access to additional spray systems with dispersant stored on vessels + Access to additional vessels by contracting vessels to remain on standby for chemical dispersion + Faster access to response personnel via Santos employment of local personnel in locations such as Dampier or Karratha + Santos to contract personnel from Exmouth freight and logistics to deploy and operate vessel spray systems + Access to aircraft via additional service provider + Access to additional dispersant stockpiles owned by Santos Performance Standards and Measurement Criteria that have been developed for the in effect and accepted Control Measures are shown in **Table 13-12**.
Containment and Recovery
Containment and recovery is a secondary response strategy limited to amendable scenarios at the time of a spill and when deemed environmentally beneficial by an operational NEBA (SIMA). Santos, AMOSC and AMSA equipment is available in the northwest region and within WA (including stockpiles at Karratha, Dampier and Exmouth) which includes offshore rated boom and skimmers suitable for application in response to a potential spill. Containment and recovery equipment availability is not considered a limiting factor to containment and recovery operations; the quantity of equipment available to Santos through contractual arrangements and the positioning of equipment in first strike locations is considered adequate for the scale of worst-case containment and recovery operations identified in the OPEP. The timely mobilisation of suitable vessels and personnel required for containment and recovery operations are considered to be the key constraints for this strategy. Santos has defined the specifications for containment and recovery vessels and applies this when tracking vessels. Five potential Control Measures were identified and assessed. One Control Measure was accepted as reasonably practicable. The accepted Control Measure was: - Arrangements for staff from an additional oil spill personnel provider Four Control Measures were rejected as grossly disproportionate. Rejected Control Measures were: + Purchase additional booms and ancillary equipment to be owned by Santos + Access to additional vessels by contracting vessels to remain on standby for containment and recovery + Train additional Santos personnel for spill response teams + Just-In-Time training to train personnel for spill response roles Performance Standards and Measurement Criteria that have been developed for the in effect and accepted Control Measures are shown in **Table 11-6**.
Mechanical dispersion
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 were identified. The use of mechanical dispersion in a response would be assessed as part of an operational NEBA.

ALARP assessment summary
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 12-4**.
Shoreline protection and deflection
Large quantities of various types of nearshore booms and skimmers from Exmouth, Dampier and Fremantle ensures that equipment is in place to implement this response strategy within 60-72 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 vessel. 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. Seven potential Control Measures were identified and assessed Three Control Measure were accepted as reasonably practicable. The accepted Control Measures were: + Provision for shallow draft boom tow vessels added to Master Service Agreement + Just-In-Time training to train personnel for spill response roles + Arrangements for staff from an additional oil spill personnel provider Four Control Measures were rejected as grossly disproportionate. Rejected Control Measures 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 based at strategic locations such as Dampier, Port Hedland, Karratha, Exmouth or Broome + Review of shoreline sensitivity mapping. Review of Tactical Response Plans (TRPs) and development of additional TRPs for key locations Performance Standards and Measurement Criteria that have been developed for the in-effect and accepted Control Measures are shown in **Table 14-6**.
Shoreline clean-up
Performance Standards and Measurement Criteria that have been developed for the in-effect and accepted Control Measures are shown in the OPEP. 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. Eleven additional potential Control Measures were identified and assessed. Three Control Measures were accepted as reasonably practicable. The accepted Control Measures were: + Provision for shallow draft vessels added to Master Service Agreement + Just-In-Time training to train personnel for spill response teams. + Arrangements for staff from an additional oil spill personnel provider. Eight Control Measures were rejected as grossly disproportionate. Rejected Control Measures were: + Mechanical mobile plant equipment for clean-up pre purchased and positioned at strategic locations (Dampier) + Prepurchase and storage of equipment (decontamination/ staging equipment, clean-up and flushing, PPE) at strategic locations (Dampier) + Access to additional shallow draft vessels owned by Santos WA to transport personnel to key sensitive areas on offshore islands + Access to additional team leaders that are locally based at strategic locations (Dampier) or can be mobilised within short time frames

ALARP assessment summary
+ Faster access to clean-up personnel via Perth based labour hire contractor + Faster access to clean-up personnel via locally based labour hire companies or emergency response organisations + Faster access to clean-up personnel via Santos employment of local personnel + Review of shoreline sensitivity mapping. Review of Tactical Response Plans (TRPs) and development of additional TRPs for key locations Performance Standards and Measurement Criteria that have been developed for the in effect and accepted Control Measures are shown in **Table 15-6.**
Oiled wildlife
Santos has developed the 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 as per the WA Oiled Wildlife Response Plan. Including mobilisation of AMOSC oiled wildlife equipment and industry OWR team to a forward staging area within 48 hours. AMSA also maintains an oiled wildlife washing container in Dampier. 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. Two potential Control Measures were identified and assessed. No additional Control Measures were accepted as reasonably practicable. Two Control Measures were rejected as grossly disproportionate. Rejected Control Measures were: + Pre-hire and/or prepositioning 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 16-8.**
Waste
The Santos contract with the waste service provider has provisions for waste management operations for the worst-case scenario detailed in **Table 6-5**. 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 Dampier within 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. An area of improvement is the availability of vessels required for waste transport at sea. One potential Control Measure to address this area of improvement was identified and assessed but cost was grossly disproportionate to risk. No other potential control measures were identified. Three potential Control Measures were identified and assessed. No additional Control Measures were accepted as reasonably practicable. Three potential Control Measures were rejected as grossly disproportionate: + 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 17-4**.
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.

ALARP assessment summary
Santos has determined the required vessel specifications required for Scientific Monitoring implementation and to improve accuracy of the Vessel Tracking System. Oil sampling kits have been purchased and are positioned at Varanus Is., Exmouth and Dampier. One Control Measure, the purchase and standby of scientific monitoring resources was found to be grossly disproportionate in cost in comparison to the reduction in risk. One additional potential Control Measure was identified and assessed. One Control Measure was rejected as grossly disproportionate. The rejected Control Measure was: + Scientific monitoring personnel and equipment on standby in Dampier Performance Standards and Measurement criteria that have been developed for the in effect and accepted Control Measures are shown in **Table 18-4**.

ALARP Assessment Worksheet

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
Blowout Preventer - Emergency Activation	BOP function testing	In effect	People	BOP rams pressure/function tested as per latest edition of API Standard 53 on deployment ensures timely activation of the BOP.	Provides functionality, availability, reliability, survivability, compatibility and independence.	Effort required to conduct BOP function test	**In effect**
	Access to ROV capability for BOP hot-stab intervention maintained with MODU ROV contractor throughout the activity	In effect	Equipment	Controlling flow of hydrocarbons as quickly as possible will reduce environmental impacts. BOP closed within 4-5 days.	Provides functionality, availability, reliability, survivability, compatibility and independence.	Cost of contract	**In effect**
	Dedicated BOP Intervention vessel equipped with ROV tooling package in field	Alternative	Equipment	BOP closed within 1-2 days (depending upon daylight hours available) reducing release of hydrocarbons by 2-3 days.	Provides functionality, availability, reliability, survivability, compatibility and independence.	Costs associated with having an additional dedicated BOP intervention vessel on contract $50-60K USD/day.	**Reject** Removes limitation of having to wait 2-3 days for a suitable vessel. However, the cost of having a vessel on standby is a fixed cost, regardless of if a spill were to occur or not. The time saving of 2-3 days is not proportionate to the expense incurred.
Surface Well Kill	Direct Surface Intervention Via Well Control Experts	In effect	Procedure	Reduce time taken to control source and reduce environmnetal impacts	1) Effectiveness of intervention of this type needs to be assessed at the time given that personnel safety considerations may preclude this control measure. 2) Mobilisation procedure for personnel as per SCERP. 3-4) Contracts and MoUs for well control personnel (WWC).	Ability to implement and effectiveness of this control can only be determined at the time of an incident.	**In effect** Santos has a standing agreement with Wild Well Control for call-out of well control experts. Arrangements already in place to access resources (SCERP, Contracts) but this control will be applied opportunitistically and will be dependent upon safety constraints.
Capping Stack	Capping stack is applicable as a secondary strategy for subsea wells and BOPs to be used. Santos has access to two Wild Well Control capping stacks (Singapore and Aberdeen). Singapore Capping Stack- Assembly and ready to mobilise will take approximately 6 days + 9 days to mobilise to incident (total= 15 days)	In effect	Equipment	Controlling flow of hydrocarbons as quickly as possible will reduce environmental impacts.	Provides functionality, availability, reliability, survivability, compatibility and independence. Would only be used where there is suitable vertical access over the wellhead.	Cost of contract	**In effect**
	Santos to purchase and maintain its own capping stack in Dampier	Alternative	Equipment	This is unlikely to provide any reduction in timeframes due to vessel access being the key time driver. In order for this to be effective, a suitable vessel would need to be on standby (with personnel) to realise benefit of capping stack in Dampier.	A capping stack positioned in Dampier or Karratha would need to be disassembled and stored at a suitable location as there is no suitable locations to store a fully assembled capping stack. Unpacking the containers, assembly and testing of the capping stack is estimated to take 4-5 days, but the limiting factor will be the availability of a suitable vessel.	USD20 million to procure and USD 2.8 million per year to maintain	**Reject** Given access to the capping stack is in Singapore, there is no significant benefit in having a dedicated capping stack available in Dampier. Critical path time will most likely be sourcing and the availability of a suitable vessel, which is most likely to be in SE Asia i.e. the vessel would have to be made available and mobilised to Australia for any response regardless of capping stack location. Therefore, the additional cost in owning and maintaining a dedicated stack is unlikely to provide any significant environmental benefit.

	Incentivise a vendor to set up a capping stack Dampier	Alternative	Equipment	This is unlikely to provide any reduction in timeframes due to vessel access being the key time driver. In order for this to be effective, a suitable vessel would need to be on standby (with personnel) to realise benefit of capping stack in Dampier	This would result in needing to moving an existing stack away from a shared logistics hub, such as Singapore. This could potentially affect other operators sharing this contracted resource. In addition, there is no local expertise available on standby in Dampier/Karratha to conduct maintenance or commence assembly operations if the capping stack was required.	Pay full time rental as a sole beneficiary.	**Reject** Critical time path will be sourcing and availability of a suitable vessel, which is most likely to be in SE Asia. Therefore, the additional cost in requesting a vendor to set up an existing capping stack in Singapore is unlikely to provide any significant environmental benefit.
	Purchase and maintain own capping stack and have suitable deployment vessel/crew on standby with pre - approved Safety Case to deploy capping stack	Alternative	Equipment People	Some debris removal may be required prior to Capping Stack installation. The SFRT would not be onsite until day 8-9 and then debris removal may take 1-2 days (depending on extent of damage). This option would therefore reduce Capping Stack deployment time by 4-6 days and potentially reduce volume of oil contacting sensitive receptors.	A capping stack positioned in Dampier or Karratha would need to be disassembled and stored at a suitable location as there are no suitable locations to store a fully assembled capping stack. Unpacking the containers, assembly and testing of the capping stack is estimated to take 4-5 days, but the limiting factor will be the availability of a suitable vessel. Purchasing a capping stack would also require training of personnel to maintain and install the stack, if it was required to be used. However, these personnel may not have the depth of experience that existing specialist personnel have whom are available through WWC, reducing the reliability and compatibility of this alternative.	Costs in addition to Capping Stack: purchase/ maintenance costs are $80k USD per day for vessel/crew plus training costs for personnel.	**Reject** Based on an activity of ~230 days the costs of vessel/crew hire would be in the order of $18.4M additional to Capping Stack purchase/maintenance costs and not including for mobilisation costs. Capping Stack deployment is a secondary source control strategy, is contingent on safety and technical considerations, and may not be effective in controlling the source. Given the low likelihood of a blowout event, the significant upfront costs involved and the presence of a more effective primary control strategy (relief well drilling) the costs are considered disproportionate to the level of risk reduction.
	Transport WWC capping stack via air	Alternative	Equipment	The mobilisation time of the capping stack intervention system via airfreight is unlikely to provide a reduction in mobilisation time. The capping stack would need to be mobilised and flown into Perth (3-5 days) as regional airports do not have the required unloading equipment for the containers. Following this the containers would need to be transported to Dampier via sea (preferred - 6-8 days) or road (8+ days). Therefore, this option is not expected to result in a significant environmental benefit.	Air transportation of the capping stack requires it to be disassembled, which may affect the functionality of the stack if any components are damaged. The process of disassembly, packing, transport, unpacking and reassembly introduces a risk of damage to equipment, especially the metal pressure sealing surfaces associated with the high pressure connections of capping stacks. While the metal sealing rings have the strength to withstand very high pressures, they require a very smooth sealing surface to form a pressure seal. Mechanical handling of sealing components during capping stack disassembly risks damage to the smooth sealing surfaces and could result in additional time necessary to prepare the capping stack for deployment. Individual pressure sealing equipment elements must be packed separately. Damage to sealing surfaces may render the capping stack unusable until repairs can be undertaken at a certified machine shop. Therefore, air transportation adds an element of risk to the reliability of this alternative.	Cost of contracting Boeing 747 or Antonov 124 to transport the containers to Perth.	**Reject** The risk associated with damaging equipment from airfreighting the capping stack and the minimal improvement in mobilisation time (13 days v's 15 days) is considered disproportionate to the incremental environmental benefit.

	Use of lightweight Rapid Cap to be mobilised via air from Houston, USA.	Additional	Equipment	The mobilisation time of the rapid cap would take approximately 10+ days, not resulting in any significant environmental benefit.	Airfreighting this cap in from Houston would not lead to any significant reduction in the estimated response time (10 days v's 15 days for preferred alternative of shipping Singapore stack). This is due to debris clearance taking 10+ days. Use of the Rapid Cap would only mitigate very specific cases (e.g. no debris) and industry experience indicates debris removal is likely for catastrophic failures. Although this lightweight cap only requires a lighter construction vessel with lesser specification on the crane and heave compensation, it is most likely this vessel will still need to be sourced from SE Asia.	Cost of having an additional contract for another capping stack.	**Reject** The mobilisation time of the rapid cap would take approximately 10+ days as the critical time path is likely to be debris clearance. The cost of having another contract with another equipment provider is disproportionate to the minimal environmental benefit gained.
	The location of suitable vessels (required vessel specs. and Safety Case approval) for capping stack deployment are monitored monthly.	In effect	Procedure	Timely access to a suitable vessel could reduce mobilisation times for the capping stack thus reducing volume of hydrocarbons released to the environment.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort spent monitoring	**In effect**
	Suitable Capping Stack deployment vessel is confirmed to be available prior to activity	In effect	Procedure	Timely access to a suitable vessel could reduce mobilisation times for the Capping Stack thus reducing volume of hydrocarbon released to the environment.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort spent monitoring	**In effect**
	Wild Well Control staff available via contract to assist with the mobilisation, deployment, and operation of the Capping Stack and well intervention equipment	In effect	People	Controlling flow of hydrocarbons as quickly as possible will reduce environmental impacts.	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of contract	**In effect**
	Preposition WWC Capping Stack standby crew in Perth	Additional	People	No environmental benefit as WWC personnel are available to provide support within 72 hours.	No change to effectiveness or reliability as WWC personnel available within a rapid timeframe under existing arrangements.	Significant additional costs in having WWC personnel on standby in Perth. Locating personnel with specialised expertise in Perth may also create issues for other operators, as WWC offer this service to multiple operators. Locating them in remote locations may increase travel times to other global locations if they are required.	**Reject** No environmental benefit in having access to personnel surplus to requirements

Relief well drilling	Santos Drilling and Completions Source Control Team mobilised within 24 hours. Well Control Specialists mobilised within 72 hours. Contract/ MOUs for source control personnel. APPEA MoU for mutual assistance for relief well drilling.	In effect	People	Controlling flow of hydrocarbons as quickly as possible will reduce environmental impacts.	This control measure provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; none identified	Cost of contracts/ MOUs	**In effect**
	Contract source control personnel through an alternative provider in addition to existing arrangements	Alternative	People	No environmental benefit if existing service provider is adequate to fulfil requirements.	Improved availability and reliability	Significant additional cost in maintaining two contracts for the same service	**Reject** No environmental benefit in having an additional service provider
	Wild Well Control personnel on standby in Perth during drilling operations in order to respond immediately to a LOWC	Additional	People	No environmental benefit as WWC personnel are available to provide support within 72 hours which will coincide with starting to commence sourcing of relief well MODU	No change to effectiveness or reliability as WWC personnel available within a rapid timeframe under existing arrangements.	Significant additional costs in having WWC personnel on standby in Perth. Locating personnel with specialised expertise in Perth may also create issues for other operators, as WWC offer this service to multiple operators. Locating them in remote locations may increase travel times to other global locations if they are required.	**Reject** No environmental benefit in having access to personnel surplus to requirements
	Source Control Planning and Response Guideline (DR-00-OZ-20001).	In effect	Procedure	Provides a set process to follow in the planning and mobilisation for relief well drilling by Santos WA Source Control Team thereby reducing the timeframe and increasing the effectiveness of relief well drilling.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort in updating and maintaining document	**In effect**
	MODU Capability Register is monitored monthly	In effect	Procedure	By monitoring MODU, it will be possible to gain an understanding of which MODU may be rapidly available for relief well operations. This could reduce mobilisation times for MODU thus reducing volume of hydrocarbons released to the environment.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort spent monitoring	**In effect**
	Relief well design assessment to identify and screen relief well spud locations prior to activity	In effect	Procedure	Reduce time taken to plan and execute relief well, and reduce environmental impacts.	Improved availability and reliability	Effort required to conduct relief well assessment	**In effect**

	Suitable MODU confirmed to be available prior to activity	In effect	Procedure	Identifcation of a suitable MODU prior to the activity would decrease the time spent searching for a suitable MODU in the event of a spill, reducing mobilisation times for MODU thus reducing volume of hydrocarbon released to the environment.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort spent monitoring	**In effect**
	Regular monitoring of Relief Well MODU Capability Register to ensure preferred MODU remains available throughout the activity	In effect	Procedure	Monitoring the Register will ensure Santos are aware of any changes in availability of suitable MODUs, enabling Santos to update the Source Control Plan and identify an alternative suitable MODU in the event one changes location.	Provides availability, reliability, compatibility and independence	Effort spent monitoring	**In effect**
	Relief well drilling supplies readily available in Western Australia	In effect	Equipment	Relief well drilling supplies such as casings and well head equipment could potentially reduce relief well drilling times.	Increase in availability	Cost of purchase, maintenance and storage of supplies	**In effect** Offshore D&C have access to common relief well equipment
	MODU on standby at activity location	Improved	Equipment	Reduce mobilisation times of MODU to drill relief well thus reducing hydrocarbons released to the environment. Instead of base timeframe for the drilling of a relief well of 77 days, relief well potentially could be drilled in 43 days (77 days less the 34 days required for MODU to be ready to spud/commence relief well operations).	Reduction in spill duration by 34 days, resulting in less hydrocarbon exposure and reduced shoreline loading volumes.	The cost of having a MODU contracted, crewed and holding a valid NOPSEMA Safety Case and WOMP to be on standby would cost between 200-250kUSD per day for a minimum negotiated contract term, plus a cost associated for MODU mob and de-mob. This cost would be paid regardless if there is a loss of containment or not.	**Reject** Likelihood of LOWC is considered unlikely and the cost of having a second MODU on standby at location is considered grossly disproportionate to the environmental benefit. It is anticipated a MODU would need to be brought in from overseas to guarantee availability of this rig in the event a relief well was required when the event occurred. The plug and abandonment activity has an expected duration of approximately 230 days. A relief MODU on standby cost over the same duration would be in the order 46-58M USD, depending on where the MODU were mobilised from/to and the market at the time.

	Having a dedicated relief well MODU on contract.	Improved	Equipment	Provides for rapid mobilisation of relief well rig to location, reducing duration of spill by approximately 20-30 days.	Results in improved availability, reliability and independence. Reduction in spill duration by 20-30 days, results in less hydrocarbon exposure and reduced shoreline loading volumes.	Significant commercial effort required to align two MODUs that are not contracted. Possible that market may not be able to supply this demand.	**Reject** In order to perform this, the MODU will need to be contracted, crewed and hold a valid NOPSEMA Safety Case. This could cost between 150-250k USD per day for a minimum negotiated contract term, plus a cost associated for MODU mob and de-mob. It is anticipated a MODU would need to be brought in from overseas to guarantee availability of this rig in the event a relief well was required when the event occurred. The plug and abandonment activity has an expected duration of approximately 230 days. Given there are adequate MODUs covered under the MOU to execute a relief well, this option was rejected as the reduction in risk is grossly disproportionate to the cost and effort required to perform it.
Subsea First Response Toolkit (SFRT)	AMOSC SFRT stored at Oceaneering yard in Jandakot and can be transported to Dampier. It is estimated this would take 10 hours to arrange and up to 4-5 days to load and transport to Dampier, depending on the time of the year. A suitable vessel would be acquired by Santos during this timeframe and arrive in Dampier within 7-8 days of call-out. Once the equipment is loaded, the vessel will mobilise to site and be ready to commence operations by day 8-9 from call out.	In effect	Equipment	May improve capability to perform subsequent source control measures (e.g. capping stack). Equipment needed to clean the area around the wellhead, enable intervention and prepare for relief well drilling and safe installation of a well capping or containment device.	Provides functionality, availability, reliability, survivability, compatibility and independence. Availability - whilst the SFRT takes several days to mobilise to site and conduct initial surveys, this timeframe is considered reasonable given the technical nature of this equipment.	Cost of AMOSC membership for SFRT	**In effect**
	Oceaneering personnel contracted for the deployment of the SFRT.	In effect	People	Equipment needed to clean the area around the wellhead, enable intervention and prepare for relief well drilling.	Provides functionality, availability, reliability, survivability, compatibility and independence. Area of improvement; none identified	Cost of Oceaneering contract for personnel	**In effect**
	Level 2: Suitable vessel sourced through Santos contractors. Vessel requirements outlined in Santos Source Control Planning and Response Guideline (DR-00-ZF-1001).	In effect	Equipment	Enhance subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants.	Provides functionality, availability, reliability, survivability, compatibility and independence. Area of improvement; early vessel availability	Cost of existing contracts with vessel providers	**In effect**

Source Control - Vessel Collision	Vessel Spill Response Plan (SOPEP/SMPEP)	In effect	Procedure	Provides a set process to follow in the planning and mobilisation for spill response actions by the Vessel Contractor thereby reducing the timeframe and increasing the effectiveness of spill response.	Provides functionality, availability, reliability, survivability, compatibility and independence.	Effort required in contractor procedure due diligence.	**In effect**
No alternate, additional or improved control measures identified							

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
Oil Spill Trajectory Modelling	Maintain contract with Oil Spill Trajectory Modelling service provider. The service provider will be contacted immediately (within 2 hours) upon notification of a level 2 or 3 spill. Upon activation, the service provider will provide trajectory models within: - 2 hours for OILMAP model for offshore and open ocean; - 4 hours for OILMAP operations for near-shore; and - Detailed modelling service is available for the duration of the incident.	In effect	System	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of contract	**In effect**
	Access to additional spill modelling capability through OSRL	In effect	System	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact	An additional service provider ensures redundancy (independence) if for some reason the other service provider was unable to fulfil the function. There is also the possibility of increased functionality associated with improved certainty of the modelling results if both service providers are activated.	Cost of membership	**In effect**
	Purchase of oil spill modelling system and internal personnel trained to use system	Alternative	System, people	This could result in the faster generation of the initial model which may result in an environmental benefit as a consequence of the IMT making operational decisions quicker	Potentially increases availability Decrease in functionality- in house service may not be across technical advances to same extent as contracted service providers	Purchase of system, training of personnel, and on-call roster	**Reject** The cost of purchasing the system, training and having personnel on-call is disproportionate to any potential gains from potentially being able to deliver initial results quicker than the 2 hour turn-around currently guaranteed by the service provider
Tracking buoy	Level 1: Two tracking buoys located on the MODU/LWIV ready for deployment 24/7. Tracking buoys deployed within 2 hrs.	In effect	Equipment	Tracking buoys provide real-time verification data (particularly beneficial at night and in conditions limiting aerial surveillance)	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of equipment	**In effect**
	Level 2: Two tracking buoys available from Dampier supply Base during activity. Travel time from Dampier to MEFF field is 10 hours via vessel.	In effect	Equipment	Tracking buoys provide real-time verification data (particularly beneficial at night and in conditions limiting aerial surveillance)	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of equipment	In effect

	Level 2/3: 14 tracking buoys mobilised from across Dampier, Varanus Island, Ningaloo Vision and Harriet Alpha. Mobilisation timeframe- 48-72 hrs	In effect	Equipment	Tracking buoys provide real-time verification data (particularly beneficial at night and in conditions limiting aerial surveillance)	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of equipment	In effect
	Level 2/3: tracking buoys available from AMOSC and through AMOSC Mutual Aid Mobilisation timeframe- 42-72 hrs	In effect	Equipment	Tracking buoys provide real-time verification data (particularly beneficial at night and in conditions limiting aerial surveillance)	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership	**In effect**
Aerial surveillance - aircraft and crew	Level 1: Maintain contract with service provider for dedicated aerial platform operating out of Karratha (Helicopter services available through Santos primary contracted suppliers. Wheels up within 1 hr for emergency response. Spill surveillance <6 hrs [daylight dependent]. Surveillance and recording using helicopter pilots is considered adequate for situational awareness.)	In effect	System	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation of aerial observers in initial 24 hours of incident	Cost of contract	**In effect**
	Level 2/3: Drones available via AMOSC. Mobilisation timeframe: <48 hrs	In effect	System	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact Drones may be necessary for some sensitive environments and where personnel safety is at risk.	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership	**In effect**
	Level 2/3: Drones available via OSRL.- Third Party provider Mobilisation timeframe: depending on the port of departure, 1-2 days if within Australia	In effect	System	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact Drones may be necessary for some sensitive environments and where personnel safety is at risk.	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership	**In effect**
No alternate, additional or improved control measures identified							

Aerial surveillance - observers	Level 2: Trained Santos observers will be mobilised to airbase within 24 hrs, following activation	In effect	People	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation of aerial observers in initial 24 hours of incident	Cost of training and maintaining trained staff	**In effect**
	Level 2: Access to additional aerial observers through AMOSC Staff and Industry Mutual Aid Core Group Responders	In effect	People	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of AMOSC membership	**In effect**
	Level 3 : Access to additional aerial observers through OSRL (18 people). OSRL staff initial 5 technical advisors available from 2 to 3 days of activation in Dampier, remaining personnel available from 4 to 5 days in Dampier, subject to approvals/ clearances.	In effect	People	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of OSRL membership	**In effect**
	Level 1: Ensure trained aerial observers based at strategic locations such as Karratha.	Additional	People	Current capability meets need and therefore environmental benefit would be incremental. Having trained observers living locally and on short notice to mobilise ensures trained aerial observers available from Day 2, and potentially from Day 1 (current arrangements are that the pilot would provide the initial observations and recording on Day 1).	Improved availability and reliability	Costs associated with staff employment and training	**Reject** Cost is considered disproportionate to the incremental benefit given surveillance on Day 1 by pilots is considered sufficient
Aerial surveillance - unmanned aerial vehicles	Level 2: Unmanned Aerial Vehicles for aerial surveillance available through AMOSC (UAVs and pilots can be accessed through AMOSC with a mobilisation time of <48 hrs)	In effect	Equipment	Use of UAVs may provide an environmental benefit compared to alternative options (such as helicopters and fixed wing aircraft) given shorter deployment time and ability to assess difficult areas.	Provides functionality and availability Area of improvement; none identified	Cost of membership with AMOSC	**In effect**
	Level 3: Unmanned Aerial Vehicles for aerial surveillance available through OSRL	In effect	Equipment	Use of UAVs may provide an environmental benefit compared to alternative options (such as helicopters and fixed wing aircraft) given shorter deployment time and ability to assess difficult areas.	Provides functionality and availability Area of improvement; none identified	Cost of membership with OSRL	**In effect**

No alternate, additional or improved control measures identified							
Vessel surveillance	Level 1/2: vessels in use by Santos could be used for surveillance purposes in the event of a spill.	In effect	People	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact. In comparison to aerial surveillance, vessel surveillance provides limited information.	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of existing contracts with vessel providers	**In effect**
	Level 2/3: vessels sourced through Master Service Agreement, located in region and tracked by Santos Vessel Monitoring System.	In effect	Equipment	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact. In comparison to aerial surveillance, vessel surveillance provides limited information.	Improves availability and reliability Area of improvement; none identified	Cost of vessel monitoring. Cost of contracts at the time of requirement.	**In effect**
	Level 3: vessels sourced without existing contracts from any location	In effect	Equipment	Knowledge of the spill, provided in a short-time frame, will inform the IMT decisions with the aim of reducing and mitigating environmental impact. In comparison to aerial surveillance, vessel surveillance provides limited information.	Improves availability and reliability Area of improvement; none identified	Cost of contracts at the time of requirement.	**In effect**
No alternate, additional or improved control measures identified							
Water Quality Monitoring (operational and scientific)	Maintain monitoring service provider contract for water quality monitoring services. Water quality monitoring personnel, equipment and vessel mobilised to Dampier within 72 hrs of notification.	In effect	System	This monitoring will confirm the distribution and concentration of oil, validating spill trajectory modelling and inform the IMT decisions with the aim of reducing and mitigating environmental impact	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; availability of vessels	Cost of contracts	**In effect**
	Access to additional water quality monitoring services through OSRL.	In effect	System	This monitoring will confirm the distribution and concentration of oil, validating spill trajectory modelling and inform the IMT decisions with the aim of reducing and mitigating environmental impact	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; availability of vessels	Cost of OSRL membership	**In effect**
	Required vessel specifications included in Vessel Tracking System	In effect	Procedure	Improve mobilisation time	Improved availability and reliability	Cost to maintain and operate vessel tracking system	**In effect**

	First Strike Oil sampling kits to be positioned at Exmouth, VI and Dampier. Development of technical procedure for sample collection by untrained personnel.	In effect	Equipment, procedure	Will enable Oil fingerprinting, and initial measurements of oil concentrations	Improve function, availability, survivability and compatibility	Cost of purchasing equipment and developing procedure	**In effect**
	Trained monitoring specialists in Dampier.	Additional	People	Ensure sampling is conducted correctly	Improves reliability	Costs associated with staff employment	**Reject** This is not necessary as a good procedure for sample collection is already in place.
Satellite Imagery	Maintain membership with AMOSC provider to enable access and analysis of satellite imagery.	In effect	Systems	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	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership with AMOSC	**In effect**
	Maintain membership with OSRL to enable access to and analysis of satellite imagery	In effect	System	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	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership with OSRL	**In effect**
No alternate, additional or improved control measures identified							
Wildlife Reconnaissance (aerial/ vessel surveillance. Shoreline clean-up assessment)	Maintain contract with scientific monitoring service provider for access to fauna aerial observers and personnel experienced in conducting relevant fauna surveys.	In effect	People, procedures	Wildlife reconnaissance aids the IMT to plan and make decisions for executing an oiled wildlife response and for minimising impacts to wildlife associated with the clean-up response	Provides functionality, availability and compatibility Area for improvement; availability - reduce time to mobilise personnel to strategic locations	Cost of contract	**In effect**
	Maintain a list of providers that could assist with fauna aerial observations	In effect	People	Wildlife reconnaissance aids the IMT to plan and make decisions for executing an oiled wildlife response and for minimising impacts to wildlife associated with the clean-up response	Improves availability and reliability Area of improvement; none identified	Cost of maintaining list	**In effect**
	Ensure trained marine mammal/fauna observers based in Dampier	Additional	People	Having trained marine mammal/fauna observers living locally and on short notice to mobilise would result in trained aerial observers available from Day 1	Improved availability and reliability	Costs associated with staff employment and training	**Reject** Maintaining trained fauna observers at location is considered grossly disproportionate as they are required only for the initial stages of the response until observers from scientific monitoring provider can be mobilised.
No alternate, additional or improved control measures identified							

Shoreline Assessment	Level 2: WA-based AMOSC staff and core group operations personnel (Santos WA has arrangements through AMOSC to mobilise WA-based AMOSC staff and Core Group personnel to site 24-48 hours following initiation)	In effect	People, procedures	To assist in determining which response methods are most appropriate for shorelines, it is necessary to obtain information about shoreline character, 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.	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; availability - reduce time to mobilise personnel to strategic locations	Cost of AMOSC membership	**In effect**
	Level 3: Maintain membership with OSRL to access SCAT trained responders	In effect	People, procedures	To assist in determining which response methods are most appropriate for shorelines, it is necessary to obtain information about shoreline character, 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	Provides additional functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of OSRL membership	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
Containment and recovery - booms, ancillary equipment	Level 2: Booms, ancillary equipment from Dampier/Karratha (Santos, 2*200m boom, 1 skimmer; AMSA, 6 lengths boom, 5 skimmers), Exmouth (AMOSC, 2*200m boom), Varanus Is. (Santos, 4*200m boom, 1 skimmer), Fremantle (AMOSC, 6*200m boom, 3 skimmers; AMSA, 6 boom lengths, 5 skimmers). Deployable from Varanus Is., Exmouth, Dampier, Fremantle within 24 hours. Transit times (vessel): Dampier to MEFF field = ~10 hrs Transit times (road) Fremantle to Dampier= ~24 hrs Fremantle to Exmouth = ~24 hrs Broome to Exmouth = 16 hrs	In effect	Equipment	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities.	Provides functionality, availability, reliability, survivability, compatibility and independence. Functionality is attained through access to various equipment types that may be used according to nature of hydrocarbon and metocean conditions. reliability is attained through maintenance contracts. Area of improvement; none identified.	Cost of equipment purchase and maintenance for Santos stockpile. Cost of membership, MOUs in place for AMOSC and AMSA.	**In effect**
	Level 2/3: Booms, ancillary equipment from Geelong (AMOSC, 7*200m boom, 3 skimmers). OSRL offshore booms and skimmers across worldwide base locations (Singapore, UK, Bahrain, Fort Lauderdale): 37 x Ro-boom (200m), 2 x Hi-sprint boom (300m), 100 x Ocean boom (30m); 50 x Offshore skimmers. Transit time (road/ air) Geelong or Singapore to Exmouth or Karratha/Dampier = 3–5 days	In effect	Equipment	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities.	Provides functionality, availability, reliability, survivability, compatibility and independence.	Cost of contracts, MOUs in place for AMOSC, AMSA and OSRL	**In effect**
	Purchase additional booms and ancillary equipment to be owned by Santos	Additional	Equipment	Greater capacity for containment and recovery in the initial 2-5 days of response	Improved availability and reliability	Cost of equipment purchase and maintenance	**Reject** Equipment available within rapid timeframes under current arrangements for Exmouth, Varanus Is. or Dampier deployment
Containment and recovery - liquid oil waste tanks	Liquid waste storage tanks (e.g. Isotanks) available through Santos contracted waste service provider	In effect	Equipment	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities.	Provides functionality, availability, reliability, survivability, compatibility and independence. Area of improvement; increasing the functionality of liquid waste storage tanks through decanting operations approved by DoT or AMSA.	Cost and effort in maintaining contract	**In effect**

Containment and recovery-vessels	Level 1: vessels in use by Santos and located at (or in transit to) Dampier, Ningaloo Vision, Exmouth, or Varanus Is. Suitable towing vessels mobilised to deployment port within 12 hrs. Suitable collection vessels mobilised to deployment port within 24 hrs.	In effect	Equipment	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities.	Provides functionality, availability, reliability, survivability, compatibility and independence. Area of improvement; none identified.	Cost of variation to existing contracts with vessel providers	**In effect**
	Level 2: vessels sourced through Master Service Agreement, located in region and tracked by Santos Vessel Monitoring System (IHS Maritime Portal)	In effect	Equipment	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities.	Provides survivability, compatibility and independence. Area of improvement; functionality, availability and reliability of tow vessels.	Cost of vessel monitoring systme (IHS Maritime Portal subscription). Cost of contracts at the time of requirement/ appointment.	**In effect**
	Level 3: vessels sourced without existing contracts from any location and tracked by Santos Vessel Monitoirng System (IHS Maritime Portal)	In effect	Equipment	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities.	Provides survivability, compatibility and independence. Area of improvement: none identified	Cost of vessel monitoring systme (IHS Maritime Portal subscription), cost of brokers fees. Cost of contracts at the time of requirement/ appointment.	**In effect**
	Access to additional vessels by contracting vessels to remain on standby for containment and recovery	Additional	Equipment	Greater capacity for containment and recovery in the initial 2-5 days of response	Improved availability and reliability	Cost of vessel to be on standby when not required for oil spill operations	**Reject** Santos monitors vessel availability through Santos Vessel Monitoring System. Regularly contracted vessels could be supplemented with vessels of opportunity
	Define containment and recovery vessel specifications for deployment and towing vessels and input this information to improve vessel tracking.	In effect	System	More accurate vessel tracking may lead to faster mobilisation times, potential for response operations at more locations	Improved availability and reliability.	Cost and effort to gather and input data	**In effect**
Containment and recovery-personnel	Level 2: Spill responders from Varanus Is., Devil Creek, Perth (Santos), Fremantle (AMOSC staff), Perth (AMOSC Core Group). AMOSC Staff and AMOSC Core Group mobilised to deployment port within 24 hrs.	In effect	People	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities	Provides functionality, availability, reliability, survivability, compatibility and independence. Functionality attained through training and exercises. Area of improvement; availability - rapid mobilisation of personnel.	Employment and training of Santos staff. Cost of contracts in place for AMOSC staff	**In effect**

	Level 3: Spill responders from Geelong (AMOSC staff), interstate (AMOSC Core Group, AMSA) and international (OSRL). Interstate staff available from 2 to 3 days. OSRL staff initial 5 technical advisors available from 2 to 3 days, remaining personnel available from 4 to 5 days, subject to approvals/ clearances.	In effect	People	Reduce the volume of surface hydrocarbons to reduce contact with protection priorities	Provides functionality, availability, reliability, survivability, compatibility and independence. Area of improvement; availability - rapid mobilisation of personnel.	Employment and training of Santos staff. Cost of contracts with AMOSC and OSRL, MOU in place for AMOSC Core Group	**In effect**
	Train additional Santos personnel for spill response teams	Additional	Personnel	Greater capacity for containment and recovery in the initial 2-5 days of response	Improved availability and reliability	Cost of training and staff hours	**Reject** AMSA, AMOSC, AMOSC Core Group and OSRL have sufficient numbers of personnel with the appropriate skill set
	Just-In-Time training to train personnel for spill reponse roles	Additional	Personnel	Greater capacity for containment and recovery in the later stages of response	Improved availability and realiability, lower dependence	Difficult to identify trainees with appropriate prior skill sets such as maritime experience. Concerns around adequacy of training. Supervisors of complex operations require long term experience.	**Reject** Not required to address any gap, and not feasible due to adequacy and safety concerns

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
Mechanical Dispersion	Use of vessel crews, contract vessels and vessels of opportunity to disperse small areas of amenable hydrocarbon types such as marine diesel.	In effect	People, equipment	Enhanced dispersion and biodegradation of released hydrocarbons	Provides availability, reliability, survivability, compatibility and independence. Limited functionality as mechanical dispersion is secondary response strategy limited by weather conditions, hydrocarbon type, hydrocarbon volume.	Cost of vessel time	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
Vessel based surface chemical dispersant application- spray systems	Level 2: Vessel spray systems from Exmouth (WA, 3*Afedo; AMOSC, 1*Afedo, 1*Vikospray), Dampier/ Karratha (WA, 3*Afedo; AMSA, 2*Ayles Fernie), Broome (AMOSC, 2*Afedo) Fremantle (AMOSC, 5*Afedo, 1*Global) Vessel spray system equipment mobilised to deployment port within 12 hrs. Transit times (vessel): Dampier to MEFF field = ~8 hrs Transit times (road): Fremantle to Karratha/Dampier = ~24 hrs Fremantle to Port Hedland = ~24 hrs	In effect	Equipment	Enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities. Consideration given to harmful impacts of chemical dispersants.	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; none identified	Cost of equipment purchase and maintenance Costs of membership and MOUs with AMOSC, AMSA	**In effect**
	Level 3: Vessel spray systems from Geelong (AMOSC, 3*Afedo, 3*Vikospray), Singapore (OSRL, 10*systems, additional systems stored at global stockpiles) Transit time (road/ air) Geelong or Singapore to Exmouth or Karratha/Dampier = 3–5 days	In effect	Equipment	Enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities. Consideration given to harmful impacts of chemical dispersants.	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; none identified	Costs of membership with AMOSC, OSRL	**In effect**
	Access to additional spray systems stored in Dampier	Additional	Equipment	Additional spray systems could increase encounter rate with fresh hydrocarbons	Improved availability and reliability	Additional cost for purchase and maintenance of vessel spray systems	**Reject** Spray systems are already available at this location as well as Port Hedland, Karratha, Exmouth, Broome and Fremantle. Mobilisation time for spray systems from these other locations is less than 48 hours
	Access to additional spray systems with dispersant stored on vessels	Additional	Equipment	Additional spray systems could increase encounter rate with fresh hydrocarbons	Improved availability and reliability	Additional cost for purchase and maintenance of vessel spray systems. Cost and maintenance of dispersant stock. Storage of equipment on vessels may impede vessel functionality. Storage of equipment on vessels may prevent vessels from being used by other clients. Training for vessel crew.	**Reject** Spray systems could be rapidly mobilised from Dampier and Exmouth. Vessels are multi tasked, hence there is no guarantee that the vessel with spray storage would be in the right place at the right time.

Vessel based surface chemical dispersant application-vessels	Level 1: vessels in use by WA and located at (or in transit to) Ningaloo Vision, Exmouth, Dampier or Varanus Is. Suitable Dispersant Vessels mobilised to nearest deployment port (Dampier) within 12 hrs.	In effect	Equipment	Enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities. Consideration given to harmful impacts of chemical dispersants.	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; vessel availability	Cost of existing contracts with vessel providers	**In effect**
	Level 2: vessels sourced through Master Service Agreement, located in region and tracked by WA Vessel Monitoring System	In effect	Equipment	Enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities. Consideration given to harmful impacts of chemical dispersants.	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; vessel availability	Cost of vessel monitoring. Cost of contracts at the time of requirement.	**In effect**
	Level 3: vessels sourced without existing contracts from any location	In effect	Equipment	Enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities. Consideration given to harmful impacts of chemical dispersants.	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; vessel availability	Cost of contracts at the time of requirement.	**In effect**
	Access to additional vessels by contracting vessels to remain on standby for chemical dispersion	Additional	Equipment	Additional vessels with spray systems could increase encounter rate with fresh hydrocarbons	Improved functionality, availability and reliability	Cost of vessel purchase or cost of contract to engage vessel on standby	**Reject** Cost is disproportionate to benefit. Multiple vessels in the region are tracked and could be contracted at short notice.
	Define spray vessel specifications and input this information to improve vessel tracking	In effect	System	More accurate vessel tracking may lead to faster mobilisation times could improve dispersant efficacy.	Improved functionality, availability and reliability	Cost and effort to gather and input data	**Accept**
Vessel based surface chemical dispersant application-personnel	Level 2: Spill responders from Varanus Is., Devil Creek, Perth (WA), Fremantle (AMOSC staff), Perth (AMOSC Core Group). Santos Offshore Core Group mobilised to deployment port (Dampier) within 12 hrs.	In effect	People	Enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Availability - WA access to helo services ensures that regional personnel can be quickly mobilised to the appropriate port. Area of improvement; none identified	Cost of employing and training Santos Core Group Costs of membership, MOUs with AMOSC staff and AMOSC core group personnel	**In effect**

	Level 3: Spill responders from Geelong (AMOSC staff), interstate (AMOSC Core Group; AMSA) and international (OSRL). Interstate staff available from 2 to 3 days. OSRL staff initial 5 technical advisors available from 2 to 3 days, remaining personnel available from 4 to 5 days, subject to approvals/ clearances.	In effect	People	Enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Costs of membership with OSRL	**In effect**
	Faster access to response personnel via Santos employment of local personnel in locations such as Dampier or Karratha.	Improved	People	Improve mobilisation time	Improved availability and reliability	Costs associated with personnel employment and training	**Reject** Cost of permanently employing personnel is grossly disproportionate to benefits of availability in initial 24 hours following incident. Personnel from regional facilities (Varanus Is., Devil Creek) can be quickly transported by helicopter.
	Santos to contract personnel from Exmouth freight and logistics to deploy and operate vessel spray systems	Additional	People	Improve mobilisation time	Improved availability and reliability. Skills required to mount and operate equipment and perform preliminary checks of dispersant effectiveness could be obtained through basic training.	Costs associated with increasing scope of existing contract with Exmouth Freight and Logistics. Personnel training.	**Reject** Cost is disproportionate to benefit.
Aerial based surface chemical dispersant application-aircraft	Level 2: Access to Fixed Wing Aerial Dispersant Aircraft equipment and personnel through AMOSC under contract conditions. AMOSC to mobilise Fixed Wing aircraft to nominated airbase within 12 hrs. First FWADC test spray within 48 hrs.	In effect	Equipment, people, system	Enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities. Consideration given to harmful impacts of chemical dispersants.	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement: none identified	Costs of membership with AMOSC	**In effect**
	Level 3: Access to aircraft (C130 or B727) for aerial application system through OSRL. C130 available in Karratha or Learmonth within 24 hrs.	In effect	Equipment, people, system	Enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities. Consideration given to harmful impacts of chemical dispersants.	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement: none identified	Costs of membership with OSRL	**In effect**

	Access to aircraft via additional service provider	Alternate	Equipment, people, system	Increased volume of hydrocarbons treated with chemical dispersant	Improved availability and reliability	Cost for contract with additional service provider. Potential challenges in managing safety interactions of two different service providers	**Reject** The current contracts with AMOSC and OSRL meet requirements for aerial based application based on a ramp up to 2 FWADC aircraft from 48 hours followed by additional OSRL aircraft if required, which is considered achievable based on resourcing arrangements.
Aerial based surface chemical dispersant application-personnel	Level 2: Aerial Attack Supervisor sourced by AMOSC. AMOSC to mobilise all FWADC capability personnel to nominated airbase within 48 hours.	In effect	People	Enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities. Consideration given to harmful impacts of chemical dispersants.	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Costs of membership with AMOSC and aerial service provider	**In effect**
	Level 3: Pilots, spill specialists sourced through OSRL. OSRL staff initial 5 technical advisors available from 2 to 3 days, remaining personnel available from 4 to 5 days.	In effect	People	Enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Costs of membership with OSRL	**In effect**
no additional control measures identified							
Dispersant stocks	Level 2: Dispersant stocks from Exmouth (AMOSC, $75m^3$ Slickgone NS); Dampier (AMSA, $10m^3$ Slickgone NS, $10m^3$ Slickgone EW); Broome (AMOSC, $14m^3$ Ardrox), Fremantle (AMOSC, $27m^3$ Corexit 9500, $258m^3$ Slickgone NS; AMSA, $48m^3$ Slickgone NS, $52\ m^3$ Slickgone EW). Dispersants mobilised to deployment port within 12 hrs.	In effect	Equipment	Enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Availability exceeds requirements	Costs of membership, MOUs with AMOSC, AMSA.	**In effect**

	Level 3: Dispersant stocks from other national stockpile locations (AMOSC, 137m^3) (AMSA, 255m^3). OSRL dispersant stocks available in Singapore and worldwide (50% of 732m^3 as SLA and 5000m^3 as a subscriber to the Global Dispersant Stockpile). Transit time (road/ air) Geelong or Singapore to Exmouth or Karratha/Dampier = 3–5 days UK or other OSRL bases to Karratha/Dampier = 7-10 days.	In effect	Equipment	Enhance biodegradation of hydrocarbons and reduce the impact of surface hydrocarbons on protection priorities. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified. Availability exceeds requirements	Costs of memberships, MOUs with AMOSC, AMSA, OSRL	**In effect**
	Access to additional dispersant stockpiles owned by Santos	Additional	Equipment	No additional environmental benefit if surplus to requirements	Improved availability and reliability	Additional cost for purchase and maintenance of stockpiles	**Reject** Resource Needs Analysis indicates that dispersant supplies sufficient for worst case oil treatment can be met through Australian stockpiles within required timeframes. International stockpiles also available.

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
ROV survey	ROV Survey conducted at the release point to determine the nature of the release. This information will inform the applicability of subsea chemical dispersion and initial choice of dispersant injection methods (e.g., number of nozzles, nozzle sizes) and DOR.	In effect	Procedure, equipment	SSDI can break-up oil droplets forcing greater entrainment of the oil into the water column below the sea surface. Has ability to reduce volatile organic compounds in the vicinity of a spill, making the area safer for responders. It typically requires smaller volumes of dispersant to be used as it has a higher encounter rate with the hydrocarbons than surface application.	Provides functionality, availability, reliability, survivability, compatibility and independence.	Costs associated with vessel contract	**In effect**
Subsea First Response Toolkit (SFRT) The SFRT includes debris clearance equipment and subsea dispersant equipment, including a dedicated dispersant stockpile (500 m³ of Dasic Slickgone NS) and ancillary equipment (e.g., pumps, flying leads, coiled tubing head, dispersant wands).	AMOSC SFRT stored at Oceaneering yard in Jandakot and can be transported to Dampier. It is estimated this would take 10 hours to arrange and up to 7 days to load and transport to Dampier, depending on the time of the year. A suitable vessel would be acquired by Santos during this timeframe and arrive in Dampier within 9 days of call-out. Once the equipment is loaded, the vessel will mobilise to site and be ready to commence operations by day 11-12 from call out.	In effect	Equipment	SSDI can break-up oil droplets forcing greater entrainment of the oil into the water column below the sea surface. Has ability to reduce volatile organic compounds in the vicinity of a spill, making the area safer for responders.	Provides functionality, availability, reliability, survivability, compatibility and independence. Availability - whilst the SFRT takes several days to mobilise to site and conduct initial surveys, this timeframe is considered reasonable given the technical nature of this equipment.	Cost of AMOSC membership for SFRT	**In effect**
	Purchase of Santos SFRT to be located at Exmouth or Dampier	Improved	Equipment	Reduces mobilisation time between storage and port of deployment (Dampier) by approx. 48 hrs	Improved availability however limited by vessel availability to deploy	Cost of SFRT purchase, storage and maintenance	**Reject** SFRT is estimated to arrive in Dampier only 2-3 days before vessel. Taking into account the significant costs of purchasing and maintaining a Santos-owned SFRT, an improvement of 2-3 days mobilisation time is not considered to provide a proportionate benefit.

	Relocate AMOSC SFRT to Dampier	Improved	Equipment	Reduces mobilisation time between storage and port of deployment (Dampier) by approx. 48 hrs	Improved availability however limited by vessel and personnel availability to deploy	AMOSC unable to alter storage location of SFRT as this could negatively impact other members	**Reject** Positioning of SFRT in Dampier in order to reduce deployment time was assessed but was found to be disproportionate in terms of costs to the reduction in risk gained and may adversely affect other SFRT members and their committed deployment times.
	Subsea bladder dispersant system positioned next to well site	Alternative	Equipment	Subsea dispersant bladder system can be prepositioned and operate remotely if SSDI is determined a suitable strategy via an operational NEBA. Bladder systems are positioned in framed housings next to the well site. Autonomous application could commence by Day 1-2, reducing application times by 7-8 days.	Possible improved availability and independence, however technical development and procurement would be required as existing components in the market would need to be combined to develop this system. Placing bladders adjacent to the well site exposes them to risk of damage from debris in the event of a loss of well control. Additionally, bladder systems require extensive equipment and fluid deployment/recovery operations at each wellsite, exposing personnel to significant additional HES risks. Therefore, the design and development of this technology includes a high degree of uncertainty. Subsea bladders also have limited volume capacity, meaning this alternative would offer a short term application option until SSDI arrives via the SFRT.	Purchase of bladder system on top of SFRT membership as both systems would still be required.	**Reject** Subsea bladder systems are a unproven technology and bring additional risks to the environment and personnel. In addition, the cost of having a subsea bladder system in place is a fixed cost, regardless of if a spill were to occur or not.
Subsea dispersant injection - planning	Source Control Planning and Response Guideline (DR-00-ZF-20001).	In effect	Procedure	Provides a set process top follow for the mobilisation of SFRT and suitable vessel by Santos Source Control Team thereby reducing the timeframe and increasing the effectiveness of SFRT.	Provides functionality, availability, reliability, survivability, compatibility and independence	Effort in updating and maintaining document	**In effect**
Subsea dispersant injection - vessels	Level 1: Suitable vessel sourced through Santos contractors. Vessel requirements outlined in Santos Source Control Planning and Response Guideline (DR-00-ZF-1001).	In effect	Equipment	Enhances subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; early vessel availability	Cost of existing contracts with vessel providers	**In effect**

	Level 2: Suitable vessel sourced through any regional contractors and monitored through WA Vessel Tracking System.	In effect	Equipment	Enhances subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; early vessel availability	Cost of vessel monitoring. Cost of contracts at the time of requirement.	**In effect**
	Level 3: Suitable vessel sourced as Vessels of Opportunity.	In effect	Equipment	Enhance subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; early vessel availability	Cost of contracts at the time of requirement.	**In effect**
	Enable improved vessel access by contracting a suitable, dedicated vessel on standby	Improved	Equipment	This alternative would result in SSDI commencing on Day 8-9, instead of Day 11-12 as vessel would be in Dampier on standby. Although this would treat released hydrocarbons for an additional 3 days, this would have a negligible reduction in shoreline accumulation volumes at protection priorities.	Improved availability and reliability	Costs associated with having a suitable vessel on contract and standby in Dampier - $50-60K USD/day.	**Reject** Removes bottleneck of having to wait 3 days for a suitable vessel. However, the cost of having a vessel on standby is a fixed cost, regardless of if a spill were to occur or not. The time saving of 3 days is not proportionate to the expense incurred, especially as SSDI is not anticipated to significantly reduce shoreline accumulation volumes if it were applied for an additional 3 days.
Subsea dispersant injection - personnel	Oceaneering personnel for the deployment of the SFRT	In effect	People	Enhance subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of Oceaneering contract for personnel	**In effect**
Subsea dispersant injection - dispersant stocks	Level 2: Dedicated SFRT dispersant stockpile stored with SFRT at Jandakot (AMOSC, 500m^3 Dasic Slickgone NS). Additional dispersant stocks stored at Exmouth (AMOSC, 75m^3 Slickgone NS); Dampier (AMSA, 10m^3 Slickgone NS, 10m^3 Slickgone EW); Broome (AMOSC, 14m^3 Ardrox), Fremantle (AMOSC: 8m^3 Slickgone NS, 27m^3 Corexit 9500; AMSA: 48m^3 Slickgone NS, 52m^3 Slcikgone EW). Available within 24 hours.	In effect	Equipment	Enhance subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Availability exceeds requirements	Costs of contract with AMOSC, AMSA through NatPlan	**In effect**

	Level 3: Dispersant stocks stored at other national stockpile locations (AMOSC, 137m^3) (AMSA, 255m^3). OSRL dispersant stocks available in Singapore and worldwide (50% of 732m^3 as SLA and 5000m^3 as a subscriber to the Global Dispersant Stockpile) Mobilisation times depend on location.	In effect	Equipment	Enhance subsea dispersion and biodegradation of hydrocarbons. Consideration given to harmful impacts of chemical dispersants	Provides functionality, availability, reliability, survivability, compatibility and independence Availability exceeds requirements	Costs of contracts, MOUs with AMOSC, AMSA, OSRL	**In effect**
	Access to additional dispersant stockpiles owned by Santos	Additional	Equipment	No additional environmental benefit if surplus to requirements	Improved availability and reliability	Additional cost for purchase and maintenance of stockpiles	**Reject** Analysis indicates that dispersant supplies accounted for in the OPEP are sufficient. Santos is already subscribing to OSRL stockpiles in excess of 5,000m^3.
	Rent dispersant stockpiles and place in Dampier	Additional	Equipment	No additional environmental benefit as existing dispersant stockpiles can be relocated to Dampier and dispersant manufacture can commence in a timeframe where dispersant demand does not exceed supply.	Availability already meets requirements	Additional cost for renting dispersant stockpiles	**Reject** Analysis indicates that timeframes for mobilising and relocating dispersant supplies are sufficient.
Dispersant effectiveness monitoring	To assess the effectiveness of dispersant application, Santos will use the Industry Recommended Subsea Dispersant Monitoring Plan (API, 2020) to determine the efficacy of subsea dispersant application.	In effect	Procedure	The Industry Recommended Subsea Dispersant Monitoring Plan (API, 2020) to assist in characterising the nature and extent of subsea or near surface dispersed oil, aid in the validation and accuracy of plume trajectory models and allow for rapid quantification of data to enable the IMT to make decisions about continuation of dispersant application. The IMT assesses the effectiveness of continued dispersant use against an operational NEBA assessment.	Provides functionality, availability, reliability, survivability, compatibility and independence	Cost of contracts to provide monitoring capability	**In effect**

No alternate, additional or improved control measures identified

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
Protection and deflection- booms and ancillary equipment	Level 2: Shoreline and nearshore booms plus ancillary equipment from Varanus Is. (Santos, 8*Beach Guardian, 16*25m Zoom Boom, 2*skimmer), Exmouth (AMOSC, 20*25m Beach Guardian, 20*25m Zoom Boom, 2 skimmers), Dampier (Santos, 1*skimmer; AMSA, 5* Canadyne Inflatable, 10* Structureflex Inflatable, 5* Versatech Zoom Inflatable, 2 Slickbar Solid Buoyancy, 3*Structureflex Solid Buoyancy, 30* Structureflex Land Sea), Fremantle (AMOSC, 23*35m Beach Guardian, 30*25m Zoom Boom, 18* Curtain Boom, 1*skimmer; AMSA, 15*Structureflex Inflatable, 13*Versatech Zoom Inflatable, 10*Structureflex Solid Buoyancy, 30* Structureflex Land Sea), Broome (AMOSC, various equipment). Vehicles sourced from local hire companies. Transit times (vessel): Varanus Is to Dampier = 7 hrs Varanus Is. to Exmouth = 18 hrs Transit times (road) Fremantle to Exmouth = ~24 hrs Fremantle to Karratha/Dampier = ~24 hours Fremantle to Port Hedland = ~24 hours Exmouth to Dampier/ Karratha= 7 hrs Exmouth to North West Cape = 0.5 hr.	In effect	Equipment	Reduce hydrocarbon contact with coastal protection priorities. Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; none identified	Costs associated with equipment purchase and maintenance Costs of contracts, MOUs with AMOSC and AMSA	**In effect**
	Level 3: Shoreline and nearshore booms plus ancillary equipment from Geelong (AMOSC), interstate (AMSA) and Singapore (OSRL). Transit times (road/ air) Geelong or Singapore to Exmouth or Karratha = 3–5 days. These resources in place to commence protection and deflection within 3-10 days.	In effect	Equipment	Reduce hydrocarbon contact with coastal protection priorities. Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; none identified	Costs associated with equipment purchase and maintenance Costs of contracts, MOUs Costs associated with staff training	**In effect**
	Santos to purchase additional shoreline and nearshore booms and ancillary equipment	Additional	Equipment	Enable more protection and deflection operations to occur simultaneously to protect more key areas	Improved availability and reliability	Costs associated with equipment purchase and maintenance	**Reject** Sufficient quantities of equipment located in the region.
Protection and deflection- vessels	Level 2: Shallow draft vessels in use by Santos and located at (or in transit to) Ningaloo Vision, Exmouth, Dampier or Varanus Is. Boom deployment vessel / remote island transfer vessel mobilised to FOB location/ port within 12 hrs.	In effect	Equipment	Reduce hydrocarbon contact with coastal protection priorities. Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; early vessel availability	Cost of existing contracts with vessel providers	**In effect**

	Level 2: Shallow draft vessels sourced through Master Service Agreement, located in region	In effect	Equipment	Reduce hydrocarbon contact with coastal protection priorities. Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; vessel availability	Cost of vessel monitoring. Cost of contracts at the time of requirement.	**In effect**
	Level 3: Shallow draft vessels sourced without existing contracts from any location	In effect	Equipment	Reduce hydrocarbon contact with coastal protection priorities. Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; vessel availability	Cost of contracts at the time of requirement.	**In effect**
	Maintain a list of small vessel providers for nearshore booming	In effect	Equipment	Reduce hydrocarbon contact with coastal protection priorities. Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; vessel availability	Cost of contracts at the time of requirement.	**In effect**
	Access to additional shallow draft boom tow vessels owned by Santos	Additional	Equipment	Faster response times to facilitate protection of key sensitive areas	Improved availability and reliability	Costs of vessel purchase and maintenance	**Reject** High numbers of shallow draft vessels located in the region. One vessel can help to set boom at multiple locations.
	Provision for shallow draft boom tow vessels added to Master Service Agreement	Improved	Equipment	Reduce time required to source vessels and crew in initial phase of response. Improve mobilisation time, potential for response operations at more locations	Improved availability and reliability	Time involved in providing vessel specifications and liaising with existing suppliers	**Accept**
Protection and deflection- personnel	Level 2: Spill responders from Varanus Is., Devil Creek, Perth (Santos), Fremantle (AMOSC), Perth (AMOSC Core Group). Santos Offshore Core Group mobilised to Exmouth within 12 hrs. AMOSC Staff and Industry Core Group mobilised to FOB within 24 hrs.	In effect	Personnel	Reduce hydrocarbon contact with coastal protection priorities Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Availability - Santos access to helo services ensures that regional personnel can be quickly mobilised to the appropriate location. Area for improvement; none identified	Costs of contracts, MOUs with AMOSC, AMSA Costs associated with staff training	**In effect**

	Level 3: Spill responders from Geelong (AMOSC staff, 11 people), interstate (AMOSC Core Group, up to 84 people; AMSA, unspecified) and international (OSRL, 18 people). Interstate staff available from 2 to 3 days. OSRL staff initial 5 technical advisors available from 2 to 3 days, remaining personnel available from 4 to 5 days, subject to approvals/ clearances.	In effect	Personnel	Reduce hydrocarbon contact with coastal protection priorities Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement; none identified	Costs of contracts, MOUs with AMOSC, AMSA, OSRL Costs associated with staff training	**In effect**
	Ensure trained personnel based at strategic locations such as Dampier, Port Hedland, Broome, Karratha or Exmouth	Improved	Personnel	Faster response times to facilitate protection of key sensitive areas	Improved availability and reliability	Costs associated with staff employment and training	**Reject** No Santos personnel currently based at Port Hedland, Broome, Karratha or Exmouth so employment costs would be significant and not justified given that helicopters enable rapid transportation of Santos staff within the region. In addition, trained personnel from existing locations would be able to reach protection priorities in adequate time to conduct pre-impact protection tactics.
	Just- In- Time training to train personnel for spill response roles	Additional	Personnel	Greater capacity for protection and deflection in the later stages of response	Improved availability and reliability, lower dependence	High cost of training at time of requirement. It may be difficult to identify trainees with appropriate prior skill sets such as maritime experience.	**Accept** IMT has scope to evaluate and implement training if required. Creates a contingency plan to access trained personnel in numbers above the expected requirement
	Arrangements for staff from an additional oil spill personnel provider	Additional	Personnel	Greater capacity for protection and deflection in the later stages of response	Improved availability and reliability, lower dependence	Time and cost of management	**Accept** The Response Group will increase available numbers of personnel with the appropriate experience and skill set
Protection and deflection- planning	Ningaloo Coast shoreline sensitivity and access data/maps and TPRs	In effect	Procedures	Reduce hydrocarbon contact with coastal protection priorities Consideration given to harmful impacts of boom, vessels, vehicles and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence	Cost of document preparation and maintenance	**In effect**
	Review of shoreline sensitivity mapping. Review of Tactical Response Plans (TRPs) and development of additional TRPs for key locations	Improved, additional	Procedures	Improved level of response planning to streamline resourcing and logistics and effect a better response	Improved functionality	Cost involved in revision of sensitivity mapping and tactical response plans and preparation of additional tactical response plans	**Reject** Current maps/plans are adequate to initiate an effective response. Plans will have to be reassessed at the time of the incident, to take into account variables such as weather and tides.

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
Shoreline Clean-up - equipment	Level 1: Manual clean-up equipment from local hardware outlets. Decontamination/staging equipment from Exmouth (AMOSC, 1*decon station). Mobile plant from local hire companies. PPE from Exmouth (Santos WA, 1*container). Clean-up equipment mobilised to location within 12 hrs.	In effect	Equipment	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology.	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation of equipment in initial 48 hours of incident	Cost of equipment purchase and hire at the time of incident Cost of membership with AMOSC	**In effect**
	Level 2: Manual clean-up and flushing equipment from Varanus Is. (Santos WA, 1*container), Fremantle (AMOSC, 1*shoreline support kit and 1*flushing kit) and state hardware outlets. Decontamination/staging equipment from Karratha (AMSA; 2*decon stations) and Fremantle (AMOSC, 1*decon station; AMSA, 2* decon stations). Mobile plant from state hire companies. PPE from Dampier and Varanus Is (Santos WA, 2*containers) and Fremantle (AMOSC, 1*container, 2*gas detectors). Transit times (vessel): Varanus Is. to Dampier = 7 hrs Varanus Is. to Exmouth = 18 hrs Transit times (road) Fremantle to Dampier = 24 hrs Exmouth to Dampier/ Karratha = 7 hrs Resources in place to commence shoreline clean-up within 1–3 days	In effect	Equipment	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology.	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - procurement and mobilisation of equipment	Cost of equipment purchase and hire at the time of incident Cost of equipment purchase and maintenance Cost of membership with AMOSC	**In effect**
	Level 3: Manual clean-up and flushing equipment from Geelong (AMOSC, 1*shoreline support kit, 1* flushing kit, 1*shoreline impact lance kit), Singapore (OSRL) and national hardware outlets. Decontamination/ staging equipment from Geelong (AMOSC, 1*decon station). Mobile plant sourced from national hire companies. PPE from Geelong (AMOSC, 1*container, 7*gas detectors). Transit time (road/ air) Geelong or Singapore to Exmouth or Karratha = 3–5 days	In effect	Equipment	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - procurement and mobilisation of equipment	Cost of equipment purchase and hire at the time of incident Cost of equipment purchase and maintenance Cost of memberships with AMOSC and OSRL	**In effect**

	Mechanical mobile plant equipment for clean-up pre purchased and positioned at strategic locations (Dampier)	Additional	Equipment	Environmental benefits and impacts are dependant on hydrocarbon fate and local ecology. Reduced mobilisation times and improved access would assist, should mobile plant be deemed advantageous	Improved availability and reliability	Costs associated with equipment purchase and maintenance	**Reject** There is a high likelihood that mobile plant equipment is not used due to negative environmental impacts, leaving purchased equipment unutilised and costs disproportionate. Locally available hire plant can be used. Additional plant could be purchased and mobilised from Perth if required.
	Prepurchase and storage of equipment (decontamination/ staging equipment, clean-up and flushing, PPE) at strategic locations (Dampier)	Additional	Equipment	Improve mobilisation time, potential for more response locations	Improved availability and reliability	Cost in purchase and maintenance of equipment	**Reject** Equipment for first strike available at Exmouth. Additional equipment can be mobilised to Exmouth in less than 24 hours.
Shoreline Clean-up - vessels	Level 1: Shallow draft vessels in use by Santos and located at (or in transit to) Ningaloo Vision, Exmouth, Dampier or Varanus Is. Remote island transfer vessel mobilised to FOB location/ port within 12 hrs.	In effect	Equipment	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; early vessel availability	Cost of existing contracts with vessel providers	**In effect**
	Level 2: Shallow draft vessels sourced through Master Service Agreement, located in region and tracked by Santos WA Vessel Monitoring System	In effect	Equipment	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; vessel availability	Cost of vessel monitoring. Cost of contracts at the time of requirement.	**In effect**
	Level 3: Shallow draft vessels sourced without existing contracts from any location	In effect	Equipment	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; vessel availability	Cost of contracts at the time of requirement.	**In effect**
	Access to additional shallow draft vessels owned by Santos WA to transport personnel to key sensitive areas on offshore islands	Additional	Equipment	Faster response times to facilitate protection of key sensitive areas on offshore islands	Improved availability and reliability	Costs of vessel purchase and maintenance	**Reject** High numbers of shallow draft vessels located in the region. One vessel can help to set boom at multiple locations.
	Provision for shallow draft vessels added to Master Service Agreement	Improved	Equipment	Reduce time required to source vessels and crew in initial phase of response. Improve mobilisation time, potential for response operations at more locations	Improved availability and reliability.	Time involved in providing vessel specifications and liaising with existing suppliers	**Accept**

Shoreline Clean-up - personnel	Level 2: Clean-up team leaders from Varanus Is., Devil Creek, Perth (Santos WA), Fremantle (AMOSC staff), Perth (AMOSC Core Group). Santos Offshore Core Group mobilised to Exmouth within 12 hrs. AMOSC Staff and Industry Core Group mobilised to FOB within 24 hrs.	In effect	People	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation of personnel in initial 48 hours of incident	Costs associated with staff training. Costs of membership, MoU with AMOSC, AMSA through NatPlan.	**In effect**
	Level 3: Clean-up team leaders from Geelong (AMOSC staff), interstate (AMOSC Core Group; AMSA) and international (OSRL). Interstate staff available from 2 to 3 days. OSRL available from 2 to 3 days, remaining personnel available from 4 to 5 days, subject to approvals/ clearances.	In effect	People	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation of personnel	Costs associated with staff training Costs of membership, MoUs with AMOSC, AMSA	**In effect**
	Access to additional team leaders that are locally based at strategic locations (Dampier) or can be mobilised within short time frames.	Additional	People	Improve mobilisation time, potential for more response locations.	Improved availability and reliability.	Cost of employment and training of staff Cost of being locally based or on a rapid mobilisation plan	**Reject** Santos WA already employs trained oil spill responders in the region that can be mobilised to key areas by helicopter within short time frames.
	Clean-up labour personnel predominantly based in Perth.	In effect	People	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation of personnel in initial 48 hours of incident	Costs of labour hire through existing service provider	**In effect**
	Faster access to clean-up personnel via Perth based labour hire contractor	Improved	People	Improve mobilisation time, potential for response operations at more locations	Improved availability and reliability	Not feasible to mobilise labour hire personnel in less than 72 hours	**Reject** Not required as shoreline contact times are >8 days and accumulation volumes would be able to be met by AMOSC Core Group personnel and mutual aid (if required).
	Faster access to clean-up personnel via locally based labour hire companies or emergency response organisations	Improved	People	Improve mobilisation time, potential for response operations at more locations	Improved availability and reliability	No identified regional labour hire companies	**Reject** Not required as shoreline contact times are >8 days and accumulation volumes would be able to be met by AMOSC Core Group personnel and mutual aid (if required).

	Faster access to clean-up personnel via Santos employment of local personnel	Improved	People	Improve mobilisation time, potential for response operations at more locations	Improved availability and reliability	Costs associated with personnel employment and training	**Reject** Cost of permanently employing personnel is grossly disproportionate to benefits of availability in initial phase of response. In addition, shoreline contact times are >8 days and clean-up activities would be able to be met by AMOSC Core Group personnel and mutual aid (if required).
	Just- In- Time training to train personnel for spill response roles	Additional	Personnel	Greater capacity for shoreline clean-up in the later stages of response	Improved availability and reliability, lower dependence	High cost of training at time of requirement. Extended period prior to minimum shoreline contact provide window of opportunity to train workforce Trainees require minimal prior skills and will be easily sourced.	**Accept** A contingency to create a pool of trained personnel in the early stages of a response in numbers above the expected requirement.
	Arrangements for staff from an additional oil spill personnel provider	Additional	Personnel	Greater capacity for shoreline clean-up in the later stages of response	Improved availability and reliability, lower dependence	Time and cost of management	**Accept** The Response Group will increase available numbers of personnel with the appropriate experience and skill set
Shoreline Clean-up - planning	Shoreline sensitivity mapping and Tactical Response Plans	In effect	Procedures	Remove stranded hydrocarbons from shorelines in order to reduce impact on coastal protection priorities and facilitate habitat recovery. Consideration given to negative impacts of equipment and personnel on sensitive coastal ecology	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation in initial 48 hours of incident	Cost associated with development and maintenance of mapping and Tactical Response Plans	**In effect**
	Review of shoreline sensitivity mapping. Review of Tactical Response Plans (TRPs) and development of additional TRPs for key locations	Improved, additional	Procedures	Improved level of response planning to streamline resourcing and logistics and effect a better response	Improved functionality	Cost involved in revision of sensitivity mapping and tactical response plans and preparation of additional tactical response plans	**Reject** Current maps/plans are adequate to initiate an effective response. Plans will have to be reassessed at the time of the incident, to take into account variables such as weather and tides.
Shoreline Clean-up response	Prioritise use of existing roads and tracks	In effect	Procedures	Reduced environmental impact as a result of shoreline access activities, improve response time and efficiency			**In effect**
	Soil profile assessment prior to earthworks	In effect	Procedures	Improved baseline information for shoreline condition			**In effect**
	Pre-cleaning and inspection of equipment (quarintine)	In effect	Procedures	Reduced potential for contaminating environment during response activities			**In effect**
	Use of Heritage Advisor if spill response activities overlap with potential areas of cultural significance	In effect	Procedures	Improved capacity to respond appropriately to areas of potential cultural significance			**In effect**

	Select temporary base camps in consultation with DoT and DBCA	In effect	Procedures	Optimise response based on camp location, reduce environmental impact of camps			**In effect**
	OSR Team Leader assessment/selection of vehicle appropriate to shoreline conditions	In effect	Procedures	Improved response efficiency			**In effect**
	Establish demarcation zones for vehicle and personnel movement considering sensitive vegetation, bird nesting/roosting areas and turtle nesting habitat.	In effect	Procedures	Reduced environmental impact as a result of shoreline access activities			**In effect**
	Operational restriction of vehicle and personnel movement to limit erosion and compaction	In effect	Procedures	Reduced environmental impact as a result of shoreline access activities			**In effect**
	Stakeholder consultation	In effect	Procedures				**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
Oiled wildlife response - planning	Implementation of the Western Australian Oiled Wildlife Response Plan (WAOWRP) and the WA OWR Manual	In effect	Procedure	Working within the guidelines of the WAOWRP and WA OWR Manual will ensure a coordinated response and that the expectations of the Control Agency are met with the overall aim to increase the likelihood of success of the OWR (success in terms of wildlife survivorship and rates for release back into the wild).	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement- framework for how Santos will integrate with Control Agencies for OWR	Effort and time involved in developing OWR implementation plan within OPEP based on guidance from WAOWRP and WA OWR Plan	**In effect**
	Santos Oiled Wildlife Response Framework Plan (SO-91-BI-20014) which sets the corporate guidance for OWR preparedness and response and defines how Santos will integrate with Control Agencies to provide a coordinated response	In effect	Procedure	The Santos Oiled Wildlife Response Framework Plan (SO-91-BI-20014) is complementary to the WAOWRP and the WA OWR Manual and facilitates a rapid coordinated response, and the provision of resources by Santos in order to increase the likelihood of success of the OWR.	Improved functionality and reliability.	Cost of document development and maintenance	**In effect**
Oiled wildlife response - equipment	Level 2 OWR kits and containers available from AMOSC, AMSA, DBCA or DoT in Exmouth, Darwin, Broome, Karratha, or Fremantle. WA equipment (OWR containers) mobilised to Exmouth region within 24 hrs.	In effect	Equipment	Timely access to appropriate equipment is needed for the effective treatment of wildlife in order to increase the likelihood of success of the OWR	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership with AMOSC	**In effect**
	Level 3 OWR equipment available from OSRL. Transit times (road/ air) Singapore to Karratha = 3–5 days.	In effect	Equipment	Appropriate equipment is needed for the effective treatment of wildlife in order to increase the likelihood of success of the OWR	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership with OSRL	**In effect**
No alternate, additional or improved control measures identified							
Oiled wildlife response - personnel	Level 2 Santos personnel trained in OWR (AMOSC/DBCA training). OWR trained personnel mobilised to Exmouth region within 24 hrs.	In effect	People	Timely access to skilled personnel will enhance the likelihood of success of an OWR.	Provides functionality, availability, reliability, survivability, compatibility and independence. Area of improvement; ensure personnel are based not just in the Perth Office but also at VI and DC facilities.	Cost of training and maintaining training	**In effect**
	Level 2 OWR personnel from AMOSC, AMOSC-activated Wildlife Response contractors, and Industry Mutual Aid. Mobilisation of OWR personnel to site will start to occur in 24-48 hours following notification of actual or imminent impact to wildlife.	In effect	People	Timely access to skilled personnel will enhance the likelihood of success of an OWR.	Provides functionality, availability, reliability, survivability, compatibility and independence Area for improvement - availability - rapid mobilisation of personnel in initial 48 hours of incident	Cost of membership with AMOSC	**In effect**
	Level 3 OWR personnel available through OSRL. OSRL staff initial 5 technical advisors available from 2 to 3 days, remaining personnel available from 4 to 5 days, subject to approvals/ clearances.	In effect	People	Access to skilled personnel will enhance the likelihood of success of an OWR.	Provides functionality, availability, reliability, survivability, compatibility and independence Area of improvement; none identified	Cost of membership with OSRL	**In effect**

	Maintain labour hire arrangements for access to untrained personnel. Untrained personnel accessed through labour-hire arrangements would receive an induction, on-the-job training and work under the supervision of an experienced supervisor.	In effect	People	During a large scale OWR the ability to access large numbers of personnel through labour hire arrangements is imperative in terms of capability for conducting an OWR.	Provides functionality, availability, reliability, survivability, compatibility and independence	Cost of labour hire at time of incident	**In effect**
	Maintain personnel trained in OWR and positioned at VI and Perth	Additional	People	Personnel trained in OWR and whom are located at facilities will enhance the first strike capability of Santos and therefore enhance the likelihood of success of the OWR, particularly for those instances where oil is ashore within 48 hours.	Improved functionality, availability, reliability and independence.	Cost of training staff	**In effect**
	Prehire and/or prepositioning of staging areas and responders	Additional	System	This may enhance response times and first strike capability and hence improve the likelihood of success of the OWR. Conversely, prepositioned personnel and staging areas may result in negative impacts to the environment and wildlife.	Improved functionality, availability, reliability and independence.	Additional wildlife resources could total $1,500 per operational site per day. This is a guaranteed cost regardless of whether a spill occurs or not.	**Reject** The cost of setting up staging areas and having responders on standby is considered disproportionate to the environmental benefit gained. Further, prepositioned personnel and staging sites may have negative impacts on the environment and wildlife. The overall OWR capability Santos can access through Santos staff, AMOSC, AMOSC mutual aid, Santos labour force hire arrangements, DBCA and wildlife carer network are considered adequate, with further advice and international resources available through OSRL.
	Direct contracts with service providers	Alternative	System	This option duplicates the capability accessed through AMOSC and OSRL and would compete for the same resources without providing a significant environmental benefit.	Does not improve effectiveness	Cost of contract	**Reject** This option is not adopted as the existing capability meets the need.

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcome	Effectiveness	Feasibility	Accept/ Reject
Waste Management	Waste management sourced through contract with waste service provider. Contract with waste service provider to be maintained and periodically reviewed. Waste service provider waste receptacles mobilised within 24 hrs of activation for containment and recovery, protection and deflection and shoreline clean-up response strategies, respectively.	In effect	System	Timely and efficient handling of waste will reduce environmental impacts of waste and waste management. Consideration given to risks of secondary contamination.	Provides functionality, availability, reliability, survivability, compatibility and independence. Area of improvement; none identified	Cost of contract	**In effect**
	Maintain contracts with multiple service providers	Additional	System	Contract with additional waste service provider will not provide an additional environmental benefit as there are two major service providers in the region and reciprocal arrangements facilitate access to equipment of both.	Provides functionality, availability, reliability, survivability, compatibility and independence.	Significant additional cost in maintaining two contracts for the same service	**Reject**
	Temporary waste storage capacity available through waste service provider, AMOSC, AMSA, OSRL stockpiles	In effect	Equipment	Timely and efficient handling of waste will reduce environmental impacts of waste and waste management. Consideration given to risks of secondary contamination.	Provides functionality, availability, reliability, survivability, compatibility and independence. Area of improvement; none identified	Costs of contracts, MOU with waste service provider, AMOSC, AMSA and OSRL	**In effect**
	Procure temporary waste storage for Santos stockpile	Additional	Equipment	Additional storage available if required. Tanks may be stored in geographic locations that may reduce mobilisation times and allow faster collection and storage of waste. Additional storage may facilitate continuous collection operations to occur.	Provides functionality, availability, reliability, survivability, compatibility and independence	Additional cost in purchase and maintenance of tanks	**Reject** Purchasing this equipment for Santos stockpile is surplus to Santos requirements as AMOSC, AMSA and OSRL provides this equipment in strategic locations. Reduced mobilisation time is not an advantage, as waste storage can be mobilised at the same time as collection response strategies, and no waste needs to be stored prior to collection commenced.
	Vessels for waste transport through Santos contracted providers.	In effect	Equipment	Timely and efficient handling of waste will reduce environmental impacts of waste and waste management. Consideration given to risks of secondary contamination.	Provides functionality, availability, reliability, survivability and compatibility. Area of improvement; dependence and availability of vessels.	Contract with vessel contractors to be maintained and periodically reviewed.	**In effect**

	Contract additional vessels on standby for waste transport	Additional	Equipment	Reduce delays in transportation of waste in the initial 2-5 days of response	Provides functionality, availability, reliability, survivability, compatibility and dependence	Cost in contracting vessels to remain on standby for incident waste requirements	**Reject** Expense of maintaining vessels on standby that are surplus to day to day requirements is disproportionate to environmental benefit. Santos is accustomed to coordinating logistics for tasks around finite resources. Santos monitors vessel availability through Santos Vessel Tracking System. Regularly contracted vessels could be supplemented with vessels of opportunity.
	Vessel to vessel waste transfer plan to be developed in line with the waste transfer concept of opertations (defined in 7710-650-ERP-0001). Plan to give details of waste storage requirements and procedures.	In effect	Procedure	Allows effective use of available vessels and minimises vessel decontamination requirements	Provides functionality, availability, reliability, survivability, compatibility and independence.	Cost of documentation development, implementation, maintenance and exercising	**In effect**
	Decanting oily water, by returning into boomed area, to be undertaken subject to necessary approvals from AMSA or DoT	In effect	System, Procedure	Allows more effective handling, transportation and disposal of concentrated wastes	Provides functionality, availability, reliability, survivability, compatibility and independence.	Effort to obtain and adhere to approvals	**In effect**

Strategy	Control Measure	Alternative, Additional, Improved	Control Measure Category	Environmental Outcomes	Effectiveness	Feasibility	Accept/ Reject
Scientific Monitoring - monitoring service provider and equipment	Maintenance of Monitoring Service Provider contract for scientific monitoring services and annual review of standby manual. SMP provider and monitoring equipment mobilised to site within 72 hrs of activation.	In effect	System	This is the main tool for determining the extent, severity and persistence of environmental impacts from an oil spill and allows operators to determine whether their environmental protection outcomes have been met (via scientific monitoring activities). It is used to inform areas requiring rehabilitation. This strategy also evaluates the recovery from the spill.	Provides functionality, availability, reliability, survivability, compatibility and independence Area of potential improvement; none identified	Cost of contract with Scientific Monitoring Service Provider	**In effect**
	Regular capability reports from Monitoring Service Provider shows personnel availability and annual reviews of standby manual	In effect	System	This ensures the Monitoring Service Provider has the capability to undertake Scientific Monitoring, including, post-spill pre-impact surveys within the EMBA of receptors with deficient baseline data.	Improves functionality, availability and reliability	Cost of contract with Scientific Monitoring Service Provider	**In effect**
	Conduct periodical review of existing baseline data sources across the Santos combined EMBA	In effect	System	This ensures that receptors within the EMBA with deficient baseline data are identified.	Improves functionality and provides compatibility	Cost of contract with Scientific Monitoring Service Provider	**In effect**
	Oil sampling kits for scientific monitoring personnel positioned at Varanus Is., Exmouth and Dampier	Improved	Equipment	Improve response time	Improved availability and reliability	Cost associated with purchase of equipment and maintenance	**In effect**
No alternate, additional or improved control measures identified							
Scientific Monitoring - vessels	Level 2: Vessels sourced through Master Service Agreement, located in region and tracked by Santos Vessel Monitoring System. Santos to mobilise monitoring vessels to deployment location within 72 hrs.	In effect	Equipment	Improve response time	Provides availability and reliability	Effort associated with maintaining MSA	**In effect**

	Level 3: Vessels sourced without existing contracts from any location	In effect	Equipment	Provision of vessels to support monitoring programs	Provides survivability, compatibility and independence. Area of improvement; functionality, availability and reliability of tow vessels.	Cost of contracts at the time of requirement.	**In effect**
	Required vessel specifications included in Vessel Tracking System	In effect	Procedure	Improve mobilisation time	Improved availability and reliability	Cost to maintain and operate vessel tracking system	**In effect**
No alternate, additional or improved control measures identified							
Scientific monitoring - personnel	Scientific monitoring personnel and equipment on standby at Dampier	Additional	Personnel, equipment	Improve mobilisation time	Improved availability and reliability	The cost of training and employing dedicated pre-positioned monitoring personnel is disproportionate to the potential benefit	**Reject** Cost of permanently employing personnel is grossly disproportionate to benefits of availability in initial phase of response.

Appendix C Pollution Report

Department of
Transport

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: ________________

ADDITIONAL INFORMATION

Response action undertaken? ☐ Yes ☐ No If yes, provide details below, please include any environmental impact.

Equipment used? ☐ AMSA ☐ State / NT ☐ Industry

Is assistance for an investigation required from DoT ◯ Yes ◯ No

ORIGINAL REPORT SOURCE

Name:__________ Position:__________ Phone: __________

Combat agency:__________ Statutory agency: __________

SENDER DETAILS

Name:__________ Agency:__________ Date:__________

Phone: __________ Fax: __________ Email:__________

PRIVACY STATEMENT

The Department of Transport is collecting the information on this form to enable it to carry out its role as Jurisdictional Authority as per WestPlan - Marine Oil Pollution. The Department of Transport and/or AMSA may give some or all of this information to other government bodies, non-government organisations who have responsibilities under the National Plan, and law enforcement agencies.

Once you have completed the form please check that all relevant fields have been filled with accurate data.
Please email completed form to marine.pollution@transport.wa.gov.au

Appendix D Situation Report

Department of **Transport**

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:	

To post the form please click on the "POST" button below

POST

RESET

MEP_Sitrep_1114

Appendix E Vessel Surveillance Observer Log

Santos

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

Santos

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)

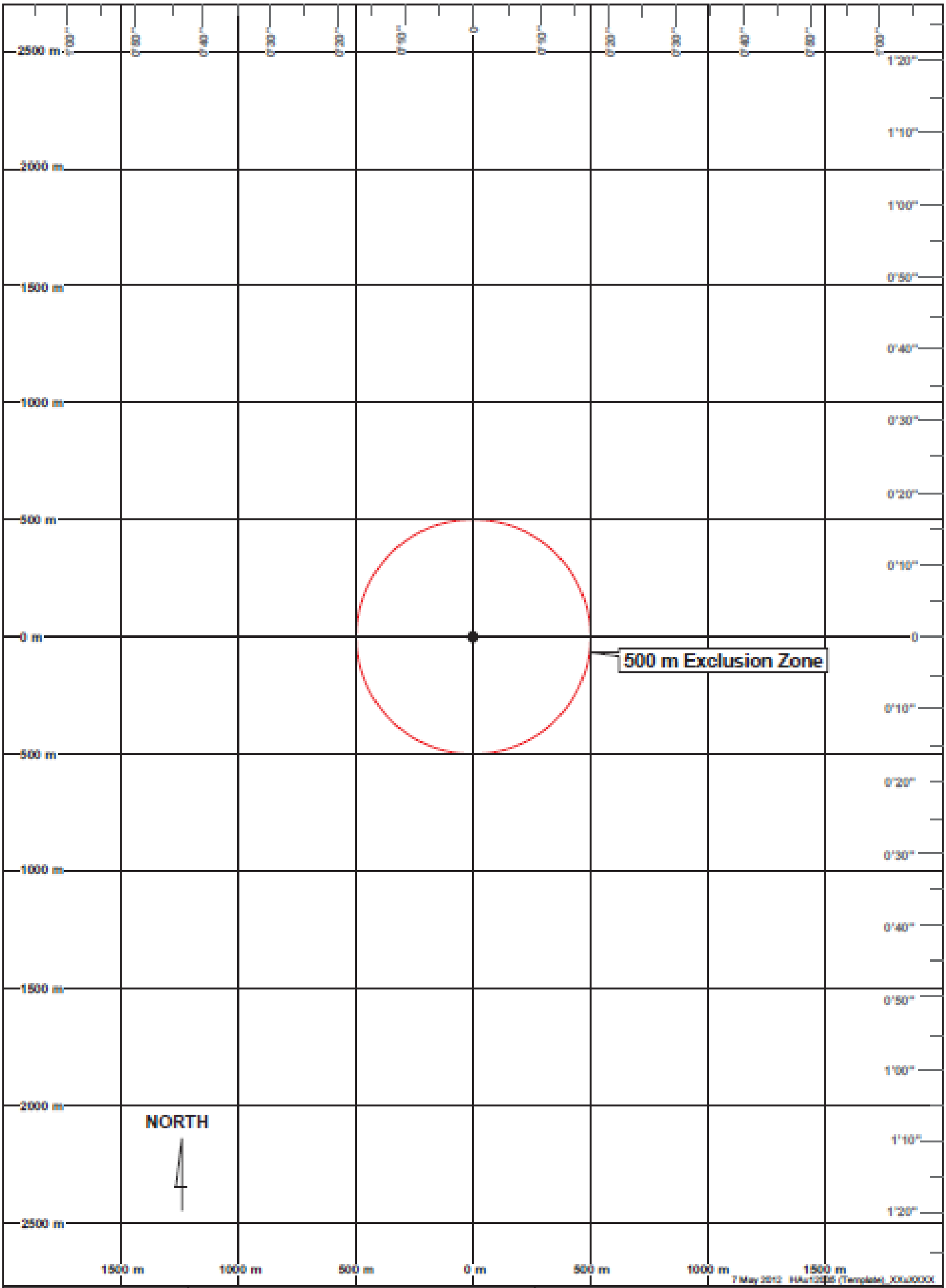
Santos

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



	NAME:	**VESSEL / AIRCRAFT:**
	DATE / HOUR:	**OTHER REFERENCE:**

Appendix H Aerial Surveillance Marine Fauna Sighting Record

Santos

OIL SPILL SURVIELLANCE - MARINE FAUNA SIGHTING RECORD SHEET

Date:		**Time:**	
Latitude:		**Longitude:**	

MARINE FAUNA ID GUIDE


○ Humpback whale


○ Blue whale


○ Minke whale


○ Sperm whale


○ Killer whale


○ Bryde's whale

○ Whale species unknown


○ Bottlenose dolphin


○ Spinner dolphin

○ Dolphin species unknown


○ Whale shark


○ Dugong


○ Hawksbill turtle


○ Loggerhead turtle


○ Green turtle


○ Flatback turtle


○ Leatherback turtle

○ Turtle species unknown

Santos

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					

Santos

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					
	Rocky Cliffs		Boulder and cobble beaches		Sheltered tidal flats
	Exposed artificial structures		Riprap		Mixed sand and gravel beaches
	Inter-tidal platforms		Exposed tidal flats		Fine-Medium sand grained beaches
	Mangroves		Sheltered rocky shores		Other
	Wetlands		Sheltered artificial structures		

Operational Features (tick appropriate box)					
	Direct backshore access		Alongshore access		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	- 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	- 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	- 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	- 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	- 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)	- 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	- 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	- 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.

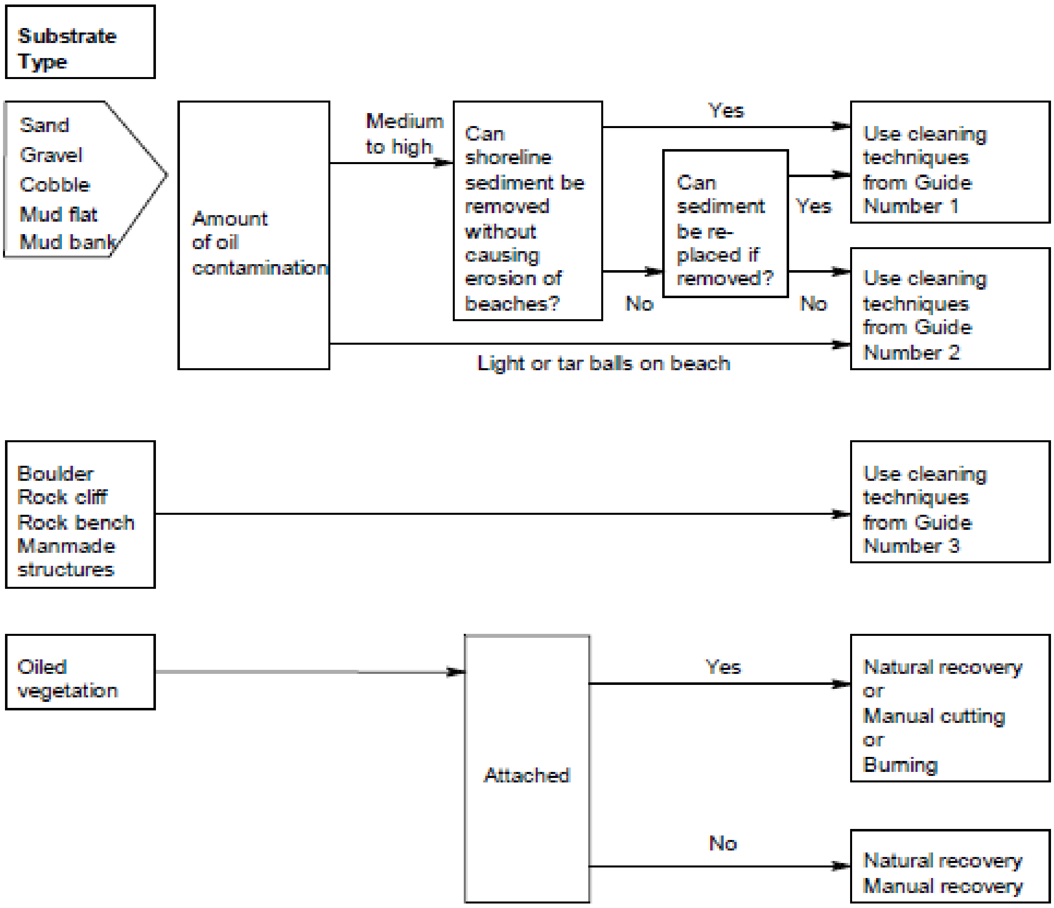


Figure K-1: Shoreline Clean-up Master Decision Guide

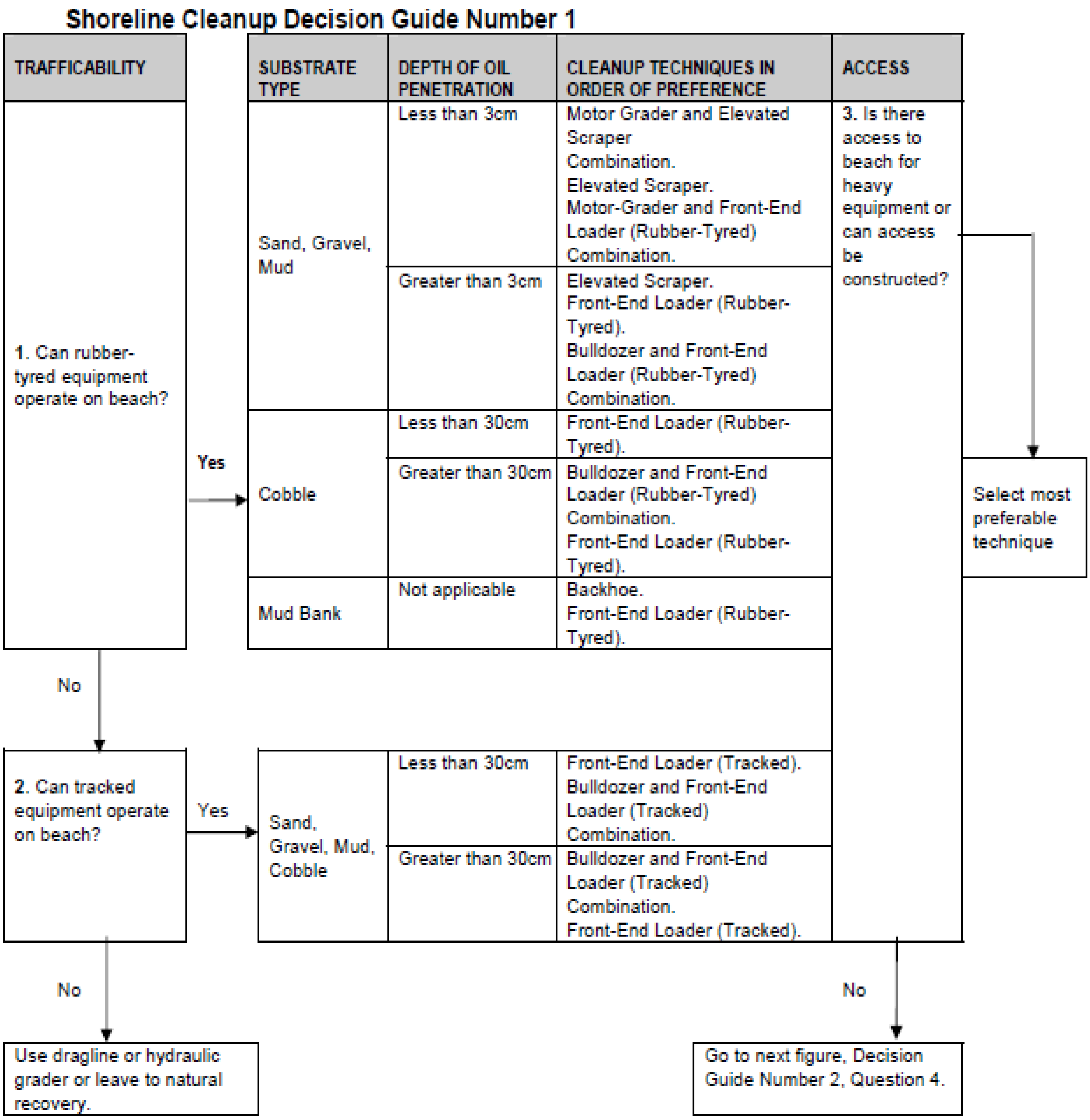


Figure K-2: Shoreline Clean-Up Decision Guide 1

Shoreline Cleanup Decision Guide Number 2

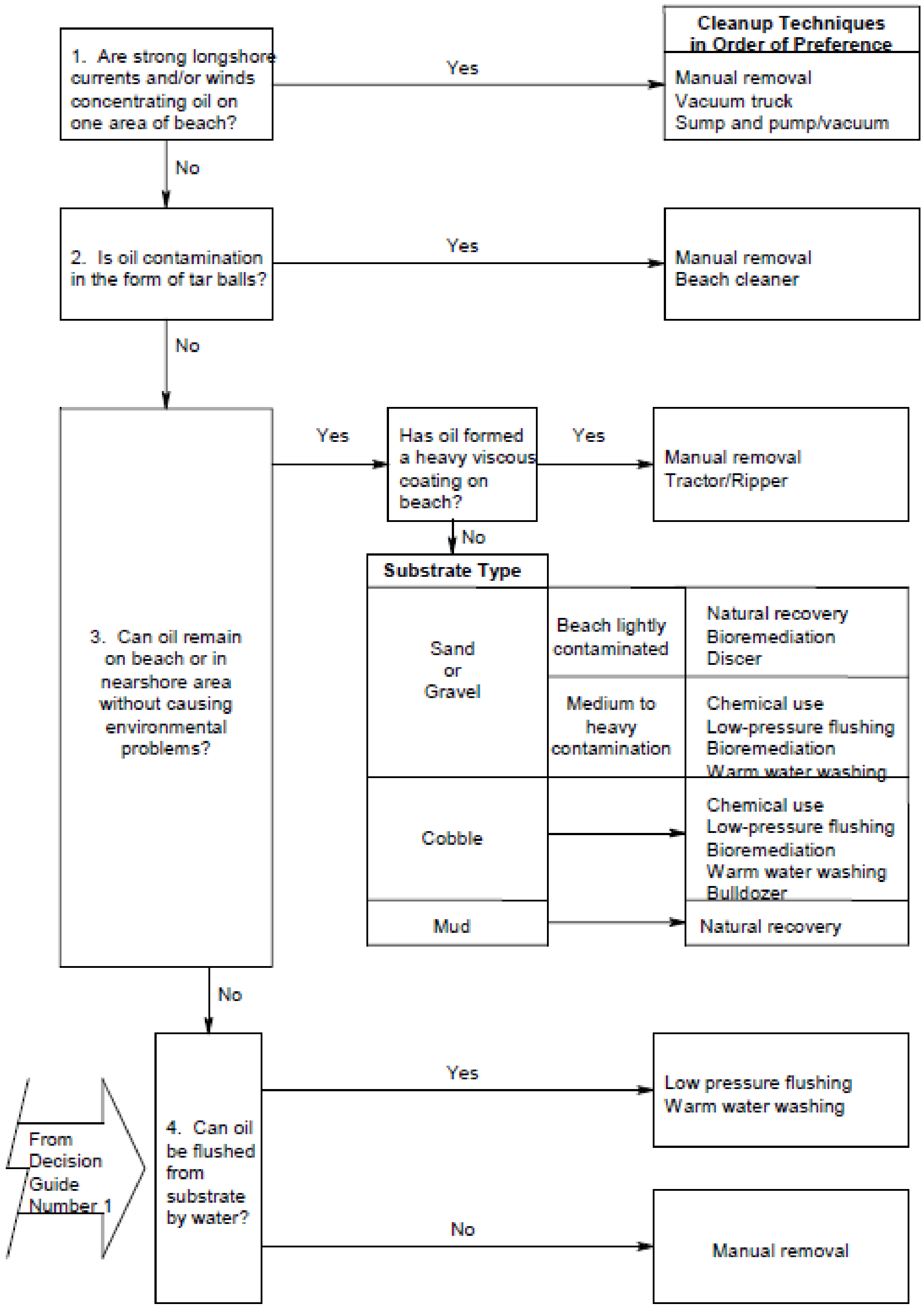


Figure K-3: Shoreline Clean-Up Decision Guide 2

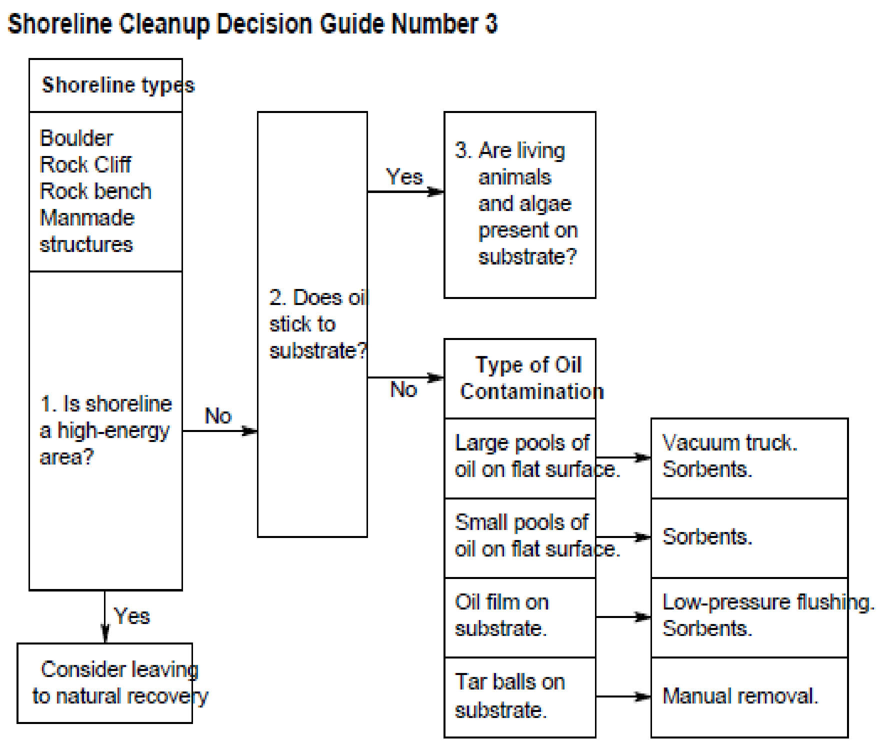


Figure K-4: Shoreline Clean-Up decision Guide 3

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 ✓ Barrier tape and stakes ✓ Signposting equipment	✓ Bins, barrels, skips, tanks ✓ Hot and cold beverages (Welfare) ✓ 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.

✓ 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:
    - o Staging areas
    - o Pits if necessary
    - o Platform within earth berms
    - o 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 and 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, expose and responder activity.

- ✓ Divide the response personnel among three functions:
    - o Collection/scraping/gathering
    - o Placing in bags/waste containers
    - o 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:
  - o (case 1) fluid oil: radial or converging scraping towards a collection point on the foreshore; removal by pumping
  - o (case 2) more viscous oil /solids: concentration to form windrows, by successive slightly curing 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

1.1.4 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 Dampier, Darwin, 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 State Hazard Plan for Maritime Environmental Emergencies and 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 Wildlife 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, July 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 have 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

2 Scientific Monitoring Plans by Receptor

The following components of the SMP are outlined in this section:

+ SMP1: Water Quality
+ SMP2: Sediment Quality
+ SMP3: Sandy Beaches and Rocky Shores
+ SMP4: Mangroves
+ SMP5: Intertidal Mudflats
+ SMP6: Benthic Habitats
+ SMP7: Seabirds and Shorebirds
+ SMP8: Marine Mammals
+ SMP9: Marine Reptiles
+ SMP10: Seafood Quality
+ SMP11: Fish, Fisheries and Aquaculture
+ SMP12: Whale Sharks.

Given the low likelihood and unpredictable nature of a Level 3 incident, it is very unlikely that one pre-established monitoring design will be appropriate for all scenarios. Instead, monitoring will require an adaptive approach which may employ previous baseline monitoring, new post-spill data, spatial control sites, or post-spill pre-impact data that follows a consistent decision framework (Department of Environment and Conservation 2009). The scientific monitoring implemented will be in accordance with the scale, location, and duration of the oil spill. Only the relevant plans as determined by the initiation criteria will be implemented.

Table 1 provides a glossary of an SMP as prepared in this report.

Table 1: 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 Baseline Data Review (SO-91-RF-20022).
Contact	Contact is defined as occurring where any aerial, visual or florescence 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.

Santos

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.
Implementation	Mobilisation requirements for service provider(s).
Analysis and reporting	Summary of analysis, data management and reporting.

SMP1 Marine Water Quality

SMP1 – Marine Water Quality	
Rationale	The release of hydrocarbons at sea will pollute marine waters via floating, entrained or dissolved aromatic hydrocarbons. 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.
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	Refer to the Baseline Data Review (SO-91-RF-20022). In addition, relevant available metadata will be reviewed for applicable marine water quality baseline data. In the absence of baseline data for hydrocarbons, data from appropriate reference sites will be used in place of the baseline values.
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	Concentrations of hydrocarbon contaminants, attributable to the released hydrocarbon, are not significantly higher than baseline data or similar non-impacted sites data.

SMP1 – Marine Water Quality	
	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. 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.
Receptor impact	Impacts to specific receptors from hydrocarbons within marine waters are described in individual SMPs.
Methodological approach	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): 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. See **Appendix A** 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. <u>Water profiles</u> 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). <u>Water quality</u> 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.

SMP1 – Marine Water Quality	
	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 Appendices: + 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 (Grochowsi and Stat 2017).
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP having been activated.
Resources	+ 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	Chemical analysis will be carried out by NATA-accredited laboratories. A government endorsed laboratory for forensic fingerprinting (GS/MS) will be used.

SMP1 – Marine Water Quality	
	Data will be entered to spatially explicit database. 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. 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.

SMP2 Sediment Quality

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	To monitor the fate and persistence of hydrocarbons in marine sediments following an oil spill and associated response activities. To monitor marine benthic infauna assemblages as an indicator of sediment quality, in relation to an oil spill and associated response activities.
Baseline	Refer to the Baseline Data Review (SO-91-RF-20022). In addition, relevant available databases will be reviewed for applicable marine baseline sediment quality and infauna data. 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. 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.
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	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. 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. For infauna assemblages, abundance and species diversity/richness/composition are not significantly different from baseline (where baseline data exists) or are not

SMP2 – Sediment Quality	
	statistically significantly different from comparable non-impacted benthic infauna assemblages. 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.
Receptor impact	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 is measured through change(s) in: + Taxonomic diversity + Assemblage composition + Abundance of indicator species Other pressures to these states are: + Discharge of other toxicants + Physical disturbance including dredging + Sedimentation + Introduction of marine pests + Shading from marine infrastructure + Climate change
Methodological approach	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): 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. See **Appendix A** 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 Sediment quality 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.

SMP2 – Sediment Quality	
	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). 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. At each site, replicate sediment samples will be taken including those for QA/QC purposes. 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. 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: + Appendix G hydrocarbon analysis (Grab samplers) + Appendix H hydrocarbon analysis (Ship borne corer) + Appendix H Manual push corer, and + Appendix O Sediment infauna. 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. Sediment samples shall be analysed for key contaminants of concern including metals, hydrocarbons, nutrients, particle size distribution, and nutrients. <u>Infauna samples</u> 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. 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.
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP having been activated.
Resources	+ 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

SMP2 – Sediment Quality	
	+ Decontamination/washing facilities + Safety aircraft/rescue vessels on standby
Implementation	Service provider to be capable of mobilising within 72 hours of the SoW having been approved by Santos. Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	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. A government endorsed laboratory for forensic fingerprinting (GC/MS) will be used. Infauna samples sorted and identified by qualified marine invertebrate specialist to acceptable taxonomic groups. Data will be entered to spatially explicit database and analysed statistically in order to detect significant differences among sites. 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 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

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 (SO-91-RF-20022). 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

SMP3 – Sandy Beaches and Rocky Shores	
	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 + Over-collection + Nutrification + Climate change.
Methodological approach	Monitoring will be designed as follows: 4. Where long-term baseline data sites are contacted, a control chart (time-series) design will be applied. 5. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 6. Where no baseline data sites are involved, a post-spill pre-impact (preferable) or gradient approach to quantifying impacts will be applied. 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. Sampling frequency will be dictated by the number and location of sampling sites and the philosophy of the sampling design. 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. 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. 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.

SMP3 – Sandy Beaches and Rocky Shores	
	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. 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. 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.
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ 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	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). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	Specimens not identified in situ (in the field) will be processed and identified in the laboratory by appropriately qualified scientists. Biota tissue samples (if collected) analysed for hydrocarbon contaminants by NATA-accredited laboratories. 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. 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.

Santos

SMP4 Mangrove Communities

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.
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 (SO-91-RF-20022). 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).

SMP4 – Shorelines and Coastal Habitats - Mangrove Communities	
	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. 1. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 2. Where no baseline data sites are involved a gradient approach to quantifying impacts will be applied (See **Appendix A** for detailed description of these approaches and **Figure 1,** detailed in Baseline Data Review (SO-91-RF-20022 On-ground monitoring of mangroves will aim to detect change in mangrove health, including canopy cover and plant/leaf health indices. 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. 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. In-field mangrove health sampling frequency will be dictated by the number and location of sampling sites and the sampling design applied.
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ 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	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. 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.

SMP5 Intertidal Mudflats

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) occurs within these habitats and may be affected by 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 (SO-91-RF-20022). 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: 7. Where long-term baseline data sites are contacted, a control chart (time-series) design will be applied. 8. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied.

SMP5 – Shorelines and Coastal Habitats - Intertidal Mudflats	
	9. Where no baseline data sites are involved a post-spill pre-impact (preferable) or gradient approach to quantifying impacts will be applied (See **Appendix A** for detailed description of these approaches and **Figure 1**). 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. 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. Sites selected for mudflat infauna sampling to be concurrently sampled for sediment quality as per SMP2. Sampling frequency will be dictated by the number and location of sampling sites and the philosophy of the sampling design. 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.
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ 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	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). Actual mobilization time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	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. 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.

SMP6 Benthic Habitats

SMP6 – Benthic Habitats	
Rationale	Benthic habitats are those habitats associated with the seafloor. Major benthic habitats at risk are: + 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). 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.
Aim	To monitor changes in the cover and composition of benthic habitats in relation to an oil spill and associated activities. To monitor change in hard coral health and reproduction in relation to an oil spill and associated activities.
Baseline	Refer to the Baseline Data Review (SO-91-RF-20022). In addition, relevant available baseline metadata databases will be reviewed for applicable benthic habitat and coral health and reproduction baseline data. 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. 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.
Initiation criteria	Benthic habitat cover and composition Operational Monitoring, SMP1 or SMP2 indicates that subtidal benthic habitats are contacted or are predicted to be contacted by a hydrocarbon spill. Coral health and reproduction + 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**.
Termination criteria	Benthic habitat cover and composition

SMP6 – Benthic Habitats	
	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. <u>Coral health and reproduction</u> 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.
Receptor impact	Impact to benthic habitats from pressures including hydrocarbons is measured through change in: + Species diversity + Assemblage composition + Percent cover. Other pressures to these states are: + Physical disturbance + Discharge of toxicants + Introduction of marine pests + Shading + Climate change.
Methodological approach	Monitoring design will be as follows: 10. Where long-term baseline data sites are contacted, a control chart (time-series) design will be applied. 11. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 12. Where no baseline data sites are involved, a gradient approach to quantifying impacts will be applied (See **Appendix A** for detailed description of these approaches and **Figure 1**). <u>Benthic Habitat Cover and Composition</u> 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. The number of sites and frequency of sampling will depend upon the sampling design philosophy. 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. 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.

SMP6 – Benthic Habitats	
	Coral Health and Reproduction 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. 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. 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.
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ 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	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). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	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. 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).

SMP6 – Benthic Habitats	
	NATA accredited laboratory analysis to determine the concentration of hydrocarbons within coral tissue. 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. Coral larval competency tests to be conducted by ecotoxicological laboratory in addition to standard suite of ecotoxicological tests using released hydrocarbon. 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. 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.

SMP7 Seabirds and Shorebirds

SMP7 – Seabirds and Shorebirds	
Rationale	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: + 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. Quantify lethal and/or sub-lethal impacts of hydrocarbon spill exposure on seabirds and shorebirds. Monitor changes in seabird populations (reproductive success) in relation to the hydrocarbon spill and clean-up activities.
Baseline	Refer to the Baseline Data Review (SO-91-RF-20022). 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.

SMP7 – Seabirds and Shorebirds	
Initiation criteria	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 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**.
Termination criteria	Detectable levels of hydrocarbons attributable to the hydrocarbon spill are not present in seabird and shorebird tissues; AND 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 Monitoring is terminated in consultation with the relevant environmental authority (relevant regional authority and/or DAWE).
Receptor impact	Impact to seabirds and shorebirds from pressures including hydrocarbons is measured through change in: + Species diversity + Bird abundance + Health/condition + Breeding success (resident species only). Other pressures to these states are: + 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.
Methodological approach	Monitoring design will be 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. 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 A** for detailed description of these approaches and **Figure 1,** detailed in Baseline Data Review (SO-91-RF-20022).

SMP7 – Seabirds and Shorebirds	
	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. 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). 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. Bird mortality to be recorded during monitoring of seabirds and shorebirds with tissue samples taken from dead birds for hydrocarbon analysis in the laboratory. Necroscopies will follow the process of Gagnon and Rawson (2010).
Scope of work	Prepared by monitoring provider for issue within 24 hours of SMP being activated.
Resources	+ 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). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and associated timing requirements.
Analysis and reporting	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. 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.

SMP8 Marine Mammals

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	Refer to the Baseline Data Review (SO-91-RF-20022). 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.
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	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 No further instances of dead marine mammals with detectable levels of hydrocarbons attributable to the hydrocarbon spill; AND Monitoring is terminated in consultation with the relevant environmental authority (relevant regional authority and/or DAWE).
Receptor impact	Impact to marine mammals from pressures including hydrocarbons is measured through observed injury and mortality. Other pressures to these states are: + Physical disturbance + Entanglement in fishing gear and litter + Accidental chemical spillage + Climate change + Over-exploitation.
Methodological approach	Aerial and marine surveys will be implemented to identify individuals in proximity of the spill and to quantify damage: + Aerial surveys will follow the protocols of Hedley et al. (2011)

SMP8 – Marine Mammals	
	+ Marine surveys will follow the protocols of Watson et al. (2009) Tissue sampling of dead or injured animals will follow the protocols of: + 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	**Aerial survey** + Senior Marine Scientist + Trained marine wildlife observers x 2 + Fixed wing aircraft (incl. pilot/s) + Refuelling facilities **Vessel-based survey** + 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
Implementation	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). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
Analysis and reporting	Data will be entered to spatially explicit database. Data and conclusions will be summarised in an environmental report card. 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. 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.

SMP9 Marine Reptiles

SMP9 – Marine Reptiles	
Rationale	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.
Aim	To observe and quantify the presence of marine reptiles in the spill and response areas, and broader regional areas. To assess and quantify lethal impacts or sub-lethal impacts of this exposure or interactions. To monitor changes in marine reptile populations in relation to an oil spill and associated activities.
Baseline	Refer to the Baseline Data Review (SO-91-RF-20022). 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.
Initiation criteria	Operational monitoring indicates that marine reptiles or nesting sites are contacted or likely to be contacted by a hydrocarbon spill; OR Operational monitoring indicates that marine reptiles are contacted, or are predicted to be contacted, by a hydrocarbon spill as defined in **Table 1**.
Termination criteria	Detectable levels of hydrocarbons attributable to the hydrocarbon spill are no longer present in marine reptile tissues collected from live or dead individuals; AND 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 Monitoring is terminated in consultation with the relevant environmental authority (relevant regional authority and/or DAWE).
Receptor impact	Impact to marine reptiles from pressures including hydrocarbons is measured through change in: + Abundance + Health/condition + Nesting success (turtles and crocodiles). Impact to other marine reptiles from pressures including hydrocarbons is measured through change in observed injury and condition. Other pressures to these states are:

SMP9 – Marine Reptiles	
	+ 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	**Abundance** In-water impacts – aerial surveys. Shoreline impacts – ground surveys (either rapid census survey or tagging program). **Health/condition** In-water impacts – vessel surveys (collecting observations on animal condition and collection of tissue samples or dead specimens for analysis). Shoreline impacts – ground surveys (collecting observations on animal condition and collection of tissue samples or dead specimens for analysis). Dead reptiles will be collected for autopsy following Gagnon (2009). **Reproductive success** Shoreline impacts – ground surveys (detailed tagging and/or nesting success studies). Design of ground surveys will be applied as follows: + Where long-term baseline data sites are contacted a control chart (time-series) design will be applied. + Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. + Where no baseline data sites are involved, and timing allows, a post spill pre-impact approach will be attempted. + 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	**Aerial survey** + Senior marine scientist + Trained marine wildlife observers x 2 + Fixed wing aircraft (incl. pilot/s)

SMP9 – Marine Reptiles	
	+ Refuelling facilities **Vessel-based Survey** + 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	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). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
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. 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. 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.

SMP10 Seafood Quality

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	Refer to the Baseline Data Review (SO-91-RF-20022). Human health benchmarks relating to the exposure of PAHs shall be used to determine health effects as per Yender et al. (2002).

SMP10 – Seafood Quality	
	Flesh samples from non-impacted sites to be used as baseline for olfactory analysis for flesh taint.
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	The following termination criteria will be adopted in consultation with responsible fisheries and human health agencies. Hydrocarbon concentrations in seafood tissues are not above levels considered a human health risk; AND Flesh taint is not detected from olfactory testing of seafood samples; AND Target species are no longer exposed to hydrocarbons in the water column.
Receptor impact	Impact to seafood quality from hydrocarbons is measured through change in: + Toxicity indicators + Olfactory taint. Other pressures to these states are: + Accidental chemical spillage + Disease.
Methodological approach	Target fish species determined from water quality monitoring results and relevant and available commercial and recreational-fished species. 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. If more than one target species is affected, replicate samples of each species shall be collected, with a minimum of five replicate samples. Olfactory testing will follow Rawson et al. (Rawson et al. 2011), following the duo-trio method (Standards Australia 2005).
Scope of work	Prepared by monitoring provider for issue within 24 hours of this SMP being activated.
Resources	+ Senior marine scientist + Marine vessel + Sample containers and preservative + NATA accredited laboratory for sample analysis + Decontamination/washing facilities
Implementation	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).

SMP10 – Seafood Quality	
	Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
Analysis and reporting	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. 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.

SMP11 Fish, Fisheries and Aquaculture

SMP11 – Fish, Fisheries and Aquaculture	
Rationale	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 inhabit near shore areas face a greater risk to an oil spill than finfish found in deeper waters.
Aim	To monitor changes in structure and distribution of fish assemblages in relation to an oil spill and associated activities. To monitor the effect of hydrocarbon exposure and physiological condition on fisheries and aquaculture species.
Baseline	Refer to the Baseline Data Review (SO-91-RF-20022). In addition, available relevant survey databases shall be reviewed for applicable baseline data.
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	Fish assemblages are not statistically significantly different than those of baseline or similar non-impacted assemblages; AND 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 Termination of monitoring is done in consultation with the responsible fisheries agencies.
Receptor impact	Impact to fish, fisheries and aquaculture from pressures including hydrocarbon concentrations is measured through change in: + Species diversity + Abundance of indicator taxa

SMP11 – Fish, Fisheries and Aquaculture	
	+ Assemblage structure + Health. Other pressures to these states are: + 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). Fish assemblages will be randomly sampled within discrete habitats at cross-shelf impact areas and non-impact areas. Sampling design for fish assemblages will be as follows: 13. Where long-term baseline data sites are contacted a control chart (time-series) design will be applied. 14. Where appropriately matched baseline data sites are impacted and non-impacted, a BACI approach to monitoring will be applied. 15. If baseline data is not available, a gradient approach to quantifying impacts will be applied (See **Appendix A** for detailed description of these approaches and **Figure 1**). 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. 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). 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). If fish kills are observed, whole specimens will be obtained and preserved (frozen) for necropsy to determine the cause of death.
Scope of work	Prepared by monitoring provider for issue within 24 hours of this SMP being activated.
Resources	+ 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

SMP11 – Fish, Fisheries and Aquaculture	
	+ Safety aircraft/rescue vessels on standby + Resources to analyse BRUV data.
Implementation	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). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
Analysis and reporting	BRUV imagery will be processed using EventMeasure (SeaGIS) software. NATA-accredited laboratories will be employed for health analyses. Data will be entered to spatially explicit database and analysed to test for statistically significant differences between non-impacted and impacted fish assemblages. 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 of final draft within two weeks of report provision to reviewer; finalise report within two weeks of peer review having been completed.

SMP12 Whale Sharks

SMP12 – Whale Sharks	
Rationale	The whale shark (*Rhincodon typus*) 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.
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	Refer to the Baseline Data Review (SO-91-RF-20022). 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.

SMP12 – Whale Sharks	
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	Measured parameters of whale shark abundance and distribution are not significantly different to baseline levels; AND The water quality at feeding/aggregation sites has been measured as not significantly different to baseline levels.
Receptor impact	Impact to whale sharks from pressures including hydrocarbons is measured through observed injury and mortality. Other pressures to these states are: + Intentional and unintentional mortality from fishing outside Australian waters + Boat strike + Habitat disruption from mineral exploration, production and transportation + Marine debris + Climate change.
Methodological approach	During spill activities may require the following surveys and sampling: + Aerial surveys + Satellite tagging + Toxicology + Food chain studies + Photo-identification + Vessel and plane logs + Acoustic tagging. The methodologies adopted will follow the approaches of those baseline studies identified allowing consistency of data from baseline to impact and recovery phases.
Scope of work	Prepared by monitoring provider for issue within 24 hours of this SMP being activated.
Resources	+ 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

SMP12 – Whale Sharks	
	+ Safety aircraft/rescue vessels on standby
Implementation	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). Actual mobilisation time will depend on the decision to adopt post-spill pre-impact monitoring and spill timing requirements.
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.

3 Receptor Description, Impact and Baseline Data

A values and sensitivities assessment is undertaken that describes the environmental receptors that occur within the particular EMBA. This includes their general distribution within the EMBA, as well as Biologically Important Areas, Key Ecological Features and habitat critical, and their potential response to hydrocarbon spills.

Potential baseline data which may be used to support monitoring for the sensitive receptors identified during the values and sensitivities assessment are reviewed and assessed for its suitability to provide a meaningful baseline from which to assess the impact of a hydrocarbon spill. The most up-to-date and spatially relevant baseline studies are detailed in the Baseline Data Review (SO-91-RF-20022). These baseline data are not intended as a static list, but are continually updated, and augmented by co-operation amongst resource companies and other agencies. During the standby phase, data quality are progressively and critically assessed following a data governance framework. These data will be accessed in the event of a spill in order to develop the most reliable monitoring program. The Baseline Data Review forms a basis for determining the level of priority for obtaining baseline data prior to oil contact, in the event of a hydrocarbon spill.

4 Scientific Monitoring Principles

4.1 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 2**). A structured decision-making framework for allocating monitoring effort in both time and space is described in **Figure 1**.

Table 2: 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
	Environmental covariates are considered in sampling design recorded and incorporated statistically. A hierarchical or stratified sampling design is used to address variation at multiple scales Design is standardized, by sampling equivalent strata (e.g., level of exposure, depth etc.).	
Assess statistical power	Where null-hypothesis tests are planned, statistical power of the design is assessed prior to execution.	Gerrodette (1987) Legg and Nagy (2006) Toft and Shea (1982)
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)

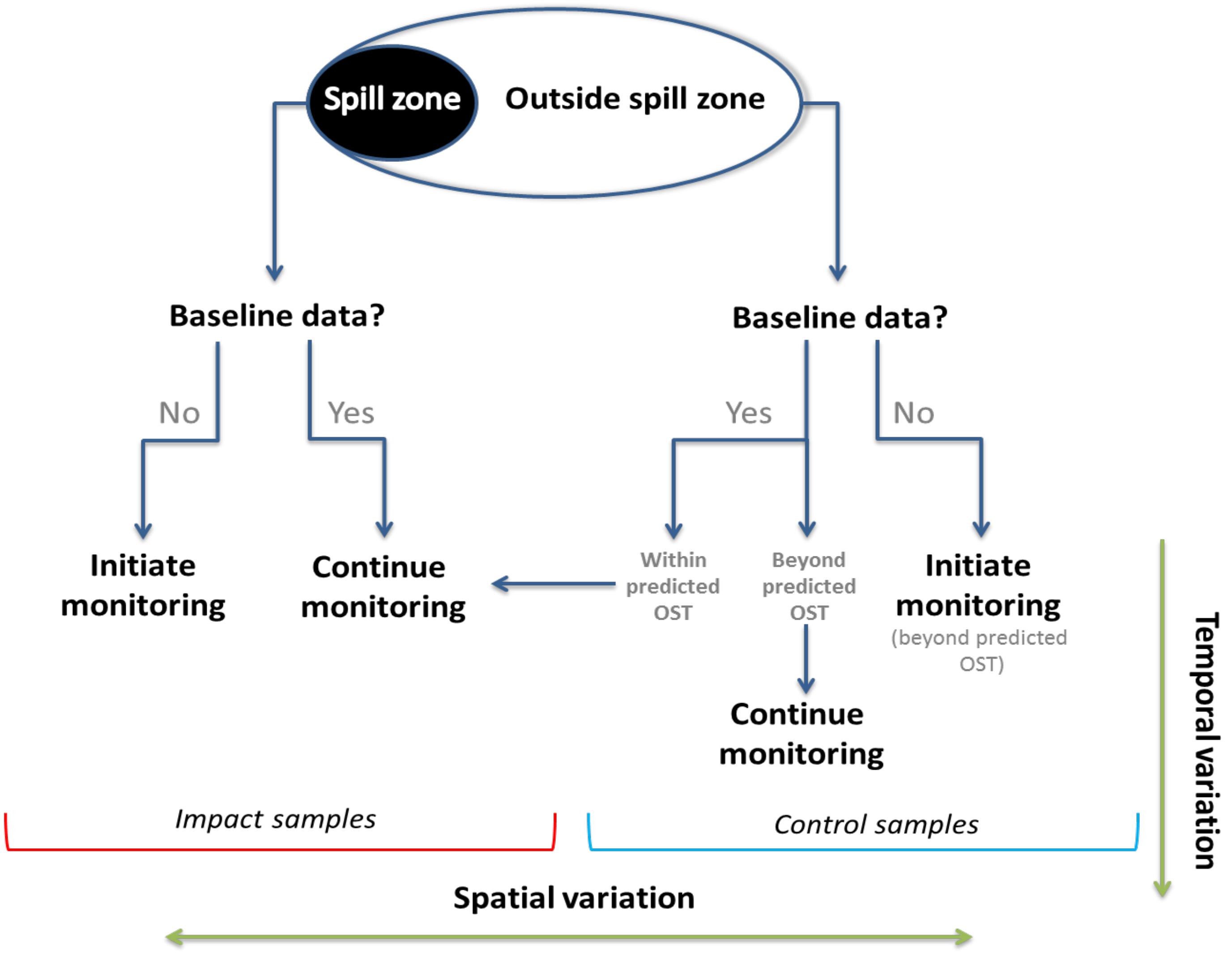


Figure 1: Structured Decision Making Process Based on Gregory et al. (2012) in Reference to Monitoring Programs, the Availability of Baseline Data, and Oil Spill Trajectory. An ideal design sampling would occur across a gradient of exposure rather than 'impact' and 'control' per se.

4.2 Data Analysis

Appendix A details the most important approaches to statistical analysis and related sampling design. These approaches are summarised in Table 3 (below). An important consideration is how this information is best summarised and communicated to guide further decision making and management. **Appendix A** also describes the reporting of environmental outcomes through the use of report card systems and includes a summary of their structure and design.

Table 3: 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.

4.3 Data Governance

Under NOPSEMA guidelines, data governance refers to the management of data and its quality, generation and enforcement of data policies and standards surrounding the handling of environmental and biodiversity data in the unlikely event of an incident (National Offshore Petroleum Safety and Environmental Management Authority 2016). **Appendix B** provides a description of the key requirements for data governance of oil spill-related data and suggests a suitable framework.

5 Mobilising Scientific Response Teams

Detailed information for activating and implementing a scientific monitoring response is provided in the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162).

6 References

Alongi, D. M. 2002. Present state and future of the world's mangrove forests. Environmental Conservation 29:331–349.

Astron Environmental Services. 2013. Apache OSMP - Desktop Mangrove Assessment. Unpublished report to Apache Energy Limited.

Astron Environmental Services. 2019. Scientific Monitoring Plan Baseline Data Review, July 2019. Unpublished report for Santos WA Energy Limited.

Australian and New Zealand Governments. 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra.

Babcock, R., M. Haywood, M. Vanderklift, G. Clapin, M. Kleczkowski, D. Dennis, T. Skewes, D. Milton, N. Murphy, R. Pillans, and A. Limbourn. 2008. Ecosystem impacts of human usage and the effectiveness of zoning for biodiversity conservation: broad-scale fish census. CSIRO Marine and Atmospheric Research, Australia.

Bamford, M., and D. Moro. 2011. Barrow Island as an Important Bird Area for migratory waders in the East Asian-Australasian flyway. Stilt 60:46–55.

Barter, M. 2002. Shorebirds of the Yellow Sea: importance, threats and conservation status. Australian Government Publishing Service, Canberra, Australia.

Bennelongia Pty Ltd, A. 2010. Analysis of possible change in ecological character of the Roebuck Bay and Eighty Mile Beach Ramsar sites.

Carey, J., and M. Keough. 2002. Compositing and subsampling to reduce costs and improve power in benthic infaunal monitoring programs. Estuaries 25:1053–1061.

Cresswell, I., and V. Semeniuk. 2011. Mangroves of the Kimberley coast: ecological patterns in a tropical ria coast setting. Journal of the Royal Society of Western Australia 94:213–237.

Department of Environment and Conservation. 2009. Nature Conservation Service: Biodiversity Conservation Appraisal System: A Framework to Measure and Report on

Biodiversity Outcome Based Conservation Achievements and Management Effectiveness. Perth.

Department of Parks and Wildlife, and Australian Marine Oil Spill Centre. 2014. Pilbara Region Oiled Wildlife Response Plan. Department of Parks and Wildlife and Australian Marine Oil Spill Centre, Western Australia.

Department of the Environment and Energy. 2017. EPBC Act Policy Statement 3.21 - Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species.

Department of the Environment and Heritage. 2006. Standardised protocols for the collection of biological samples from stranded cetacean. http://www.environment.gov.au/resource/standardised-protocols-collection-biological-samples-stranded-cetacean.

Duke, N. C., M. C. Ball, and J. C. Ellison. 1998. Factors influencing biodiversity and distributional gradients in mangroves. Global Ecology and Biogeography Letters 7:27–47.

Duke, N., A. Wood, K. Hunnam, J. Mackenzie, A. Haller, N. Christiansen, K. Zahmel, and T. Green. 2010. Shoreline ecological assessment aerial and ground surveys 7-19 November 2009. UniQuest PTY Ltd.

English, S., C. Wilkinson, and V. Baker. 1997. Survey Manual for Tropical Marine Resources. 2nd edition. Australian Institute of Marine Science, Townsville.

Eros, C., H. Marsh, R. Bonde, T. O'Shea, C. Beck, C. Recchia, K. Dobbs, M. Turner, S. Lemm, R. Pears, and R. Bowter. 2000. Procedures for the salvage and necropsy of the dugong (*Dugong dugon*) - Second Edition, Research Publication No. 85. Great Barrier Marine Park Authority, Townsville.

Gagnon, M. M. 2009. Report on biopsy collection from specimens collected from surrounds of West Atlas oil leak–sea snake specimens. Curtin University, Perth.

Gagnon, M. M., and C. Rawson. 2012. Montara Well Release, Monitoring Study S4A Phase IV – Assessments of Effects on Timor Sea Fish. Curtin University, Perth.

Gagnon, M. M., and C. A. Rawson. 2010. Montara Well Release: Report on necropsies from birds collected in the Timor Sea. Curtin University, Perth, Western Australia.

Gerrodette, T. 1987. A power analysis for detecting trends. Ecology 68:1364–1372.

Gibson, L. E., and A. P. Wellbelove. 2010. Protecting critical marine habitats: The key to conserving our threatened marine species: a Humane Society International and WWF-Australia Report.

Gregory, R., L. Failing, M. Harstone, G. Long, T. McDaniels, and D. Ohlson. 2012. Structured decision making: a practical guide to environmental management choices. Wiley-Blackwell.

Grochowsi, A., and A. Stat. 2017. Water and Sediment Sampling for Environmental DNA Extraction, Joint Technical Memorandum. BMT Oceanica & Trace and Environmental DNA (TrEnD) Laboratory at Curtin University.

Gueho, R. 2007. Rhythms of the Kimberley: a seasonal journey through Australia's north. Fremantle Press, Australia.

Hedley, S., J. Bannister, and R. Dunlop. 2011. Abundance estimates of Southern Hemisphere Breeding Stock 'D' Humpback Whales from aerial and land-based surveys off Shark Bay, Western Australia, 2008. Journal of Cetacean Research and Management:209–221.

Hilty, J., and A. Merenlender. 2000. Faunal indicator taxa selection for monitoring ecosystem health 92:185–197.

Hockings, M., S. Stolton, F. Leverington, N. Dudley, and J. Courrau. 2006. Evaluating Effectiveness: A Framework for Assessing Management Effectiveness of Protected Areas. 2nd edition. International Union for Conservation of Nature and Natural Resources.

Hook, S., G. Batley, M. Holloway, P. Irving, and A. Ross, editors. 2016. Oil Spill Monitoring Handbook. CSIRO Publishing.

Hurlbert, S. 1984. Pseudoreplication and the design of ecological field experiments. Ecological Monographs 54:187–211.

Jarman, S., and S. Wilson. 2004. DNA-based species identification of krill consumed by whale sharks. Journal of Fish Biology 65:586–591.

Kathiresan, K., and B. L. Bingham. 2001. Biology of mangroves and mangrove ecosystems. Advances in marine biology 40:81–251.

Kenkel N.C, Juhasz-Nagy P, and Podani J. 1989. On sampling procedures in population and community ecology. Vegetation 83:195–207.

Kobryn, H. T., K. Wouters, L. Beckley, and T. Heege. 2013. Ningaloo Reef: Shallow Marine Habitats Mapped Using a Hyperspectral Sensor. PLoS ONE 8:e70105.

Kohler, K. E., and S. M. Gill. 2006. Coral point count with Excel extensions (CPCe): A visual basic program for the determination of coral and substrate coverage using random point count methodology. Computers and Geosciences 32:1259–1269.

Legg, C. J., and L. Nagy. 2006. Why most conservation monitoring is, but need not be, a waste of time. Journal of Environmental Management 78:194–199.

Masini, R. J., C. B. Sim, and C. J. Simpson. 2009. Protecting the Kimberley: A synthesis of scientific knowledge to support conservation management in the Kimberley region of Western Australia. Department of Environment and Conservation.

Nagelkerken, I., G. van der Velde, M. W. Gorissen, G. J. Meijer, T. Van't Hof, and C. den Hartog. 2000. Importance of Mangroves, Seagrass Beds and the Shallow Coral Reef as a Nursery for Important Coral Reef Fishes, Using a Visual Census Technique. Estuarine, Coastal and Shelf Science 51:31–44.

National Offshore Petroleum Safety and Environmental Management Authority. 2016. Operational and Scientific Monitoring Programs Information Paper. Perth.

Pendretti, Y. M., and E. I. Paling. 2001. WA Mangrove Assesment Project 1999-2000. Perth Murdoch Univeristy.

Quadrant Energy Australia Limited. 2018. Quadrant Environmental Monitoring Program Mangrove Monitoring Method Statement, EA-00-RI-10058.06. Quadrant Energy Australia Limited, Perth.

Rawson, C., M. M. Gagnon, and H. Williams. 2011. Montara Well Release: Olfactory Analysis of Timor Sea Fish Fillets. Curtin University, Perth.

Reynolds, S. D., B. M. Norman, M. Berger, C. E. Franklin, and R. G. Dwyer. 2017. Movement, distribution and marine reserve use by an endangered migratory giant. Diversity and Distributions 2017:1–12.

Robson, B. J., M. A. Burford, P. C. Gehrke, A. T. Revill, I. T. Webster, and D. W. Palmer. 2008. Response of the lower Ord River and estuary to changes in flow and sediment and nutrient loads. Water for a Healthy Country Flagship Report, CSIRO.

Santos WA Energy Limited. 2018. Values and Sensitivities of the Western Australian Marine Environment, EA-00-RI-10062. Santos WA Energy Limited.

Shortis, M., E. Harvey, and D. Abdo. 2009. A review of underwater stereo-image measurement for marine biology and ecology applications. Pages 257–292 *in* R. Gibson, R. Atkinson, and J. Gordon, editors. Oceanography and Marine Biology: An Annual Review. CRC Press, Boca Raton, Florida USA.

Skalski, J. 1995. Statistical considerations in the design and analysis of environmental damage assessment studies. Journal of Environmental Management 43:67–85.

Sleeman, J. C., M. G. Meekan, G. Mark, B. J. Fitzpatrick, C. R. Steinberg, R. Ancel, and C. J. A. Bradshaw. 2010. Oceanographic and atmospheric phenomena influence the abundance of whale sharks at Ningaloo Reef, Western Australia. Journal of Experimental Marine Biology and Ecology 382:77–81.

Snedecor, G., and W. Cochran. 1989. Statistical methods. Iowa State University Press, Iowa.

Standards Australia. 2005. Australian Standard 2542: Sensory analysis - Method 2.4. Standards Australia, Sydney.

Stem, C., R. Margolius, N. Salafsky, and M. Brown. 2005. Monitoring and evaluation in conservation: A review of trends and approaches. Conservation Biology 19:295–309.

Thompson, A., and B. D. Mapstone. 1997. Observer effects and training in underwater visual surveys of reef fishes. Marine Ecology Progress Series 154:53–63.

Toft, C., and P. Shea. 1982. Detecting community-wide patterns: Estimating power strengthens statistical inference. The American Naturalist 122:618–625.

Underwood, A. J. 1991. Beyond BACI: experimental designs for detecting human environmental impacts on temporal variations in natural populations. Australian Journal of Marine and Freshwater Research 42:569–587.

Underwood, A. J. 1992. Beyond BACI: the detection of environmental impacts on populations in the real, but variable, world. Journal of Experimental Biology and Ecology 161:145–178.

Underwood, A. J. 1994. On Beyond BACI: sampling designs that might reliably detect environmental disturbances. Ecological Applications 4:3–15.

Varcoe, T. 2012. A park manager's perspective on ecological monitoring. Page *in* D. Lindenmayer and P. Gibbons, editors. Biodiversity Monitoring in Australia. CSIRO Publishing, Canberra.

Wade, S., and R. Hickey. 2008. Mapping Migratory Wading Bird Feeding Habitats using Satellite Imagery and Field Data, Eighty-Mile Beach, Western Australia. Journal of Coastal Research 243:759–770.

Waples, K. 2007. Kimberley Biodiversity Review. Department of Environment and Conservation.

Watson, J., L. Joseph, and A. Watson. 2009. A rapid assessment of the impacts of the Montara oil leak on birds, cetaceans and marine reptiles. Department of the Environment, Water, Heritage and the Arts, Canberra.

Wilson, B. 1994. A representative Marine Reserve System for Western Australia. Department of Conservation and Land Management.

Wilson, B. 2013. The Biogeography of the Australian North West Shelf: Environmental Change and Life's Response. Elsevier.

Wilson, S., M. Meekan, J. Carleton, T. Stewart, and B. Knott. 2003. Distribution, abundance and reproductive biology of <i>Pseudeuphausia latifrons<i> and other euphausiids on the southern North West Shelf, Western Australia. Marine Biology 142:369–379.

Wilson, S., T. Pauly, and M. Meekan. 2001. Daytime surface swarming by *Pseudeuphausia latifrons* (Crustacea, Euphausiacea) off Ningaloo Reef, Western Australia. Bulletin of Marine Science 68:157–162.

Yender, R., J. Michael, and C. Lord. 2002. Managing Seafood Safety After an Oil Spill. Hazardous Materials Response Division, Office of Response and Restoration, National Oceanic and Atmospheric Administration, Seattle.

Zell, L. 2007. Kimberley Coast. Wild Discovery.

Appendix O SMP and Operational Monitoring Activation Process

O-1 SMP Activation Form

astron.com.au

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

<table>
<tr><th colspan="8">Section 2: Spill Details</th></tr>
<tr><td colspan="2">Date and time of spill</td><td colspan="3">Click here to enter a date.</td><td colspan="3">Enter time, i.e. 1400 WST</td></tr>
<tr><td colspan="2" rowspan="2">Spill source location
(GDA94, MGA Zone 50)</td><td colspan="6">Insert coordinates in GDA94 MGA Zone 50 format (easting and northing).</td></tr>
<tr><td colspan="6">Insert location description</td></tr>
<tr><td colspan="2">Source of spill</td><td colspan="6"></td></tr>
<tr><td colspan="2">Cause of spill (if known)</td><td colspan="6"></td></tr>
<tr><td colspan="2">Status of spill</td><td colspan="6">☐ Secured ☐Uncontrolled ☐Unknown</td></tr>
<tr><td rowspan="3">Release rate</td><td>Instantaneous release</td><td colspan="5"></td><td rowspan="3">State units</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Continuous release</td><td></td><td>per hour for</td><td></td><td>☐Hours</td><td>☐Days</td></tr>
<tr><td rowspan="4">Description of spill</td><td>Estimated quantity</td><td colspan="5"></td><td rowspan="4">State units</td></tr>
<tr><td>Incident tier</td><td colspan="5">☐1 ☐2 ☐3</td></tr>
<tr><td>Direction of travel</td><td colspan="5"></td></tr>
<tr><td>Trajectory</td><td colspan="5"></td></tr>
<tr><td colspan="2">Modelling provider log in details</td><td colspan="6"></td></tr>
</table>

astron
astron.com.au

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:	

O-2 SMP Activation Process

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* to osr@astron.com.au

↓

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

Oil Spill Scientific Monitoring Activation and Response Process

Phase 1: Activation

- Monitoring provider activated

0 - 2 hours

Phase 2: Response Planning and Preparation

- Briefings
- Review of spill modelling and receptors
- Determine scale and objectives of response
- Determine personnel/equipment/ induction and medical requirements
- Monitoring Action Plan & logistics request
- License applications

2 – 53 hours

Phase 3: Mobilisation

- Inductions/medicals
- Prepare HSE documentation
- Equipment preparation and freighting
- Pre-mob briefings
- Mobilisation

29 hours – 5 days

Phase 4: Response Operations

- Daily field monitoring activity reports to Santos
- Field debriefs and reporting

5+ days

Table i: Activation and response process and timeframes. Tasks for Santos are coloured in blue, tasks for Astron are coloured in green.

Step	Responsibility	Action	Timeframe[1]	Resources	Date/Time Complete	
Phase 1 – Activation						0 – 2 hours
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 *Activation Form* 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 *Activation Form* and submit to Astron via email to osr@astron.com.au .	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, email or phone. Notify Australian Institute of Marine Science for SMP12 (Whale Sharks).[2]	Within 30 minutes of Step 3	SMS Global Guidance		
6	Astron PLO	Notify relevant staff of incident via SMS Global, email or phone.	Within one hour of receiving Activation Form	SMS Global Guidance		
7	Astron MC	Provide twice daily email updates to Santos IMT including: • latest progress • plan for next 24-48 hours • key logistical requirements/constraints • info required from Santos • any other business.	(1200 and 1700) or as agreed with Santos IMT	n/a		
8	Astron MC, Operations Officer and PLO	Maintain Functional Log throughout response.	Daily	Functional Log		

Step	Responsibility	Action	Timeframe	Resources	Date/Time Complete	Timeline
Phase 2 – Response Planning						
9	Astron MC and Astron PLO	Determine location of monitoring coordination operations (in office or remote) and ensure team is equipped to operate remotely if necessary.	Within 2 hours of activation form (Step 4)			**2 – 7 hours**
10	Santos IMT (ETL)	Provide spill trajectory modelling (access link to portal) and sensitive receptor information to Astron.	Within 4 hours of activation form (Step 4)	APASA modelling Department of Transport database Santos GIS Mapping		
11	Astron MC, PLO and BMT Operations Officer	Attend Santos incident briefing if required and relay information to MCT.	As advised by the Santos IMT (ETL)	n/a		
12	MCT and Technical advisors	MCT and Technical Advisors to convene to review personnel and equipment resource status.	Within 6 hours of activation form (Step 4)	Capability report Training matrix Resource chart		
13	Astron PLO Astron Operations officer	Confirm availability of additional personnel and equipment resources.	Within 8 hours of activation form (Step 4)	External Supplier Details Requisition Request Form		
14	Astron MC in consultation with Santos ETL	Define the scale of response - identify which SMPs are activated and if a First Strike Response[3] approach is necessary. Identify if operational water quality monitoring is required.	Within 2 hours of receiving spill and receptor information (Step 10).	Scientific Monitoring Plan[4] Relevant OPEP Spill trajectory modelling Operational monitoring results		

Step	Responsibility	Action	Timeframe	Resources	Date/Time Complete	Timeline
15	Astron Technical Advisors in consultation with Santos ETL	**Determine monitoring locations for activated SMPs:** • Identify monitoring locations in order of priority for activated SMPs based on: 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 12 hours of receiving spill modelling (Step 10).	Relevant SMPs Information from Astron: • baseline information for relevant receptors. Information from Santos IMT: • 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.		**17 hours**

Step	Responsibility	Action	Timeframe	Resources	Date/Time Complete	Timeline
16	Astron Operations Officer, PLO & Technical Advisors in consultation with Santos ETL	**Determine personnel requirements:** • Identify number and competencies of personnel required for monitoring teams for each SMP based on: 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.Determine status of required Santos induction/medicals for personnel and request online training profiles and medical bookings if required.	Within 12 hours of receiving spill modelling (Step 10).	Information from Astron: • Capability report • Training matrix • Resource chart • relevant SMPs and WMS. Information from Santos IMT: • 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).		17 hours
17	Astron Operations Officer, PLO & Technical Advisors in consultation with Santos ETL	**Determine equipment requirements:** • Identify number and competencies of equipment required for each SMP based on: 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 hours of receiving spill modelling (Step 10).	Information from Astron: • Resource chart • relevant SMPs and WMS. Information from Santos IMT: • equipment (i.e. vessels, aircraft) availability • logistics (availability of flights, accommodation, etc).		

Step	Responsibility	Action	Timeframe	Resources	Date/Time Complete	Timeline
18	Astron MC, Operations Officer, PLO & Technical Advisors	**Submit Monitoring Action Plan (MAP)** (mission, objectives, strategies, tactics, tasks), including scope of works and spatial information for survey locations to inform Santos SIMOPS and other permission requirements. **Prepare and submit cost estimate.** **Prepare and submit logistics request:** • 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 24 hours of receiving spill modelling (Step 10) for relevant SMPs.	Information from Astron: • Resource chart • relevant SMPs and WMS • agreed monitoring locations • Mobilisation and Logistics Form (incorporating SOW) • Monitoring Action Plan. Information from Santos IMT: • request for SoW • agreed monitoring locations.		17 - 53 hours
19	Astron Technical Advisors in consultation with Santos ETL	• Submit fauna licence applications	Within 24 hours of receiving spill modelling (Step 10).	• Proposed monitoring locations • SMP methods		
20	Santos IMT (ETL)	• Santos to approve MAP, provide purchase order and initiate logistical arrangements.	Within 24 hours of MAP submission (Step 18). [5]	• Astron Mobilisation and Logistics Request		
21	Astron MC	Advise field personnel by email meeting invite, or phone if not in office. Delegate and initiate tasks for field preparation.	Preliminary notification prior to submission of MAP, then confirm once approved by Santos	• Field team allocation		

Step	Responsibility	Action	Timeframe	Resources	Date/Time Complete	Timeline
Phase 3 – Mobilisation						**29 hours – 5 days**
24	Astron PLO	GIS and device preparation requests (field maps, data capture) submitted, and discussed with Geospatial team.	To be initiated during MAP preparation	https://voyager/		
26	Field Team Leaders	Compile SMP field documentation, forms, GIS information, field equipment, and prepare and submit HSE documentation to Santos IMT.	Commence once MAP submitted (Step 18). Submit HSE documentation 24 hours prior to mobilisation.	Information from Astron • SoW • Grab packs, SMP WMS and HSE documentation • GIS information/field maps • field equipment. Information from Santos IMT: • booking and logistics confirmations.		
27	Astron Technical Advisors	Conduct scope specific pre-mobilisation briefings.	24 hours prior to mobilisation.	Pre-mob Briefing Template		
28	Santos ETL	Santos to approve HSE plan.	8 hours prior to mobilisation.	Mobilisation and Logistics Form HSE plan		
29	Astron PLO	Personnel mobilised to site for First Strike Response.	Within 72 hrs of MAP approval (Step 20)	Approved SOW		

Step	Responsibility	Action	Timeframe	Resources	Date/Time Complete	
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		5 days +
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		

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

[2] AIMS will be activated by Astron for scientific monitoring of SMP12 (Whale Sharks); SMP12 is separate to Astron's scope and Santos will interface with AIMS directly following activation.

[3] First Strike Response is a rapid initial mobilisation of personnel and equipment following an oil spill incident to undertake priority scientific monitoring. Objectives of this first strike response may include:

- collection of pre-impact baseline data,
- collection of impact data for areas or receptors of high environmental significance,
- rapid assessment to determine impacts on receptors to inform operational monitoring or the future scientific monitoring requirements, if required.

The initial first strike response may not include monitoring of all activated SMPs, and may include a smaller contingent of personnel and equipment, depending on the objective. The objectives and approach of the first strike response will be determined in consultation with Santos.

[4] 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.

[5] Approval of the MAP in a timeframe longer than 24 hours after submission may result in delays to mobilisation.

Santos

O-3 Dispersant Operational Monitoring Activation Form

Operational Monitoring – Dispersants Activation Form

Activation Summary
In the event of a spill requiring a response from Advisian: 1. **Phone (03) 9389 3637 to alert the Advisian Operational Standby Response.** 2. **Complete the Activation Form below and email to spillresponse@advisian.com** **If you do not receive a response from the Advisian Operational Standby Response Team within 60 minutes, please call again.**

A. Activation Contact			
Date/Time of Activation (AWST)			
Notification Contact Name			
Position in ICT			
Phone		**Mobile**	
Email		**ICT Link**	
CC		**ICT Phone**	

B. Spill Details			
Date/Time of spill (AWST)			
Spill source location coordinates		**Geographic Coordinate System**	
Spill Status & Details if Known: • Quantity • Release rate • Source & cause • Trajectory • Controlled/uncontrolled			

C. Activation Details			
Operational Monitoring Scope	Operational water quality monitoring – Dispersant monitoring		
Dispersant Application (Surface/Subtidal)			
Survey Vessel (if known)			
Mobilisation Port (if known)/Via vessel/Helo		**12/24 hour ops?**	
Other Notes on Mobilisation/Logistics:			

O-4 Dispersant Operational Monitoring Activation Process

Operational Monitoring – Dispersants Activation Summary

1.1 Introduction

The Santos operational and scientific monitoring plan (OSMP) would be activated after a level two or three unplanned hydrocarbon release, or any release event with the potential to contact sensitive environmental receptors. One of the response options available as part of a response is to apply chemical dispersants either surface or subsurface. Monitoring the effectiveness, distribution and fate of any application of chemical dispersants is essential to verify impact and contact predictions for response planning and other monitoring plans.

1.2 Scope

Advisian will provide a response that is scalable to the size, type and duration of the spill, and chosen dispersant application response. Advisian will mobilise resources and expertise to undertake the operational monitoring required to implement both the SMART protocol for surface-applied dispersants and (with minor modification) the subsea dispersant monitoring plan, as described in the API Technical Report 1152.

Advisian will:

- provide a 24/7 spill response standby service
- participate in an annual exercise as requested
- provide monthly resourcing and capability reports
- maintain pool of equipment dedicated to oil spill response and ready for rapid mobilisation
- mobilise resources in alignment with the implemented strategy (SMART or API 1152).

1.3 Activation

Advisian maintains a maintain a call service number and dedicated email address, twenty-four hours a day, seven days a week (24/7), to contact in the event that a spill has occurred, and the response option of dispersant application has been decided on. Advisian spill response resource activation is summarised below:

Activation Summary
In the event of a spill requiring a response from Advisian: 1. **Phone (03) 9389 3637 to alert the Advisian Operational Standby Response.** 2. **Complete the Activation Form (Attachment 1) and email to spillresponse@advisian.com** **If you do not receive a response from the Advisian Operational Standby Response Team within 60 minutes, please call again.**

Advisian
Worley Group

1.4 Mobilisation

Mobilisation times will algin with existing monitoring plans. Advisian will make all reasonable endeavors to mobilise Personnel for at least 1 team will be ready to deploy (ex-Perth) within 72 hours of receipt of approved Monitoring Action Plan (MAP), subject to contractual agreements (PO), logistics (Non-Advisian equipment preparation, consumables and freight) and deployment documentation being in place (Field plans, HSE documentation and risk assessments).

1.5 Contractual Arrangements

Advisian has agreement with Santos for the provision of operational monitoring – dispersants (Purchase Order: 4800010987) and would deliver works under the existing Outline Agreement between Santos Ltd and Advisian Pty Ltd (Contract No.4821176).

Activation of monitoring services will be via verbal authorisation by the Santos IMT to the Advisian Operational Standby Response, submission of an Activation Form, and by a purchase order as soon as possible after activation.

1.6 Proposed approach to delivering the operational monitoring program – dispersants

Operational monitoring will be undertaken aligned with sampling strategies outlined in the SMART protocol for surface dispersant application or API for subsurface dispersant application, specifically:

- The Special Monitoring of Applied Response Technologies (SMART) program for monitoring of dispersant application
- The Industry Recommended Subsea Dispersant Monitoring Plan form the American Petroleum Institute (API 1152 2020),

Together these plans represent industry best-practice for monitoring dispersant application during a significant hydrocarbon spill response.

Where practicable, the standard operating procedures for monitoring activities will be aligned with existing standards and processes, including:

- CSIRO Oil Spill Monitoring Handbook
- Australian Marine Safety Authority (AMSA) sampling guides
- Australian and New Zealand Environment and Conservation Council (ANZECC) Guidelines
- revised ANZECC/Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) Sediment Quality Guidelines.

The main scope of operational and scientific spill response will be managed by a separate contractual arrangement (currently with Astron/BMT). The data obtained from these scopes may be used to inform this scope, potentially providing required baseline, reactive baseline, reference and additional operational data for the dispersant application monitoring.

Appendix P Scientific Monitoring Capability

Scientific Monitoring Assurance and Capability Assessment

Assurance arrangements

Santos has a primary Monitoring Service Provider (MSP) for the implementation of Scientific Monitoring Plans (SMPs) 1-11. A contractual arrangement exists between Santos and the MSP to maintain standby arrangements as per the Oil Spill Scientific Monitoring Standby and Response Manual (EA-00-RI-10162); The MSP has the resourcing capability to implement a first-strike response at all times. The MSP maintains a relationship with primary sub-contractors for the provision of scientific monitoring for those SMPs where the MSP does not have the required capability. Between the MSP and primary sub-contractors, 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 MSP and subcontractor 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 the MSP 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 MSP standby arrangements are adequate through its exercise and auditing program. Santos regularly conducts exercises and tests with the MSP and its subcontractors to ensure that Santos IMT roles and MSP/subcontractor monitoring roles are familiar with the SMP activation arrangements while providing spot checks on resource availability. Santos has previously also undertaken an audit of the MSP 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

The Santos approach to undertaking a baseline assessment is to first consider the nature and scale of the worst-case spill scenarios within the overall Santos EMBA. For activities where the worst-case scenarios are deemed to result in the greatest potential impact a baseline assessment is undertaken, focussing on those sensitive receptors for which modelling predicts contact[22] within seven days at a probability > 5% (**Table P-1**). It is considered that contact within seven days would require an enhanced understanding of available baseline data to ensure a timely response.

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 (Oil

[22] Contact is defined as oil concentrations at sensitive receptors of >1 g/m^2 for surface oil, >10 g/m^2 shoreline oil and > 10 ppb for entrained and dissolved oil.

Spill Scientific Monitoring Baseline Data Review [SO-91-RF-20022]) looked at all high biodiversity value receptors in the EMBA.

The assessment of baseline data included:

1. A review of the following parameters for each program identified:
    - Integrated Marine and Coastal Regionalisation of Australia
    - Custodian- contact point for data
    - Spatial extent
    - Variables available for monitoring
    - Methods applied to monitoring
    - Year of most recent data capture
    - Total duration of monitoring program
    - Data completeness (number of years monitored as proportion of program duration)
    - How often data is captured
    - Appropriateness of variables (Judgement as to whether variables are appropriate for future oil spill monitoring)
    - Is there any clear indication that the monitoring will continue?
2. The quality of the following parameters was then ranked as high, medium, low or unknown:
    - Year of most recent capture:
        - 2017-2021 (if a single data capture has occurred in the last two years, then the overall program can be considered of high quality) = high
        - 2011-2016 = medium
        - <2011 = low
    - Duration
        - >4 years = high
        - 2-4 years = medium
        - 1 year = low
    - Data completeness:
        - 100% = high
        - 75-99% = medium
        - <75% = low
    - Frequency of capture
        - Annually = high
        - Bi-annually = medium
        - <Bi-annually = low
    - Appropriateness of parameters
        - High/medium/low

    Appropriateness of parameters was based on reference to the Scientific Monitoring Plan's targeted states for each receptor and considering whether the monitoring parameters were sufficient to compare against these states. Parameters were considered highly appropriate if all targeted states for a receptor could be quantified, of medium appropriateness if only some states could be quantified and low if the monitored parameters had little relevance to the targeted states of an individual receptor.

3. An overall assessment of each study program was then made as follows:
   - All parameters rated high = overall 'good'
   - At least one parameter rated medium = overall 'fair'
   - At least one parameter rated low = overall 'poor'
   - Unknown = overall not enough data to rate

The above assessment was then used to determine if 1) the baseline data available could be used to detect change in the state in the event of a significant impact – Classified as "good" in the above assessment (i.e., data was current, of reasonable duration and frequency, and employed appropriate methodologies) or 2) the existing baseline data is unlikely to be suitable to detect change in state – classified as "fair" or "poor" by the above assessment (i.e., the data was dated, infrequent, of limited duration and/or relied on inappropriate methodologies). Following this assessment, a scientific monitoring protection priority area (SMPPA) by SMP matrix summarising recommendations on baseline data status and recommendations for further action was developed (**Table P-2**) based on three categories:

+ **Not applicable** – SMP is not applicable to the scientific monitoring priority protection area as sensitive receptor does not occur.
+ **Survey** – current monitoring/knowledge is considered sufficient (i.e., could be used to detect change in state in the event of a significant impact) and is considered a lower priority for post-spill pre-impact data collection.
+ **Priority survey** – current monitoring/knowledge is insufficient, not in place or not practicable; or a baseline assessment has not been undertaken. Post-spill pre-impact baseline data collection should be prioritised.

The next comprehensive baseline review will occur in early 2023 and will include all SMPPAs within the overall Santos EMBA.

MEFF Plug and Abandonment

The scientific monitoring protection areas for this activity are presented in **Table P-1**. A baseline review has previously been undertaken for all identified locations apart from the Rowley Shoals Surrounds. **Table P-2** outlines the outcome of the baseline assessment and recommendations for response at the time of a spill. For the Rowley Shoals, given a baseline review has previously not been undertaken, a precautionary approach was applied, and 'priority survey' assigned for all applicable SMPs.

Table P-3 outlines the required scientific monitoring capability for rapid response per SMPPA. When determining actual team capability, personnel were only allocated to a single SMP team, unless otherwise stated. The list of scientific monitoring protection priority areas (**Table P-1)** is based on stochastic modelling data, and it is therefore unlikely that all of these receptors would be contacted, or contacted within 7 days, during a spill event. For example, in consideration of the oceanic currents and prevailing winds that occur in the north-west of Australia, a LOWC that impacts the Rowley Shoals surrounds within 7 days is unlikely to contact Ningaloo Offshore, Montebello AMP and Dampier AMP within the same time frame or potentially may not contact some locations at all. At the time of a spill, oil spill trajectory modelling, and aerial and vessel based surveillance would be used to determine where scientific monitoring response teams should be sent.

In the unlikely event of shoreline contact in less than 72 hours, alternative approaches exist for detecting impacts where it is not feasible to conduct first-strike pre-impact baseline surveys prior to shoreline contact, for example, impact sites versus multiple control sites and/or a gradient approach. Pre-impact baseline information can also be strengthened by using retrospective remote sensing data for the quantification of baseline conditions to feed into post-spill monitoring designs for interpretation of environmental impact and ecosystem recovery. 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.

The results of the Baseline Data Review document (SO-91-RF-20022) and subsequent baseline and capability assessment of SMPPAs summarised herein (but detailed further in *Oil Spill Scientific Monitoring – Baseline Data Review Part 1 - Priority Protection Area Update, February 2021* [SO-91-RI-20114]) has been provided within the Environment Functional Team Folder on the Emergency Response Intranet page (with further updates pending the completion of the baseline review) so that this information is accessible to guide Santos IMT Environmental roles and monitoring provider roles in the event of activating oil spill scientific monitoring.

Table P-1: MEFF plug and abandonment modelling results for locations with a probability of contact >5% and <7 days (GHD, 2022)

Shoreline contact-locations	Total contact probability (%) shoreline oil >10 g/m²	Minimum arrival time >10 g/m² (days)
Subsea LOWC		
Dampier Archipelago	15.3	5.5
Surface LOWC		
No contact < 7 days		
Floating contact locations	**Total contact probability (%) floating oil >1 g/m²**	**Minimum arrival time > 1 g/m² (days)**
Subsea LOWC		
Glomar Shoals	20.7	3.7
Rowley Shoals surrounds	30.0	6.3
Surface LOWC		
Glomar Shoals	17.3	4.4
Rowley Shoals surrounds	31.3	6.4
Submerged locations	**Total contact probability (%) total submerged oil >10 ppb**	**Minimum arrival time >10 ppb (days)**
Subsea LOWC		
Glomar Shoals	14.0	3.7
Montebello AMP	45.3	3.9
Ningaloo - Offshore	63.3	3.1
Surface LOWC		
Glomar Shoals	15.3	3.8
Rankin Bank	16.7	5.9
Montebello AMP	44.0	6.6
Ningaloo - Offshore	68.0	2.7

Table P-2: Summary of recommendations for further action based on review of available baseline data

SMP	Scientific monitoring priority protection areas (SMPPAs)					
	Dampier Archipelago	Glomar Shoals*	Rankin Bank*	Rowley Shoals surrounds*	Montebello AMP	Ningaloo Offshore*
Water Quality (SMP1)	Priority Survey	Priority Survey	Priority Survey	Priority Survey	Priority Survey	Priority Survey
Sediment Quality (SMP2)	Priority Survey	Priority Survey	Priority Survey	Priority Survey	Priority Survey	Priority Survey
Sandy Beaches/Rocky Shorelines (SMP3)	Priority Survey	Not Applicable	Not Applicable	Not Applicable	Priority Survey	Not Applicable
Mangroves (SMP4)	Survey	Not Applicable	Not Applicable	Not Applicable	Survey	Not Applicable
Intertidal Mudflats (SMP5)	Priority Survey	Not Applicable	Not Applicable	Not Applicable	Priority Survey	Not Applicable
Benthic Habitats (SMP6)	Priority Survey	Priority Survey	Priority Survey	Priority Survey	Priority Survey	Survey
Seabirds/ shorebirds (SMP7)	Priority Survey	Priority Survey	Priority Survey	Priority Survey	Priority Survey	Priority Survey
Marine megafauna (SMP8)	Survey	Survey	Survey	Priority Survey	Survey	Survey
Marine reptiles (SMP9)	Survey	Priority Survey	Priority Survey	Priority Survey	Priority Survey	Priority Survey
Seafood Quality (SMP10)	Survey	Priority Survey	Priority Survey	Priority Survey	Survey	Priority Survey
Fish, Fisheries & Aquaculture (SMP11)	Priority Survey	Priority Survey	Priority Survey	Priority Survey	Priority Survey	Priority Survey
Whale sharks (SMP12)	Not Applicable	Priority Survey	Priority Survey	Not Applicable	Priority Survey	Survey

** Fully submerged receptor*

Santos

Table P-3: Capability assessment for rapid sampling of scientific monitoring protection priority areas within seven days

SMP	Required capability for rapid response (per Scientific Monitoring Priority Area)	Team capability	Summary of team capability
Water Quality (SMP1) Sediment Quality (SMP2)	1 team of 2 personnel + At least one member in each team to have experience in water sampling + At least one member to have experience in deep sea sediment sampling	2 teams of 2 available	4 potential field team members all with water sampling experience and vessel-based sediment sampling experience (3 FTLs, 2 TMs and 1 FS), 1 office-based TA and 3 office support
Sandy Beaches/Rocky Shorelines (SMP3) Intertidal Mudflats (SMP5)	1 team of 2 personnel + At least one team member with experience in shoreline macrofauna/ infauna assessment	3 teams of 2 available	6 potential field team members all with shoreline assessment experience (3 FTLs and 2 TMs and 1 FS), 1 office-based TA and 3 office support
Mangroves (SMP4)	Not required[3]		
Benthic Habitats (SMP6)	1 team of 2 personnel + At least one team member with experience in benthic habitat assessment ROV operator or divers	2 teams of 2 available	4 potential field team members all with benthic habitat assessment experience (2 FTLs [1 is ADAS diver], 1 TM [with ROV operator experience] and 1 FS), 1 office-based TA and 3 office support
Seabirds/ shorebirds (SMP7)	1 ground-based survey team of 2 personnel [2] + At least one member be an experienced ornithologist	4 teams of 2 available	11 potential field team members (4 FTLs (experienced ornithologists), 5 Moderate Experience, 2 Low Experience)
Marine megafauna (SMP8) (including whale sharks)	1 aerial survey team of 2 personnel [1,4] + Both to be experienced wildlife observers 1 vessel-based survey team of 2 personnel [1,5] + Both to be experienced wildlife observers	Aerial: 2 teams of 2 available Vessel: 2 teams of 2 available	9 potential field team members (7 FTLs (experienced wildlife observers), 2 Relevant Experience)

SMP	Required capability for rapid response (per Scientific Monitoring Priority Area)	Team capability	Summary of team capability
Marine reptiles (SMP9)	1 aerial survey team of 2 personnel [1,4] + Both to be experienced wildlife observers 1 vessel-based survey team of 2 personnel [1,5] + Both to be experienced wildlife observers 1 ground-based survey team of 2 personnel [2] + At least one member with experience in turtle survey techniques	Aerial: 2 teams of 2 available[1] Vessel: 3 teams of 2 available[1] Ground: 3 teams of 2 available[2]	14 potential field team members (10 FTLs (7 experienced wildlife observers and 3 turtle survey experience), 5 Relevant Experience)
Seafood Quality (SMP10) Fish, Fisheries & Aquaculture (SMP11)	1 team of 3 personnel + At least one member to have experience in fish identification and necropsy + At least one member to have BRUV experience	2 teams of 3 available	6 potential field team members with fish identification and necropsy experience and/or BRUV experience (3 FTLs, 4 TMs and 2 FS), 1 office based TA and 3 office support

[1]*Aerial and vessel surveys could be conducted by the same team. The aerial-based surveys would be conducted first and then this would help inform target areas for vessel-based surveys.*

[2]*Ground based surveys for shorebirds/seabirds and marine reptiles could be conducted concurrently by one survey team per location.*

[3]*Remote sensing data would be collected for mangroves, with no field team required to be mobilised.*

[4]*Aerial surveys for marine mammals and reptiles could be conducted by the same team, provided they have the appropriate skills and targeting the applicable areas for the target species.*

[5]*Vessel-based surveys for marine mammals and reptiles could be conducted by the same team per location, provided they have the appropriate skills and targeting the applicable areas for the target species.*

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. Further information on FOBs is provided in the Santos Oil Spill Response – Forward Operating Base Guideline (SO-91-IF-20017).

Forward Operating Base (FOB)

For a significant Level 2/3 response requiring coordination of resources to be deployed to the field, Santos will establish an FOB. For a level 2/3 spill crossing from Commonwealth to State waters (cross-jurisdictional spills) DoT will establish an FOB.

For a MEFF plug and abandonment activity spill response, Santos will establish an FOB at the Santos Dampier facilities leased from Toll Energy. These facilities are located in Toll Energy's Yard 1 and Yard 2 on Streckfuus Road Dampier; the facilities consist of a conference room and multiple offices that could be used as break-out rooms. The Toll Energy Dampier facilities are connected to the Santos internet and telephone system. These facilities are also available to the DoT to establish an FOB for State based response.

Additional FOBs may be set up as operational requirements dictate. Based on shoreline areas that might be impacted, potential additional FOB locations include Port Hedland, Broome and Exmouth. Refer to Santos Oil Spill Response – Forward Operating Base Guideline (SO-91-IF-20017) for details on the other potential FOB locations.

Santos

Appendix R Cumulative Response Capability Assessment

Table R-1 below shows the total cumulative worst-case response needs for the MEFF plug and abandonment activities. The table assesses the accumulative requirement for personnel based on a LOWC incident for the MEFF plug and abandonment activity against the Santos resource capability. It must be noted, that during a real event, the resourcing may be different to the below based on operational NEBA. This is presented for an assessment purpose only, to ensure adequate resources are available for response strategy implementation.

Table R-2 and **Table R-3** provide additional detail on personnel requirements for Surface Dispersant Application.

The personnel numbers in **Table R-1** represent the operational requirements. Additionally, it is assumed the total number of personnel required would be approximately 50% greater to cover shift arrangements to manage responder fatigue. It is estimated that 80 skilled field response personnel will be required to allow for shift changes across the response. Additional personnel requirements will be resourced through a combination of the following:

+ Ad-hoc training for specific response strategy needs on a just-in-time basis; and
+ Sourcing of additional personnel from OSROs on a case-by-case/ best endeavours basis.

Surge capacity to cover shift changeovers during peak periods will occur well into the response (week ten onwards) allowing adequate time to make arrangements with OSRO’s and/or complete any Just-In-Time training required to boost trained personnel numbers.

Table R-1: Cumulative Response Capability Assessment

Function	Response Strategy	MEFF Plug and Abandonment Peak Response Need Requirement	Capability to meet MEFF plug and abandonment requirement					
			Santos	AMOSC staff	Industry Core Group	OSRL	TRG	Mutual Aid, Contractors and Service Providers
Source control [23]		39	39	-	-	-	-	Additional personnel available from WWC and Oceaneering[24]
Monitor and Evaluate	Vessel surveillance	2 vessel crew	-	-	-	-	-	2 vessel crew
	Aerial surveillance[25]	2 aerial observers 1 flight crew	-	1 aerial observer	1 aerial observer	-	-	1 flight crew
	Tracking buoys	1 vessel crew	-	-	-	-	-	1 vessel crew
	Oil spill trajectory modelling	*Services provided with no specific personal numbers required.*						
	Satellite imagery	*Services provided with no specific personal numbers required.*						
	Initial oil characterisation	1 vessel crew	-	-	-	-	-	1 vessel crew (Santos contracted vessel provider)
	Operational water quality monitoring	1 field team 1 vessel crew	-	-	-	-	-	1 field team of 3 personnel (1 Team Leader/ 2 Team Members) 1 vessel crew

[23] The cumulative capability for Source Control is assessed on its own, as the resources do not impact other strategy implementation. 60 Santos source control personnel available.
[24] WWC has confirmed availability of 34 source control personnel.
[25] Based on 1 aircraft conducting 2 sorties per day.

Function	Response Strategy	MEFF Plug and Abandonment Peak Response Need Requirement	Capability to meet MEFF plug and abandonment requirement					
			Santos	AMOSC staff	Industry Core Group	OSRL	TRG	Mutual Aid, Contractors and Service Providers
	Shoreline clean-up assessment technique (SCAT) resources as per **Table 10-40**	Maximum of 21 Teams (each with 1 Team Leader and 1-2 Team Members)	4 SCAT Team Leaders	7 SCAT Team Leaders	10 SCAT Team Leaders	Available on request		Labour hire: 42 Up to 2,000 Team Members available, who can complete shoreline assessment training, working under direction of Team Leader (contracted work force hire company).
Containment and recovery		6 (1 C&R system, each with 1 x vessel master, 1 x Supervisor, 4 x deployment crew)	-	-	1	-	-	Vessel contracted: Vessel masters and deployment crew (5)
Mechanical dispersion		*n/a – personnel as per vessel availability*	-	-	-	-	-	As per in-field vessel availability
Chemical dispersant application	Surface application: Vessel systems (as per **Table R-2**)	7 total, as per **Table R-2**	-	1	-	1	-	Labour Hire: 2 Vessel contracted: 3
	Surface application: Aircraft systems (as per **Table R-3**)	15 total, as per **Table R-3**	-	Air Attack Sup.: 1	-	-	-	FWAD Contract: 12 Air Attack Helicopter (Santos contracted): 2

Function	Response Strategy	MEFF Plug and Abandonment Peak Response Need Requirement	Capability to meet MEFF plug and abandonment requirement					
			Santos	AMOSC staff	Industry Core Group	OSRL	TRG	Mutual Aid, Contractors and Service Providers
	Subsea injection	8 + vessel contracted numbers	Santos Company Rep.: 1[26]	-	-	-	-	Oceaneering staff (via AMOSC SFRT contract): 3 WWC SSDI staff via contract: 4 SFRT vessel through contracted vessel providers – vessel personnel as per contract.
Shoreline protection and deflection	P&D resources as per **Table 14-5**	14 x team leaders 126 x Protection and deflection operatives (9 per team x 14 teams) 28 x vessel crew (2 per team x 14 teams)	-	-	10 Protection and Deflection Supervisors	4 Protection and Deflection Supervisors	-	Labour Hire: 126 Vessel personnel as per contract.
Shoreline clean-up resources as per **Table 15-5**.		12 teams: 12 Shoreline Clean-up Supervisors 120 team members	4 Shoreline Clean-up Sup.	-	8 Shoreline Clean-up Sup.	-	-	Labour Hire: 120 team members, working under direction of Shoreline Clean-up Supervisors
Oiled wildlife response		93	Sourced as per the WAOWRP arrangements (High predicted impact) (DBCA, 2022a)					
Waste management		*n/a – personnel as per shoreline clean-up and OWR resourcing*	-	-	-	-	-	WSP to provide personnel under existing contract to collect and transport waste
Scientific monitoring		21[27]	-	-	-	-	-	21 from MSPs

[26] From additional available numbers from source control.

[27] As per the resourcing requirements in **Table P-3**.

Function	Response Strategy	MEFF Plug and Abandonment Peak Response Need Requirement	Capability to meet MEFF plug and abandonment requirement					
			Santos	AMOSC staff	Industry Core Group	OSRL	TRG	Mutual Aid, Contractors and Service Providers
Response need (excluding Source Control)			8	10	30	5		*Santos has either contracts in place, or can appoint ad-hoc contracts, to resource the above numbers required.*
Response need including +50% for shift change			12	15	45	8		
Total Available (excluding Source Control)			12	16	84[28]	18		
Total Required Source Control			39	-	-	-		Additional personnel available from WWC and Oceaneering
Total Source Control			39	-	-	-		

[28] 84 as per the AMOSC policy, however August 2022 Core Group report total states 100 personnel in total.

Table R-2: Vessel dispersant application – field resourcing requirements

Vessel dispersant resource	No. required per vessel (minimum)	No. vessels	Total no. required	Source of personnel
Support location (onshore FOB, likely to be Dampier)				
FOB Dispersant Lead	n/a	n/a	1	AMOSC/ AMOSC Core Group
Dispersant hand			2	Labour hire
		FOB Total:	**3**	
At application site (at sea ops.)				
Vessel Master	1	1	1	Vessel contract
Supervisor	1		1	OSRL
Deckhand	2		2	Vessel contract
		At sea ops. total:	**4**	
		Total personnel:	**7**	

Table R-3: FWADC aerial dispersant application – Field resourcing requirements

Aerial dispersant resource	No. required per aircraft	No. aircraft	Total no. required	Source of personnel
Support location (AMOSC FWADC Airbase FOB, likely to be Karratha [IATA: KTA])*				
FOB Commander*	*n/a*	*n/a*	1	AMOSC FWADC contract
Airbase Manager*			1	AMOSC FWADC contract
Safety Officer*			1	AMOSC FWADC contract
Dispersant Operations Coordinator*			1	AMOSC FWADC contract
Dispersant Loading Crew*			2	AMOSC FWADC contract
Log/Admin*			1	AMOSC FWADC contract
		Airbase FOB total:	**7**	
AMOSC FWADC Dispersant Ops. Group (at sea ops. at application site)				
Dispersant Application Air Tractors				
Air Tractor Pilot†	1	1	1	AMOSC FWADC contract
Air Tractor First Officer†	1	1	1	AMOSC FWADC contract
Air Attack Helicopters				
Air Attack Helicopter Pilot†	1	1	1	Santos contracted
Air Attack Helicopter First Officer†	1	1	1	Santos contracted
Air Attack Supervisor*	1	1	1	AMOSC
		Dispersant Group total:	**5**	
AMOSC FWADC Observation Group				
Aerial Surveillance Pilot†	1	1	1	AMOSC FWADC contract
Aerial Surveillance First Officer†	1	1	1	AMOSC FWADC contract
Aerial Observer*	1	1	1	AMOSC FWADC contract
		Observation Group total:	**3**	
		Total personnel:	**15**	

* These roles as per Aerotech First Response (AFR)/ AMOSC/ Core Group fixed wing aerial response personnel resourcing in AMOSC FWADOps Plan (*AMOSC, 2020*).

† As stated in the FWADOps Plan, these roles are subject to Civil Aviation Safety Authority (CASA) requirements. The numbers stated above are reasonable estimates.