Appendix A

Matters of National Environmental Significance Report

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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- Summary
- Details
  - Matters of NES
  - Other Matters Protected by the EPBC Act
  - Extra Information
- Caveat
- Acknowledgements

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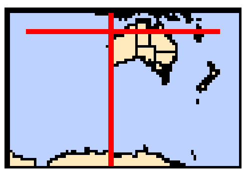
Coordinates
Buffer: 1.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	1
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	54
Listed Migratory Species:	75

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	4
Commonwealth Heritage Places:	5
Listed Marine Species:	134
Whales and Other Cetaceans:	33
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	16

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	18
Regional Forest Agreements:	None
Invasive Species:	11
Nationally Important Wetlands:	5
Key Ecological Features (Marine)	11

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
The Ningaloo Coast	WA	Listed place

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Ashmore reef national nature reserve	Within Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west
South-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Diomedea amsterdamensis		
Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea exulans		
Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata andrewsi		
Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Foraging, feeding or related behaviour known to occur within area
Limosa lapponica baueri		
Bar-tailed Godwit (baueri), Western Alaskan Bar-	Vulnerable	Species or species

Name	Status	Type of Presence
tailed Godwit [86380]		habitat may occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Malurus leucopterus edouardi White-winged Fairy-wren (Barrow Island), Barrow Island Black-and-white Fairy-wren [26194]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat likely to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Fish		
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or

Name	Status	Type of Presence
		related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Bettongia lesueur Barrow and Boodie Islands subspecies Boodie, Burrowing Bettong (Barrow and Boodie Islands) [88021]	Vulnerable	Species or species habitat known to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Isoodon auratus barrowensis Golden Bandicoot (Barrow Island) [66666]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes conspicillatus conspicillatus Spectacled Hare-wallaby (Barrow Island) [66661]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus Central Australian subspecies Mala, Rufous Hare-Wallaby (Central Australia) [88019]	Endangered	Translocated population known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Osphranter robustus isabellinus Barrow Island Wallaroo, Barrow Island Euro [89262]	Vulnerable	Species or species habitat likely to occur within area
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Other		
Kumonga exleyi Cape Range Remipede [86875]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Ctenotus zastictus Hamelin Ctenotus [25570]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea		
Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Sharks		
Carcharias taurus (west coast population)		
Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Glyphis garricki		
Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Pristis clavata		
Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus		
Common Noddy [825]		Breeding known to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna pacifica		
Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas		
Streaked Shearwater [1077]		Species or species habitat known to occur within area
Diomedea amsterdamensis		
Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea exulans		
Wandering Albatross [89223]	Vulnerable	Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Foraging, feeding or related behaviour known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Congregation or aggregation known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat likely to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat likely to occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or

Name	Threatened	Type of Presence
		aggregation known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat may occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Defence - EXMOUTH ADMIN & HF TRANSMITTING
Defence - EXMOUTH VLF TRANSMITTER STATION
Defence - LEARMONTH - AIR WEAPONS RANGE

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Ashmore Reef National Nature Reserve	EXT	Listed place
Learmonth Air Weapons Range Facility	WA	Listed place
Mermaid Reef - Rowley Shoals	WA	Listed place
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place
Scott Reef and Surrounds - Commonwealth Area	EXT	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous minutus Black Noddy [824]		Breeding known to occur within area
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat may occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Species or species habitat may occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Foraging, feeding or related behaviour known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area

Name	Threatened	Type of Presence
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Breeding known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat likely to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence
		to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Sterna albifrons Little Tern [813]		Congregation or aggregation known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area
Fish		

Name	Threatened	Type of Presence
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus fuscus Dusky Seasnake [1119]		Species or species habitat known to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area

Name	Threatened	Type of Presence
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans

[Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Indopacetus pacificus Longman's Beaked Whale [72]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale		Species or species

Name	Status	Type of Presence
[74]		habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Species or species habitat known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks

[Resource Information]

Name	Label

Name	Label
Abrolhos	Habitat Protection Zone (IUCN IV)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Ashmore Reef	Recreational Use Zone (IUCN IV)
Ashmore Reef	Sanctuary Zone (IUCN Ia)
Carnarvon Canyon	Habitat Protection Zone (IUCN IV)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
Gascoyne	National Park Zone (IUCN II)
Kimberley	Multiple Use Zone (IUCN VI)
Mermaid Reef	National Park Zone (IUCN II)
Montebello	Multiple Use Zone (IUCN VI)
Ningaloo	National Park Zone (IUCN II)
Ningaloo	Recreational Use Zone (IUCN IV)
Shark Bay	Multiple Use Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Airlie Island	WA
Barrow Island	WA
Bessieres Island	WA
Boodie, Double Middle Islands	WA
Bundegi Coastal Park	WA
Cape Range	WA
Jurabi Coastal Park	WA
Lowendal Islands	WA
Montebello Islands	WA
Muiron Islands	WA
North Sandy Island	WA
Round Island	WA
Serrurier Island	WA
Unnamed WA40322	WA
Unnamed WA40828	WA
Unnamed WA41080	WA
Unnamed WA44665	WA
Unnamed WA44667	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus		
House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus		
Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris		
Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Ashmore Reef	EXT
Bundera Sinkhole	WA
Cape Range Subterranean Waterways	WA
Learmonth Air Weapons Range - Saline Coastal Flats	WA
Mermaid Reef	EXT

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Ancient coastline at 125 m depth contour	North-west
Ashmore Reef and Cartier Island and surrounding	North-west
Canyons linking the Argo Abyssal Plain with the	North-west
Canyons linking the Cuvier Abyssal Plain and the	North-west
Commonwealth waters adjacent to Ningaloo Reef	North-west
Continental Slope Demersal Fish Communities	North-west
Exmouth Plateau	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters	North-west
Seringapatam Reef and Commonwealth waters in	North-west
Western demersal slope and associated fish	South-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-10.465 111.404,-10.465 112.146,-10.699 113.296,-10.507 113.505,-10.373 114.924,-10.607 115.997,-10.974 116.747,-12.066 118.264,-12.182 119.073,-12.249 119.539,-12.716 119.881,-12.716 120.698,-12.366 121.106,-11.832 120.806,-11.541 120.248,-12.141 123.115,-13.191 123.357,-13.124 122.923,-14.033 122.282,-14.858 121.732,-15.7 121.907,-17.042 120.914,-17.092 121.348,-17.459 121.106,-17.992 119.698,-18.642 119.206,-19.084 118.431,-19.859 117.989,-20.184 116.522,-21.218 115.597,-22.001 114.147,-21.768 114.113,-21.959 113.93,-22.66 113.672,-23.474 113.651,-23.943 113.363,-24.202 112.58,-25.552 112.196,-26.052 111.963,-25.652 111.446,-25.269 111.713,-24.627 111.521,-24.152 110.854,-24.343 110.129,-24.385 109.287,-25.102 108.72,-24.96 107.595,-23.176 106.887,-22.701 106.47,-21.784 105.928,-21.426 106.62,-20.668 106.937,-20.017 106.587,-18.35 106.253,-17.7 106.512,-17.108 106.978,-16.45 107.037,-15.216 107.687,-14.191 108.337,-13.633 108.812,-13.149 107.445,-12.382 106.787,-12.357 107.012,-12.999 107.704,-13.141 108.529,-12.382 109.029,-13.208 110.037,-12.899 110.329,-12.441 111.263,-13.233 112.08,-11.682 114.463,-10.949 111.013,-10.465 111.404

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 03/09/19 12:13:39

- Summary
- Details
  - Matters of NES
  - Other Matters Protected by the EPBC Act
  - Extra Information
- Caveat
- Acknowledgements

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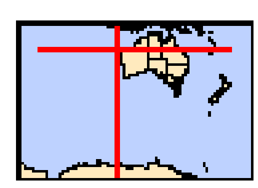
Coordinates
Buffer: 20.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	4
National Heritage Places:	9
Wetlands of International Importance:	9
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	14
Listed Threatened Species:	234
Listed Migratory Species:	107

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	31
Commonwealth Heritage Places:	29
Listed Marine Species:	211
Whales and Other Cetaceans:	43
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	1
Australian Marine Parks:	43

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	283
Regional Forest Agreements:	1
Invasive Species:	66
Nationally Important Wetlands:	45
Key Ecological Features (Marine)	24

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Status
Australian Convict Sites (Fremantle Prison Buffer Zone)	WA	Buffer zone
Australian Convict Sites (Fremantle Prison)	WA	Declared property
Shark Bay, Western Australia	WA	Declared property
The Ningaloo Coast	WA	Declared property

National Heritage Properties [Resource Information]

Name	State	Status
Natural		
Lesueur National Park	WA	Listed place
Shark Bay, Western Australia	WA	Listed place
The Ningaloo Coast	WA	Listed place
The West Kimberley	WA	Listed place
Indigenous		
Dampier Archipelago (including Burrup Peninsula)	WA	Listed place
Historic		
Batavia Shipwreck Site and Survivor Camps Area 1629 - Houtman Abrolhos	WA	Listed place
Dirk Hartog Landing Site 1616 - Cape Inscription Area	WA	Listed place
Fremantle Prison (former)	WA	Listed place
HMAS Sydney II and HSK Kormoran Shipwreck Sites	EXT	Listed place

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Ashmore reef national nature reserve	Within Ramsar site
Becher point wetlands	Within Ramsar site
Eighty-mile beach	Within Ramsar site
Forrestdale and thomsons lakes	Within Ramsar site
Hosnies spring	Within Ramsar site
Peel-yalgorup system	Within Ramsar site
Roebuck bay	Within Ramsar site
The dales	Within Ramsar site
Vasse-wonnerup system	Within Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea
Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North
North-west
South-west

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Aquatic Root Mat Community 4 in Caves of the Leeuwin Naturaliste Ridge	Endangered	Community known to occur within area
Aquatic Root Mat Community in Caves of the Swan Coastal Plain	Endangered	Community known to occur within area
Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain	Endangered	Community known to occur within area
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area
Clay Pans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	Endangered	Community known to occur within area
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Endangered	Community likely to occur within area
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain	Endangered	Community known to occur within area
Shrublands on southern Swan Coastal Plain ironstones	Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
Thrombolite (microbial) community of coastal freshwater lakes of the Swan Coastal Plain (Lake Richmond)	Endangered	Community known to occur within area
Thrombolite (microbialite) Community of a Coastal Brackish Lake (Lake Clifton)	Critically Endangered	Community known to occur within area
Tuart (Eucalyptus gomphocephala) Woodlands and Forests of the Swan Coastal Plain ecological community	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Accipiter hiogaster natalis Christmas Island Goshawk [82408]	Endangered	Species or species habitat known to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Breeding known to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Chalcophaps indica natalis Christmas Island Emerald Dove, Emerald Dove (Christmas Island) [67030]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Breeding known to occur within area
Geophaps smithii blaauwi Partridge Pigeon (western) [66501]	Vulnerable	Species or species habitat likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Malurus leucopterus edouardi White-winged Fairy-wren (Barrow Island), Barrow Island Black-and-white Fairy-wren [26194]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Malurus leucopterus leucopterus White-winged Fairy-wren (Dirk Hartog Island), Dirk Hartog Black-and-White Fairy-wren [26004]	Vulnerable	Species or species habitat likely to occur within area
Ninox natalis Christmas Island Hawk-Owl, Christmas Boobook [66671]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Breeding likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat known to occur within area
Pterodroma arminjoniana Round Island Petrel, Trinidade Petrel [89284]	Critically Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Turdus poliocephalus erythropleurus Christmas Island Thrush [67122]	Endangered	Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Turnix varius scintillans Painted Button-quail (Houtman Abrolhos) [82451]	Vulnerable	Species or species habitat likely to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat likely to occur within area
Crustaceans		
Cherax tenuimanus Hairy Marron, Margaret River Hairy Marron, Margaret River Marron [78931]	Critically Endangered	Species or species habitat may occur within area
Engaewa reducta Dunsborough Burrowing Crayfish [82675]	Critically Endangered	Species or species habitat known to occur within area
Fish		
Galaxiella nigrostriata Blackstriped Dwarf Galaxias, Black-stripe Minnow [88677]	Endangered	Species or species habitat known to occur within area
Milyeringa veritas Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Nannatherina balstoni Balston's Pygmy Perch [66698]	Vulnerable	Species or species habitat known to occur within area
Ophisternon candidum Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Insects		
Hesperocolletes douglasi Douglas' Broad-headed Bee, Rottnest Bee [66734]	Critically Endangered	Species or species habitat known to occur within area
Leioproctus douglasiellus a short-tongued bee [66756]	Critically Endangered	Species or species habitat known to occur within area
Neopasiphae simplicior A native bee [66821]	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Bettongia lesueur Barrow and Boodie Islands subspecies Boodie, Burrowing Bettong (Barrow and Boodie Islands) [88021]	Vulnerable	Species or species habitat known to occur within area
Bettongia lesueur lesueur Burrowing Bettong (Shark Bay), Boodie [66659]	Vulnerable	Species or species habitat known to occur within area
Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat likely to occur within area
Crocidura trichura Christmas Island Shrew [86568]	Critically Endangered	Species or species habitat likely to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isoodon auratus auratus Golden Bandicoot (mainland) [66665]	Vulnerable	Species or species habitat likely to occur within area
Isoodon auratus barrowensis Golden Bandicoot (Barrow Island) [66666]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes conspicillatus conspicillatus Spectacled Hare-wallaby (Barrow Island) [66661]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus Central Australian subspecies Mala, Rufous Hare-Wallaby (Central Australia) [88019]	Endangered	Translocated population known to occur within area
Lagorchestes hirsutus bernieri Rufous Hare-wallaby (Bernier Island) [66662]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus dorreae Rufous Hare-wallaby (Dorre Island) [66663]	Vulnerable	Species or species habitat known to occur within area
Lagostrophus fasciatus fasciatus Banded Hare-wallaby, Merrnine, Marnine, Munning [66664]	Vulnerable	Species or species habitat known to occur within area
Leporillus conditor Wopilkara, Greater Stick-nest Rat [137]	Vulnerable	Translocated population known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat known to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Myrmecobius fasciatus Numbat [294]	Endangered	Species or species habitat known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Breeding known to occur within area
Osphranter robustus isabellinus Barrow Island Wallaroo, Barrow Island Euro [89262]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Parantechinus apicalis Dibbler [313]	Endangered	Species or species habitat known to occur within area
Perameles bougainville bougainville Western Barred Bandicoot (Shark Bay) [66631]	Endangered	Species or species habitat known to occur within area
Petrogale concinna monastria Nabarlek (Kimberley) [87607]	Endangered	Species or species habitat known to occur within area
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Moororong, Black-footed Rock Wallaby [66647]	Endangered	Species or species habitat known to occur within area
Phascogale tapoatafa kimberleyensis Kimberley brush-tailed phascogale, Brush-tailed Phascogale (Kimberley) [88453]	Vulnerable	Species or species habitat likely to occur within area
Pipistrellus murrayi Christmas Island Pipistrelle [64383]	Critically Endangered	Species or species habitat known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Breeding known to occur within area
Pseudomys fieldi Shark Bay Mouse, Djoongari, Alice Springs Mouse [113]	Vulnerable	Species or species habitat likely to occur within area
Pteropus natalis Christmas Island Flying-fox, Christmas Island Fruit-bat [87611]	Critically Endangered	Roosting known to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat likely to occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat known to occur within area
Xeromys myoides Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat may occur within area
Other		
Idiosoma nigrum Shield-backed Trapdoor Spider, Black Rugose Trapdoor Spider [66798]	Vulnerable	Species or species habitat known to occur within area
Kumonga exleyi Cape Range Remipede [86875]	Vulnerable	Species or species habitat known to occur within area
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	Vulnerable	Species or species habitat known to occur within area
Plants		
Acacia anomala Grass Wattle, Chittering Grass Wattle [8153]	Vulnerable	Species or species habitat likely to occur within area
Acacia forrestiana Forest's Wattle [17235]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat known to occur within area
Androcalva bivillosa Straggling Androcalva [87807]	Critically Endangered	Species or species habitat known to occur within area
Anigozanthos viridis subsp. terraspectans Dwarf Green Kangaroo Paw [3435]	Vulnerable	Species or species habitat known to occur within area
Asplenium listeri Christmas Island Spleenwort [65865]	Critically Endangered	Species or species habitat known to occur within area
Austrostipa bronwenae [87808]	Endangered	Species or species habitat known to occur within area
Austrostipa jacobsiana [87809]	Critically Endangered	Species or species habitat known to occur within area
Banksia mimica Summer Honeypot [82765]	Endangered	Species or species habitat known to occur within area
Banksia nivea subsp. uliginosa Swamp Honeypot [82766]	Endangered	Species or species habitat known to occur within area
Banksia squarrosa subsp. argillacea Whicher Range Dryandra [82769]	Vulnerable	Species or species habitat known to occur within area
Beyeria lepidopetala Small-petalled Beyeria, Short-petalled Beyeria [18362]	Endangered	Species or species habitat likely to occur within area
Brachyscias verecundus Ironstone Brachyscias [81321]	Critically Endangered	Species or species habitat likely to occur within area
Caladenia barbarella Small Dragon Orchid, Common Dragon Orchid [68686]	Endangered	Species or species habitat likely to occur within area
Caladenia bryceana subsp. cracens Northern Dwarf Spider-orchid [64556]	Vulnerable	Species or species habitat known to occur within area
Caladenia busselliana Bussell's Spider-orchid [24369]	Endangered	Species or species habitat known to occur within area
Caladenia caesarea subsp. maritima Cape Spider-orchid [64856]	Endangered	Species or species habitat known to occur within area
Caladenia elegans Elegant Spider-orchid [56775]	Endangered	Species or species habitat known to occur within area
Caladenia excelsa Giant Spider-orchid [56717]	Endangered	Species or species habitat likely to occur within area
Caladenia hoffmanii Hoffman's Spider-orchid [56719]	Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Caladenia lodgeana Lodge's Spider-orchid [68664]	Critically Endangered	Species or species habitat known to occur within area
Caladenia procera Carbunup King Spider Orchid [68679]	Critically Endangered	Species or species habitat known to occur within area
Caladenia viridescens Dunsborough Spider-orchid [56776]	Endangered	Species or species habitat known to occur within area
Calectasia cyanea Blue Tinsel Lily [7669]	Critically Endangered	Species or species habitat may occur within area
Calytrix breviseta subsp. breviseta Swamp Starflower [23879]	Endangered	Species or species habitat known to occur within area
Chamelaucium sp. Gingin (N.G.Marchant 6) Gingin Wax [88881]	Endangered	Species or species habitat likely to occur within area
Chamelaucium sp. S coastal plain (R.D.Royce 4872) Royce's Waxflower [87814]	Vulnerable	Species or species habitat known to occur within area
Chorizema humile Prostrate Flame Pea [32573]	Endangered	Species or species habitat may occur within area
Chorizema varium Limestone Pea [16981]	Endangered	Species or species habitat known to occur within area
Conospermum undulatum Wavy-leaved Smokebush [24435]	Vulnerable	Species or species habitat likely to occur within area
Conostylis dielsii subsp. teres Irwin's Conostylis [3614]	Endangered	Species or species habitat likely to occur within area
Conostylis micrantha Small-flowered Conostylis [17635]	Endangered	Species or species habitat likely to occur within area
Darwinia apiculata Scarp Darwinia [8763]	Endangered	Species or species habitat known to occur within area
Darwinia whicherensis Abba Bell [83193]	Endangered	Translocated population known to occur within area
Daviesia elongata subsp. elongata Long-leaved Daviesia [64883]	Vulnerable	Species or species habitat known to occur within area
Diplolaena andrewsii [6601]	Endangered	Species or species habitat likely to occur within area
Diuris drummondii Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat known to occur within area
Drakaea concolor Kneeling Hammer-orchid [56777]	Vulnerable	Species or species habitat known to occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat known to occur within area
Drummondita ericoides Morseby Range Drummondita [9193]	Endangered	Species or species habitat known to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat known to occur within area
Eremophila glabra subsp. chlorella [84927]	Endangered	Species or species habitat known to occur within area
Eremophila sp. Narrow leaves (J.D.Start D12-150) [89307]	Critically Endangered	Species or species habitat known to occur within area
Eucalyptus argutifolia Yanchep Mallee, Wabling Hill Mallee [24263]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus beardiana Beard's Mallee [18933]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus cuprea Mallee Box [56773]	Endangered	Species or species habitat known to occur within area
Eucalyptus impensa Eneabba Mallee [56711]	Endangered	Species or species habitat likely to occur within area
Eucalyptus johnsoniana Johnson's Mallee [14516]	Vulnerable	Species or species habitat may occur within area
Eucalyptus lateritica Laterite Mallee [6271]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus leprophloia Scaly Butt Mallee, Scaly-butt Mallee [56712]	Endangered	Species or species habitat likely to occur within area
Eucalyptus suberea Cork Mallee, Mount Lesueur Mallee [5529]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus x balanites Cadda Road Mallee, Cadda Mallee [87816]	Endangered	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Eucalyptus x phylacis Meelup Mallee [87817]	Endangered	Species or species habitat known to occur within area
Gastrolobium argyrotrichum Metricup Pea [89145]	Critically Endangered	Species or species habitat known to occur within area
Gastrolobium modestum Broad-leaved Gastrolobium [78361]	Vulnerable	Species or species habitat known to occur within area
Gastrolobium papilio Butterfly-leaved Gastrolobium [78415]	Endangered	Species or species habitat known to occur within area
Goodenia arthrotricha [12448]	Endangered	Species or species habitat likely to occur within area
Grevillea batrachioides Mt Lesueur Grevillea [21735]	Endangered	Species or species habitat likely to occur within area
Grevillea brachystylis subsp. grandis Large-flowered Short-styled Grevillea [85001]	Critically Endangered	Species or species habitat known to occur within area
Grevillea bracteosa subsp. howatharra [85002]	Critically Endangered	Species or species habitat known to occur within area
Grevillea curviloba subsp. curviloba Curved-leaf Grevillea [64908]	Endangered	Species or species habitat may occur within area
Grevillea curviloba subsp. incurva Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat likely to occur within area
Grevillea elongata Ironstone Grevillea [64578]	Vulnerable	Species or species habitat likely to occur within area
Grevillea humifusa Spreading Grevillea [61182]	Endangered	Species or species habitat known to occur within area
Grevillea maccutcheonii McCutcheon's Grevillea [64522]	Endangered	Species or species habitat known to occur within area
Grevillea thelemanniana Spider Net Grevillea [32835]	Critically Endangered	Species or species habitat known to occur within area
Hakea megalosperma Lesueur Hakea [10505]	Vulnerable	Species or species habitat likely to occur within area
Hemiandra gardneri Red Snakebush [7945]	Endangered	Species or species habitat known to occur within area
Hypocalymma angustifolium subsp. Hutt River (S.Patrick 2982) [85023]	Endangered	Species or species habitat known to occur within area
Hypocalymma longifolium Long-leaved Myrtle [8081]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
Keraudrenia exastia Fringed Keraudrenia [66301]	Critically Endangered	Species or species habitat known to occur within area
Lambertia echinata subsp. occidentalis Western Prickly Honeysuckle [64528]	Endangered	Species or species habitat known to occur within area
Lechenaultia chlorantha Kalbarri Leschenaultia [16763]	Vulnerable	Species or species habitat likely to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Leucopogon marginatus Thick-margined Leucopogon [12527]	Endangered	Species or species habitat likely to occur within area
Leucopogon obtectus Hidden Beard-heath [19614]	Endangered	Species or species habitat likely to occur within area
Macarthuria keigheryi Keighery's Macarthuria [64930]	Endangered	Species or species habitat likely to occur within area
Marianthus paralius [83925]	Endangered	Species or species habitat known to occur within area
Melaleuca sp. Wanneroo (G.J. Keighery 16705) [89456]	Endangered	Species or species habitat known to occur within area
Paracaleana dixonii Sandplain Duck Orchid [86882]	Endangered	Species or species habitat known to occur within area
Petrophile latericola Laterite Petrophile [64532]	Endangered	Species or species habitat known to occur within area
Pityrodia augustensis Mt Augustus Foxglove [4962]	Vulnerable	Species or species habitat likely to occur within area
Pneumatopteris truncata fern [68812]	Critically Endangered	Species or species habitat known to occur within area
Pterostylis sinuata Northampton Midget Greenhood, Western Swan Grrenhood [84991]	Endangered	Species or species habitat known to occur within area
Ptilotus pyramidatus Pyramid Mulla-mulla [18216]	Critically Endangered	Species or species habitat known to occur within area
Sphenotoma drummondii Mountain Paper-heath [21160]	Endangered	Species or species habitat may occur within area
Stachystemon nematophorus Three-flowered Stachystemon [81447]	Vulnerable	Species or species habitat known to occur within area
Synaphea sp. Fairbridge Farm (D. Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Synaphea sp. Pinjarra (R. Davis 6578) Club-leafed Synaphea [82880]	Critically Endangered	Species or species habitat known to occur within area
Synaphea sp. Pinjarra Plain (A.S. George 17182) [86878]	Endangered	Species or species habitat likely to occur within area
Synaphea sp. Serpentine (G.R. Brand 103) [86879]	Critically Endangered	Species or species habitat known to occur within area
Synaphea stenoloba Dwellingup Synaphea [66311]	Endangered	Species or species habitat known to occur within area
Tectaria devexa [14767]	Endangered	Species or species habitat likely to occur within area
Tetraria australiensis Southern Tetraria [10137]	Vulnerable	Species or species habitat known to occur within area
Tetratheca nephelioides [83217]	Critically Endangered	Species or species habitat likely to occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat likely to occur within area
Thelymitra stellata Star Sun-orchid [7060]	Endangered	Species or species habitat known to occur within area
Trithuria occidentalis Swan Hydatella [42224]	Endangered	Species or species habitat likely to occur within area
Verticordia densiflora var. pedunculata Long-stalked Featherflower [55689]	Endangered	Species or species habitat known to occur within area
Verticordia plumosa var. ananeotes Tufted Plumed Featherflower [23871]	Endangered	Species or species habitat known to occur within area
Verticordia plumosa var. vassensis Vasse Featherflower [55804]	Endangered	Species or species habitat known to occur within area
Wurmbea calcicola Naturaliste Nancy [64691]	Endangered	Species or species habitat known to occur within area
Wurmbea tubulosa Long-flowered Nancy [12739]	Endangered	Species or species habitat known to occur within area
Reptiles		
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area

Name	Status	Type of Presence
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Cryptoblepharus egeriae Christmas Island Blue-tailed Skink, Blue-tailed Snake-eyed Skink [1526]	Critically Endangered	Species or species habitat likely to occur within area
Ctenotus lancelini Lancelin Island Skink [1482]	Vulnerable	Species or species habitat known to occur within area
Ctenotus zastictus Hamelin Ctenotus [25570]	Vulnerable	Species or species habitat known to occur within area
Cyrtodactylus sadleiri Christmas Island Giant Gecko [86865]	Endangered	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Egernia stokesii badia Western Spiny-tailed Skink, Baudin Island Spiny-tailed Skink [64483]	Endangered	Species or species habitat known to occur within area
Emoia nativitatis Christmas Island Forest Skink, Christmas Island Whiptail-skink [1400]	Critically Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Lepidodactylus listeri Christmas Island Gecko, Lister's Gecko [1711]	Critically Endangered	Species or species habitat known to occur within area
Lerista nevinae Nevin's Slider [85296]	Endangered	Species or species habitat known to occur within area
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat known to occur within area
Liopholis pulchra longicauda Jurien Bay Skink, Jurien Bay Rock-skink [83162]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Ramphotyphlops exocoeti Christmas Island Blind Snake, Christmas Island Pink Blind Snake [1262]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Breeding likely to occur within area

Name	Status	Type of Presence
Glyphis glyphis Speartooth Shark [82453]	Critically Endangered	Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Breeding known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur

Name	Threatened	Type of Presence
		within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Breeding known to occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely

Name	Threatened	Type of Presence
		to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area

Name	Threatened	Type of Presence
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella heinsohni		
Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus		
Sperm Whale [59]		Foraging, feeding or related behaviour known to occur within area
Pristis clavata		
Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis		
Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations)		
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cecropis daurica		
Red-rumped Swallow [80610]		Species or species habitat known to occur within area
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundo rustica		
Barn Swallow [662]		Species or species habitat known to occur within area
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat known to occur within area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Acrocephalus orientalis		
Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres		
Ruddy Turnstone [872]		Roosting known to occur within area

Name	Threatened	Type of Presence
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area

Name	Threatened	Type of Presence
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Christmas Island National Park
Defence - AIRTC CANNINGTON
Defence - ARTILLERY BARRACKS - FREMANTLE
Defence - BROOME TRAINING DEPOT
Defence - BUNBURY TRAINING DEPOT
Defence - CAMPBELL BARRACKS - SWANBOURNE
Defence - CARNARVON TRAINING DEPOT
Defence - EAST FREMANTLE SMALL CRAFT BASE
Defence - EXMOUTH ADMIN & HF TRANSMITTING
Defence - EXMOUTH NAVAL HF RECEIVING STATION (H/F Receiving Station, Learmonth, WA)
Defence - EXMOUTH VLF TRANSMITTER STATION
Defence - GERALDTON TRAINING DEPOT "A" Company 16th Battalion
Defence - GREENOUGH RIFLE RANGE
Defence - HMAS STIRLING-ROCKINGHAM ;HMAS STIRLING - GARDEN ISLAND
Defence - HOLDFAST BARRACKS
Defence - IRWIN BARRACKS - KARRAKATTA
Defence - LANCELIN - AIR SAFETY MARKER
Defence - LANCELIN TRAINING AREA
Defence - LEARMONTH - AIR WEAPONS RANGE

Name
Defence - LEARMONTH - RAAF BASE
Defence - LEARMONTH RADAR SITE - TWIN TANKS EXMOUTH
Defence - LEARMONTH RADAR SITE - VLAMING HEAD EXMOUTH
Defence - LEARMONTH TRANSMITTING STATION
Defence - LEEUWIN BARRACKS - EAST FREMANTLE
Defence - MUCHEA ARMAMENT RANGE
Defence - PALMER BARRACKS - SOUTH GUILDFORD
Defence - PRESTON POINT TRAINING DEPOT
Defence - ROCKINGHAM - NAVY CPSO
Defence - SWAN BARRACKS
Defence - SWANBOURNE RIFLE RANGE

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Ashmore Reef National Nature Reserve	EXT	Listed place
Christmas Island Natural Areas	EXT	Listed place
Garden Island	WA	Listed place
Lancelin Defence Training Area	WA	Listed place
Learmonth Air Weapons Range Facility	WA	Listed place
Mermaid Reef - Rowley Shoals	WA	Listed place
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place
Scott Reef and Surrounds - Commonwealth Area	EXT	Listed place
Historic		
Administrators House Precinct	EXT	Listed place
Army Magazine Buildings Irwin Barracks	WA	Listed place
Artillery Barracks	WA	Listed place
Bungalow 702	EXT	Listed place
Claremont Post Office	WA	Listed place
Cliff Point Historic Site	WA	Listed place
Drumsite Industrial Area	EXT	Listed place
Geraldton Drill Hall Complex	WA	Listed place
HMAS Sydney II and HSK Kormoran Shipwreck Sites	EXT	Listed place
Industrial and Administrative Group	EXT	Listed place
Inglewood Post Office	WA	Listed place
J Gun Battery	WA	Listed place
Malay Kampong Group	EXT	Listed place
Malay Kampong Precinct	EXT	Listed place
Perth General Post Office	WA	Listed place
Phosphate Hill Historic Area	EXT	Listed place
Poon Saan Group	EXT	Listed place
Settlement Christmas Island	EXT	Listed place
South Perth Post Office	WA	Listed place
South Point Settlement Remains	EXT	Listed place
Victoria Park Post Office	WA	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous minutus Black Noddy [824]		Breeding known to occur within area
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area

Name	Threatened	Type of Presence
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Catharacta skua Great Skua [59472]		Species or species habitat may occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Roosting known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area

Name	Threatened	Type of Presence
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered	Species or species habitat likely to occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered	Species or species habitat likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Breeding known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Roosting known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Breeding known to occur within area

Name	Threatened	Type of Presence
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat known to occur within area
Pelagodroma marina White-faced Storm-Petrel [1016]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Breeding likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding likely to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area

Name	Threatened	Type of Presence
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat may occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Foraging, feeding or related behaviour known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Puffinus assimilis Little Shearwater [59363]		Breeding known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Foraging, feeding or related behaviour likely to occur within area
Puffinus huttoni Hutton's Shearwater [1025]		Foraging, feeding or related behaviour known to occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat known to occur within area
Sterna albifrons Little Tern [813]		Breeding known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Stiltia isabella Australian Pratincole [818]		Roosting known to occur

Name	Threatened	Type of Presence
		within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Breeding known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys sculptus Sculptured Pipefish [66197]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys haematopterus Reef-top Pipefish [66201]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Cosmocampus maxweberi Maxweber's Pipefish [66209]		Species or species habitat may occur within area
Doryrhamphus baldwini Redstripe Pipefish [66718]		Species or species habitat may occur within area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus macrorhynchus Whiskered Pipefish, Ornate Pipefish [66222]		Species or species habitat may occur within area
Halicampus mataafae Samoan Pipefish [66223]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippichthys spicifer Belly-barred Pipefish, Banded Freshwater Pipefish [66232]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Micrognathus brevirostris thorntail Pipefish, Thorn-tailed Pipefish [66254]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat likely to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Vulnerable	Breeding known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus fuscus Dusky Seasnake [1119]		Species or species habitat known to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus pooleorum Shark Bay Seasnake [66061]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]		Species or species habitat may occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis inornatus Plain Seasnake [1107]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or

Name	Status	Type of Presence
		related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Hyperoodon planifrons Southern Bottlenose Whale [71]		Species or species habitat may occur within area
Indopacetus pacificus Longman's Beaked Whale [72]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area

Name	Status	Type of Presence
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Foraging, feeding or related behaviour known to occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tasmacetus shepherdi Shepherd's Beaked Whale, Tasman Beaked Whale [55]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Commonwealth ReservesTerrestrial [Resource Information]

Name	State	Type
Christmas Island	EXT	National Park (Commonwealth)

Australian Marine Parks	[Resource Information]
Name	Label
Abrolhos	Habitat Protection Zone (IUCN IV)
Abrolhos	Multiple Use Zone (IUCN VI)
Abrolhos	National Park Zone (IUCN II)
Abrolhos	Special Purpose Zone (IUCN VI)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Ashmore Reef	Recreational Use Zone (IUCN IV)
Ashmore Reef	Sanctuary Zone (IUCN Ia)
Carnarvon Canyon	Habitat Protection Zone (IUCN IV)
Cartier Island	Sanctuary Zone (IUCN Ia)
Dampier	Habitat Protection Zone (IUCN IV)
Dampier	Multiple Use Zone (IUCN VI)
Dampier	National Park Zone (IUCN II)
Eighty Mile Beach	Multiple Use Zone (IUCN VI)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
Gascoyne	National Park Zone (IUCN II)
Geographe	Habitat Protection Zone (IUCN IV)
Geographe	Multiple Use Zone (IUCN VI)
Geographe	National Park Zone (IUCN II)
Geographe	Special Purpose Zone (Mining
Jurien	National Park Zone (IUCN II)
Jurien	Special Purpose Zone (IUCN VI)
Kimberley	Habitat Protection Zone (IUCN IV)
Kimberley	Multiple Use Zone (IUCN VI)
Kimberley	National Park Zone (IUCN II)
Mermaid Reef	National Park Zone (IUCN II)
Montebello	Multiple Use Zone (IUCN VI)
Ningaloo	National Park Zone (IUCN II)
Ningaloo	Recreational Use Zone (IUCN IV)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)
Perth Canyon	Habitat Protection Zone (IUCN IV)
Perth Canyon	Multiple Use Zone (IUCN VI)
Perth Canyon	National Park Zone (IUCN II)
Roebuck	Multiple Use Zone (IUCN VI)
Shark Bay	Multiple Use Zone (IUCN VI)
South-west Corner	Multiple Use Zone (IUCN VI)
South-west Corner	National Park Zone (IUCN II)
South-west Corner	Special Purpose Zone (Mining
Two Rocks	Multiple Use Zone (IUCN VI)
Two Rocks	National Park Zone (IUCN II)

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Adele Island	WA
Airlie Island	WA
Alfred Cove	WA
Austin Bay	WA
Balannup Lake	WA
Banksia	WA
Bardi Jawi	WA
Barrow Island	WA
Bashford	WA
Bedout Island	WA
Beekeepers	WA
Bernier And Dorre Islands	WA
Bessieres Island	WA
Boodalan	WA
Boodie, Double Middle Islands	WA
Boullanger, Whitlock, Favourite, Tern And Osprey Islands	WA
Bramley	WA

Name	State
Broadwater	WA
Broome Bird Observatory	WA
Broome Wildlife Centre	WA
Browse Island	WA
Buller	WA
Bundegi Coastal Park	WA
Burnside And Simpson Island	WA
Byrd Swamp	WA
Cane River (Mount Minnie and Nanutarra)	WA
Cape Range	WA
Capel	WA
Carnac Island	WA
Chinamans Pool	WA
Coulomb Point	WA
Crampton	WA
Creery Island	WA
Cutubury	WA
Dambimangari	WA
Dirk Hartog Island	WA
Dongara	WA
Drovers Cave	WA
Escape Island	WA
Faure Island	WA
Fish Road	WA
Forrestdale Lake	WA
Francois Peron	WA
Freycinet, Double Islands etc	WA
Gibbs Road	WA
Gingin Stock Route	WA
Giralia	WA
Gnandaroo Island	WA
Goegrup Lake	WA
Haag	WA
Hamelin Station	WA
Harry Waring Marsupial Reserve	WA
Harvey Flats	WA
Hill River	WA
Howatharra	WA
Jandabup	WA
Jurabi Coastal Park	WA
Kalbarri	WA
Karajarri	WA
Keanes Point Reserve	WA
Kenwick Wetlands	WA
Koks Island	WA
Kooljerrenup	WA
Lacepede Islands	WA
Lake Joondalup	WA
Lake McLarty	WA
Lake Mealup	WA
Lancelin And Edwards Islands	WA
Leda	WA
Leeuwin-Naturaliste	WA
Len Howard	WA
Leschenault Peninsula	WA
Lesueur	WA
Little Rocky Island	WA
Locke	WA
Locker Island	WA
Lowendal Islands	WA
Matilda Bay Reserve	WA
McLarty	WA
Mealup Point	WA
Milyu	WA
Modong	WA
Monkey Mia Reserve	WA

Name	State
Montebello Islands	WA
Morangarel	WA
Muiron Islands	WA
Murujuga	WA
NTWA Bushland covenant (0003)	WA
NTWA Bushland covenant (0004)	WA
NTWA Bushland covenant (0014)	WA
NTWA Bushland covenant (0044A)	WA
NTWA Bushland covenant (0044B)	WA
NTWA Bushland covenant (0044C)	WA
NTWA Bushland covenant (0065A)	WA
NTWA Bushland covenant (0065B)	WA
NTWA Bushland covenant (0069)	WA
NTWA Bushland covenant (0070)	WA
NTWA Bushland covenant (0072A)	WA
NTWA Bushland covenant (0072B)	WA
NTWA Bushland covenant (0077)	WA
NTWA Bushland covenant (0084)	WA
NTWA Bushland covenant (0085A)	WA
NTWA Bushland covenant (0085B)	WA
NTWA Bushland covenant (0089)	WA
NTWA Bushland covenant (0095)	WA
NTWA Bushland covenant (0102)	WA
NTWA Bushland covenant (0116A)	WA
NTWA Bushland covenant (0116B)	WA
NTWA Bushland covenant (0130)	WA
NTWA Bushland covenant (0144)	WA
NTWA Bushland covenant (0148)	WA
NTWA Bushland covenant (0149)	WA
NTWA Bushland covenant (0152)	WA
NTWA Bushland covenant (0164)	WA
Nabaroo	WA
Nambung	WA
Nanga Station	WA
Neerabup	WA
Neerabup	WA
Nilgen	WA
Nilligarri	WA
Nine Mile Lake	WA
North Sandy Island	WA
North Turtle Island	WA
Northern Part Victoria Location 3721 & 3565	WA
Nyangumarta Warrarn	WA
Oakajee	WA
One Tree Point	WA
Part Murchison house	WA
Penguin Island	WA
Piara	WA
Port Gregory	WA
Port Kennedy Scientific Park	WA
Prince Regent	WA
Riverdale	WA
Rocky Island	WA
Round Island	WA
Ruabon Townsite	WA
Sabina	WA
Serrurier Island	WA
Shell Beach	WA
Southern Beekeepers	WA
Stockyard Gully Reserve	WA
Sugar Loaf Rock	WA
Sussex Location 2561	WA
Swan Island	WA
Tamala Pastoral Lease (Part)	WA
Tanner Island	WA
Tent Island	WA

Name	State
Thomsons Lake	WA
Tuart Forest	WA
Unnamed WA01086	WA
Unnamed WA03249	WA
Unnamed WA11883	WA
Unnamed WA13359	WA
Unnamed WA14567	WA
Unnamed WA21176	WA
Unnamed WA25836	WA
Unnamed WA26065	WA
Unnamed WA26400	WA
Unnamed WA26620	WA
Unnamed WA28740	WA
Unnamed WA28968	WA
Unnamed WA29815	WA
Unnamed WA31906	WA
Unnamed WA33287	WA
Unnamed WA33799	WA
Unnamed WA34039	WA
Unnamed WA35283	WA
Unnamed WA35593	WA
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Unnamed WA36915	WA
Unnamed WA37168	WA
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Unnamed WA37500	WA
Unnamed WA37997	WA
Unnamed WA38749	WA
Unnamed WA39584	WA
Unnamed WA39752	WA
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Unnamed WA41080	WA
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Unnamed WA41597	WA
Unnamed WA41775	WA
Unnamed WA42030	WA
Unnamed WA42469	WA
Unnamed WA42879	WA
Unnamed WA43290	WA
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Unnamed WA44414	WA
Unnamed WA44665	WA
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Unnamed WA44672	WA
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Unnamed WA44674	WA
Unnamed WA44682	WA
Unnamed WA44688	WA
Unnamed WA44838	WA
Unnamed WA44853	WA
Unnamed WA44977	WA
Unnamed WA44978	WA
Unnamed WA44986	WA

Name	State
Unnamed WA45057	WA
Unnamed WA45089	WA
Unnamed WA45533	WA
Unnamed WA45772	WA
Unnamed WA45773	WA
Unnamed WA46070	WA
Unnamed WA46661	WA
Unnamed WA46756	WA
Unnamed WA46926	WA
Unnamed WA46982	WA
Unnamed WA46983	WA
Unnamed WA46984	WA
Unnamed WA47244	WA
Unnamed WA48205	WA
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Unnamed WA49994	WA
Unnamed WA50017	WA
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Unnamed WA51105	WA
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Unnamed WA51376	WA
Unnamed WA51497	WA
Unnamed WA51583	WA
Unnamed WA51617	WA
Unnamed WA51658	WA
Unnamed WA51784	WA
Unnamed WA51932	WA
Unnamed WA51943	WA
Unnamed WA51944	WA
Unnamed WA51945	WA
Unnamed WA51946	WA
Unnamed WA52354	WA
Utcha Well	WA
Uunguu	WA
Victor Island	WA
Walburra	WA
Wanagarren	WA
Wandi	WA
Wedge Island	WA
Weld Island	WA
Wellard	WA
Whicher	WA
Whitmore,Roberts,Doole Islands And Sandalwood Landing	WA
Wokatherra	WA
Woodvale	WA
Y Island	WA
Yalgorup	WA
Yanchep	WA
Yardanogo	WA
Yaringga	WA

Name	State
Yelverton	WA
Zuytdorp	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Gallus gallus Red Junglefowl, Domestic Fowl [917]		Species or species habitat likely to occur within area
Lonchura oryzivora Java Sparrow [59586]		Species or species habitat likely to occur within area
Meleagris gallopavo Wild Turkey [64380]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Pavo cristatus Indian Peafowl, Peacock [919]		Species or species habitat likely to occur within area
Phasianus colchicus Common Pheasant [920]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat may occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus exulans Pacific Rat, Polynesian Rat [79]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Plants		
Andropogon gayanus		
Gamba Grass [66895]		Species or species habitat likely to occur within area
Anredera cordifolia		
Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus		
Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides		
Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus declinatus		
Bridal Veil, Bridal Veil Creeper, Pale Berry Asparagus Fern, Asparagus Fern, South African Creeper [66908]		Species or species habitat likely to occur within area
Asparagus plumosus		
Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica		
Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris		
Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Chrysanthemoides monilifera		
Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera		
Boneseed [16905]		Species or species habitat likely to occur within area
Cylindropuntia spp.		
Prickly Pears [85131]		Species or species habitat likely to occur within area
Dolichandra unguis-cati		
Cat's Claw Vine, Yellow Trumpet Vine, Cat's Claw Creeper, Funnel Creeper [85119]		Species or species habitat likely to occur within area
Eichhornia crassipes		
Water Hyacinth, Water Orchid, Nile Lily [13466]		Species or species habitat likely to occur within area
Genista linifolia		
Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana		
Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana		
Broom [67538]		Species or species habitat may occur within area
Jatropha gossypifolia		
Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara		
Lantana, Common Lantana, Kamara Lantana,		Species or species

Name	Status	Type of Presence
Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		habitat likely to occur within area
Lycium ferocissimum		
African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea		
Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp.		
Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Pinus radiata		
Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Prosopis spp.		
Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate		
Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla		
Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii		
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta		
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Solanum elaeagnifolium		
Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area
Tamarix aphylla		
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus		
Asian House Gecko [1708]		Species or species habitat likely to occur within area
Lycodon aulicus		
Wolf Snake, Common Wolf Snake, Asian Wolf Snake [83178]		Species or species habitat likely to occur within area
Lygosoma bowringii		
Christmas Island Grass-skink [1312]		Species or species habitat likely to occur within area
Ramphotyphlops braminus		
Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat known to occur within area

Nationally Important Wetlands

[Resource Information]

Name	State

Name	State
"The Dales", Christmas Island	EXT
Ashmore Reef	EXT
Barraghup Swamp	WA
Becher Point Wetlands	WA
Booragoon Swamp	WA
Brixton Street Swamps	WA
Bunda-Bunda Mound Springs	WA
Bundera Sinkhole	WA
Cape Range Subterranean Waterways	WA
De Grey River	WA
Eighty Mile Beach System	WA
Exmouth Gulf East	WA
Forrestdale Lake	WA
Gibbs Road Swamp System	WA
Hamelin Pool	WA
Herdsman Lake	WA
Hosine's Spring, Christmas Island	EXT
Hutt Lagoon System	WA
Joondalup Lake	WA
Karakin Lakes	WA
Lake Logue/Indoon System	WA
Lake MacLeod	WA
Lake McLarty System	WA
Lake Thetis	WA
Learmonth Air Weapons Range - Saline Coastal Flats	WA
Leslie (Port Hedland) Saltfields System	WA
Loch McNess System	WA
McCarleys Swamp (Ludlow Swamp)	WA
McNeill Claypan System	WA
Mermaid Reef	EXT
Murchison River (Lower Reaches)	WA
Palmer Barracks, Guildford	WA
Peel-Harvey Estuary	WA
Perth Airport Woodland Swamps	WA
Prince Regent River System	WA
Roebuck Bay	WA
Rottnest Island Lakes	WA
Shark Bay East	WA
Spectacles Swamp	WA
Swan-Canning Estuary	WA
Thomsons Lake	WA
Vasse-Wonnerup Wetland System	WA
Willie Creek Wetlands	WA
Yalgorup Lakes System	WA
Yampi Sound Training Area	WA

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Carbonate bank and terrace system of the Van	North
Pinnacles of the Bonaparte Basin	North
Ancient coastline at 125 m depth contour	North-west
Ashmore Reef and Cartier Island and surrounding	North-west
Canyons linking the Argo Abyssal Plain with the	North-west
Canyons linking the Cuvier Abyssal Plain and the	North-west
Carbonate bank and terrace system of the Sahul	North-west
Commonwealth waters adjacent to Ningaloo Reef	North-west
Continental Slope Demersal Fish Communities	North-west
Exmouth Plateau	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters	North-west
Pinnacles of the Bonaparte Basin	North-west
Seringapatam Reef and Commonwealth waters in	North-west

Name	Region
Wallaby Saddle	North-west
Ancient coastline at 90-120m depth	South-west
Cape Mentelle upwelling	South-west
Commonwealth marine environment surrounding	South-west
Commonwealth marine environment within and	South-west
Commonwealth marine environment within and	South-west
Naturaliste Plateau	South-west
Perth Canyon and adjacent shelf break, and other	South-west
Western demersal slope and associated fish	South-west
Western rock lobster	South-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-14.475 125.148,-15.86 124.397,-16.442 122.991,-17.216 122.172,-17.997 122.187,-18.125 122.367,-18.433 121.819,-19.325 121.361,-19.815 120.475,-20.071 118.935,-20.236 118.807,-20.348 118.161,-20.728 117.402,-20.412 116.952,-20.867 116.204,-21.494 115.494,-21.573 115.262,-22.38 114.169,-21.794 114.078,-22.572 113.632,-22.893 113.851,-23.469 113.77,-23.916 113.481,-24.427 113.399,-25.276 113.845,-26.177 114.265,-26.707 113.613,-27.526 114.116,-27.834 114.108,-28.13 114.199,-28.78 114.597,-29.246 114.893,-30.001 114.946,-30.729 115.134,-31.987 115.836,-33.017 115.671,-33.648 115.34,-33.531 115.01,-34.503 114.699,-33.93 113.972,-33.176 111.709,-33.064 109.125,-30.158 106.945,-30.2 104.752,-29.641 103.522,-27.364 103.495,-25.45 101.972,-26.246 100.645,-25.021 96.795,-24.151 95.14,-19.862 94.749,-16.872 94.47,-15.559 95.825,-15.28 97.068,-15.685 100.994,-11.48 101.036,-9.245 100.379,-8.714 100.617,-8.127 102.223,-8.015 107.406,-8.497 110.822,-8.462 114.789,-8.176 116.103,-8.993 116.675,-9.133 117.821,-8.309 119.246,-9.084 121.286,-8.616 123.214,-8.42 124.82,-9.28 126.594,-10.531 128.81,-12.346 127.195,-13.464 126.008,-14.475 125.148

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Australian Government

Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

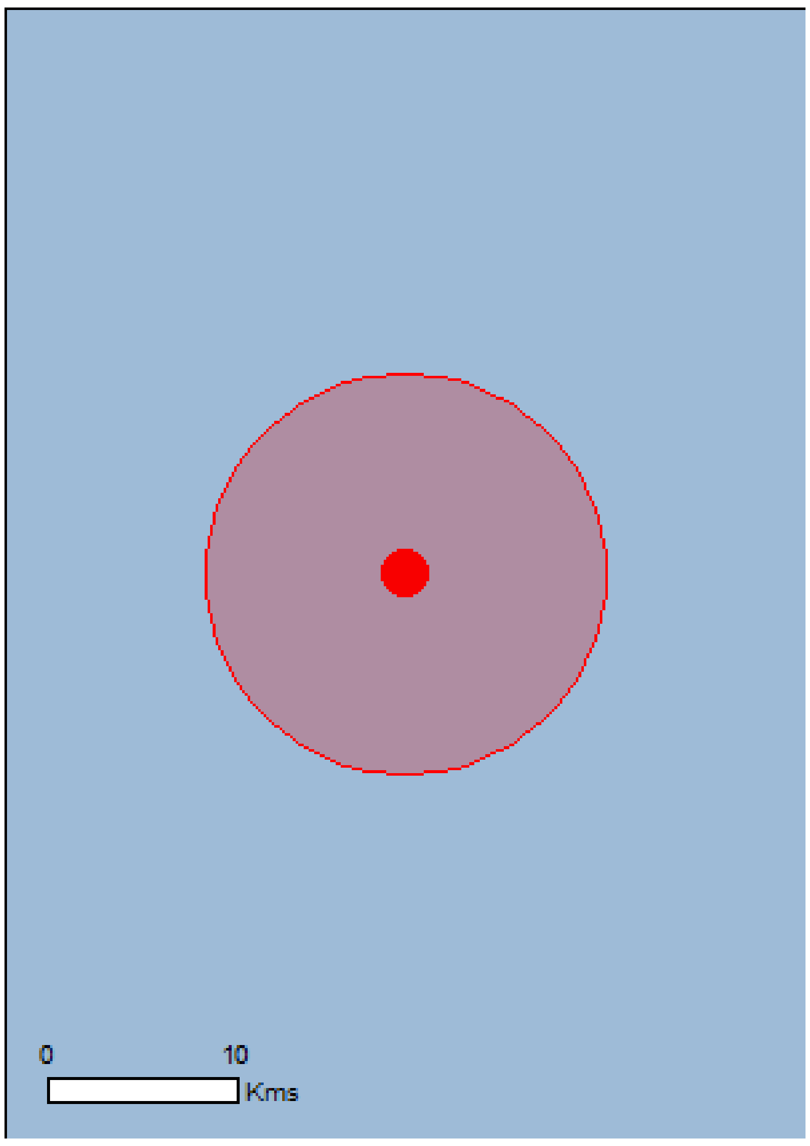
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 08/07/20 02:01:35

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

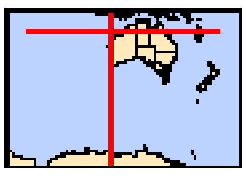
Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 10.5Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	13
Listed Migratory Species:	28

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	27
Whales and Other Cetaceans:	22
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	None
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name
EEZ and Territorial Sea

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name
North-west

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus		
Common Noddy [825]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Calonectris leucomelas		
Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel		
Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor		
Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Reptiles		
Acalyptophis peronii		
Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus duboisii		
Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii		
Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus laevis		
Olive Seasnake [1120]		Species or species habitat may occur within area
Astrotia stokesii		
Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Species or species habitat likely to occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat likely to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species

Name	Status	Type of Presence
		habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Extra Information

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-19.15928 116.07654

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix B

Cuttings and Mud Dispersion Modelling

REPORT

BP Developments Australia Ironbark Block WA-359-P

Drill Cuttings and Muds Dispersion Modelling

Document Status

Version	Purpose of Document	Authored by	Reviewed by	Review Date
RevA	Prepared for internal review	Dr Ryan Dunn	Dr Sasha Zigic	13/6/2019
Rev0	Draft issued to client	Dr Ryan Dunn	Dr Sasha Zigic	13/6/2019

Approval for issue

Name	Signature	Date
Dr Sasha Zigic		13/6/2019

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Executive Summary

Background

BP Exploration Limited (BP) is planning to drill the Ironbark-1 exploration well in the permit area WA-359-P in the Carnarvon Basin, Western Australia. The well is to be drilled in five sections, or well intervals. Cuttings and adhered muds from two surface well intervals will be returned directly to the seabed during the riserless drilling. Whilst cuttings and adhered drilling muds from the lower three intervals will be brought to the platform through the riser for treatment through solids control equipment and discharged overboard at the sea surface. The total duration total duration for the drill cuttings and muds discharge is expected to be 7.6 days.

To support the environmental management and impact assessment process, a dispersion modelling study was commissioned with the primary objective to quantify the potential sediment thickness and Total Suspended Solids (TSS) concentrations from the cuttings and unrecoverable muds to be discharged during the proposed drilling operation. The report presents the potential area that may be influenced based for each quarter (Q1 – Q4) and annualised (any time of year).

Methodology

The modelling study was carried out in several stages. Firstly, three-dimensional currents that include the combined influence of ocean and tidal currents were generated. Secondly, the current data and the cuttings discharge characteristics were input into the three-dimensional sediment dispersion model, MUDMAP. Thirdly, as the spud date can vary, twenty-five simulations were modelled for each quarter (Q1 – Q4) and well. Each simulation had a randomly chosen start time, ensuring that a range of currents conditions were considered. Lastly, the results from all 100 discharge simulations, were integrated to present the overall potential sediment thicknesses and the extent and magnitude of TSS concentrations based on a collective or annual assessment.

A thickness of 0.01 mm was used as the minimum reporting threshold for the deposited cuttings/muds, whilst intervals of 1-10 mm and above 10 mm were used to define low and high exposure, respectively.

In addition, a reporting threshold of 5 mg/L was used for the minimum TSS concentration. A threshold range of 10-1830 mg/L and above 1830 mg/L were used to define low and high exposure, respectively

Key Findings

- Based on the results from all 100 simulations (or annualised assessment), the maximum bottom thickness was 874.6 mm and the total combined area of coverage on the seafloor above the minimum reporting threshold of 0.01 mm was 27.1 km^2. While the maximum distance from the low exposure and high exposure threshold was 1.24 km and 0.40 km, respectively. the maximum distance from the well to the minimum reporting threshold was 6.09 km west. The maximum distance from the well to the low exposure and high exposure threshold was 1.24 km and 0.40 km, respectively.
- The maximum distance from the well to the minimum threshold was 6.45 east-southeast and the combined area of coverage was 11.8 km^2. While the area of coverage for the low threshold was 2.9 km^2 (or 24% of the total area of exposure) and a maximum distance from the release location was 3.95 km.

The maximum TSS concentration of 1,631.9 mg/L was immediately adjacent to the discharge point (<30 m), which is below the high threshold.

1 Introduction

1.1 Project Background

BP Exploration Limited (BP) is intending to drill the Ironbark-1 exploration well in permit area WA-359-P in the Carnarvon Basin, Western Australia. The well is to be drilled in five sections, or well intervals. Cuttings and adhered muds from two surface well intervals will be returned directly to the seabed during the riserless drilling. Whilst cuttings and adhered drilling muds from the lower three intervals will be brought to the platform through the riser for treatment through solids control equipment and discharged overboard at the sea surface. The total duration for the drill cuttings and muds discharge is expected to be 7.6 days.

To support the environmental management and impact assessment process, Green Light Environmental on behalf of BP commissioned RPS to undertake a drill cuttings and muds dispersion modelling study.

The primary objective of the study was to quantify the potential sediment thickness and Total Suspended Solids (TSS) concentrations from the cuttings and unrecoverable muds discharged during the proposed drilling operation. As the spud date can vary, the discharge accounted for a range of conditions using different start times and presented on quartile basis (Q1 – Q4) and annualised. This allows for an objective indication of all locations that maybe exposed from the discharged cuttings and unrecoverable muds.

Table 1 and Figure 1 present the location and coordinates of Ironbark-1 exploration which was used as the release location for the modelling.

Table 1 Coordinates of the Ironbark-1 exploration well, which was used as the release location for the modelling study.

Well name	Latitude	Longitude	Water depth (m)
Ironbark-1	19° 09' 34.01" S	116° 04' 35.8" E	298

The WGS84 Geographic projection was used throughout the report

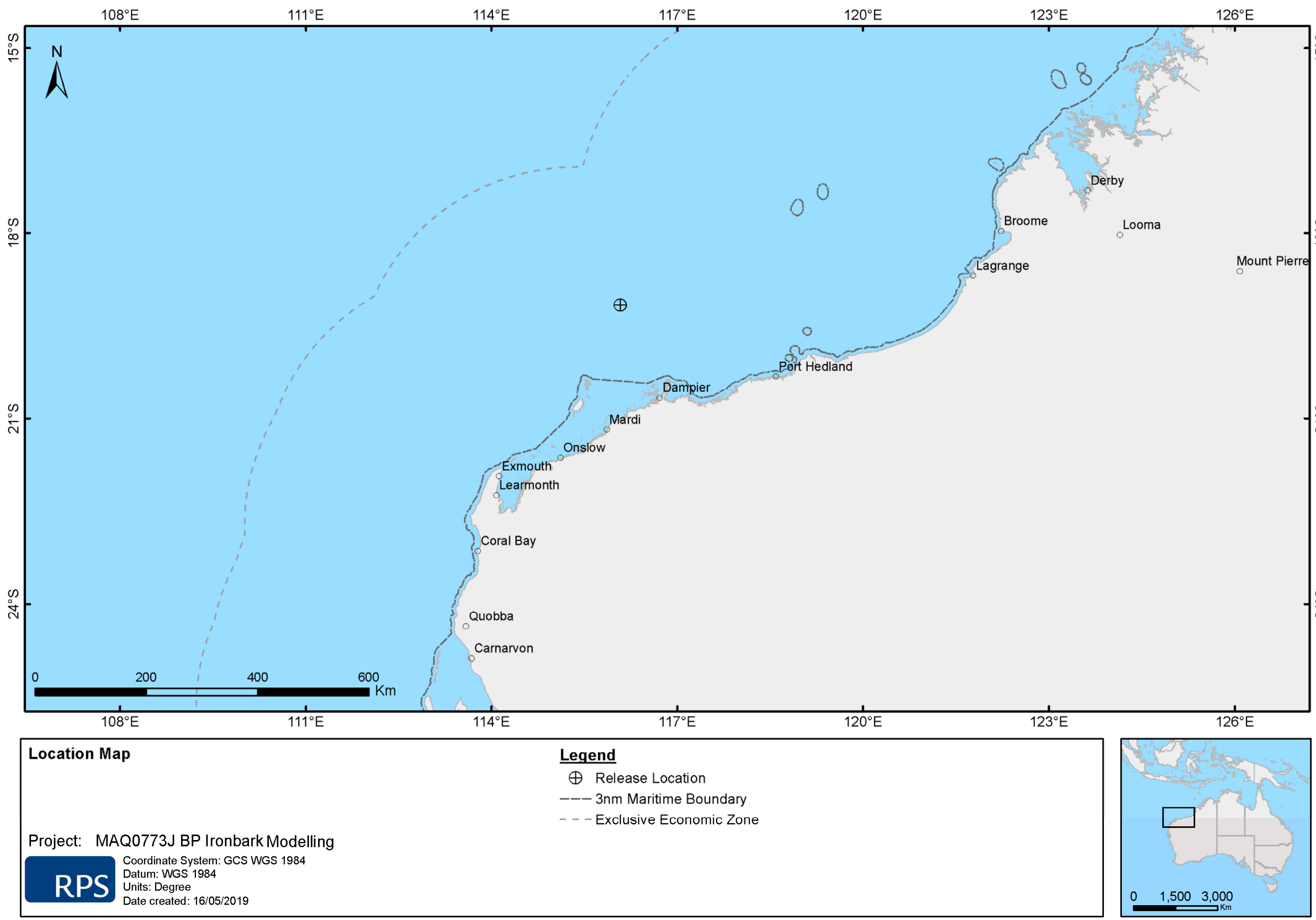

Figure 1 Location map Ironbark-1 exploration well, which was used as the release location for the modelling study.

2 Scope of Work

The scope of work included the following components:

1. Generate 3-dimensional current data (2011 to 2015 inclusive) that included the combined influence of ocean and tidal currents. The current data was suitably long to be indicative of interannual variability in ocean currents.
2. The current data and the drill cuttings/muds discharge characteristics were input into the three-dimensional sediment dispersion model (MUDMAP). Twenty-five simulations were modelled per discharge height (riserless or seabed and surface) per quarter. Each simulation had a different start time, ensuring that a range of current conditions were considered;
3. The results from all 25 combined simulations (from the near-seabed and sea surface discharges), per quarter, were integrated to identify the potential seabed deposition and water column exposure for Q1, Q2, Q3 and Q4; and
4. The results from all 100 combined discharge simulations (i.e. Q1 – Q4) were integrated to present the overall potential seabed deposition and water column exposure on a collective or annual assessment.

3 Regional Currents

The waters surrounding the Ironbark site would be affected by the Leeuwin current, a warm ocean current that flows strongly southwards along the Western Australian coastline (Holloway, 1993; Holloway and Nye, 1985; Godfrey and Ridgeway, 1985), and associated eddies and counter-currents (Figure 2).

The strength of the current is known to vary through the year, with the weakest southwards flow occurring from November to April (Sampey et al., 2004), when the winds tend to blow strongly northwards. Maximum flow velocities are generally experienced during autumn and winter when wind directions do not oppose the current. Typical current speeds in the Leeuwin Current (and its eddies) are approximately 0.5 m/s, although speeds of 1 m/s are common. Additionally, inter-annual variations in the strength of the currents are affected by El Niño - Southern Oscillation events (Pearce and Griffith, 1991). A comprehensive description of the circulation patterns of the Northwest Shelf is provided in a review by Condie and Andrewartha (2008).

The Leeuwin Undercurrent and other sub-surface currents have been observed to flow westwards (away from the coastline) offshore from the Exmouth plateau (Figure 3).

While the tidal currents are generally weaker in the deeper waters, their influence is greatest along the near shore, coastal passage regions and, in and around islands. Therefore, to accurately describe the variability in currents between the inshore and offshore region, a hybrid regional dataset was developed by combining ocean predictions obtained from HYCOM (Hybrid Coordinate Ocean Model) with 2-dimensional tidal currents developed by RPS. The following sections provide a summary of the hybrid regional data set.

Figure 4 and Figure 5 present the dominant (i.e. most frequently occurring) current conditions based on summer and winter HYCOM datasets within the region.

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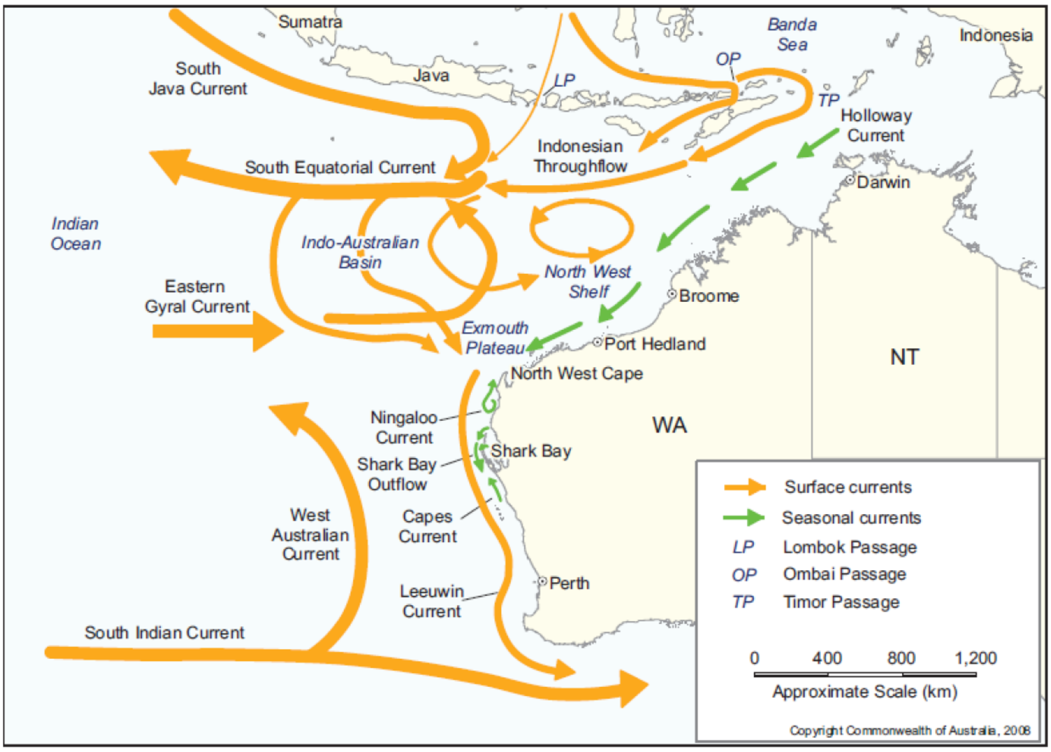


Figure 2 Schematic of ocean currents along the northwest Australian continental shelf (Source: DEWHA, 2008).

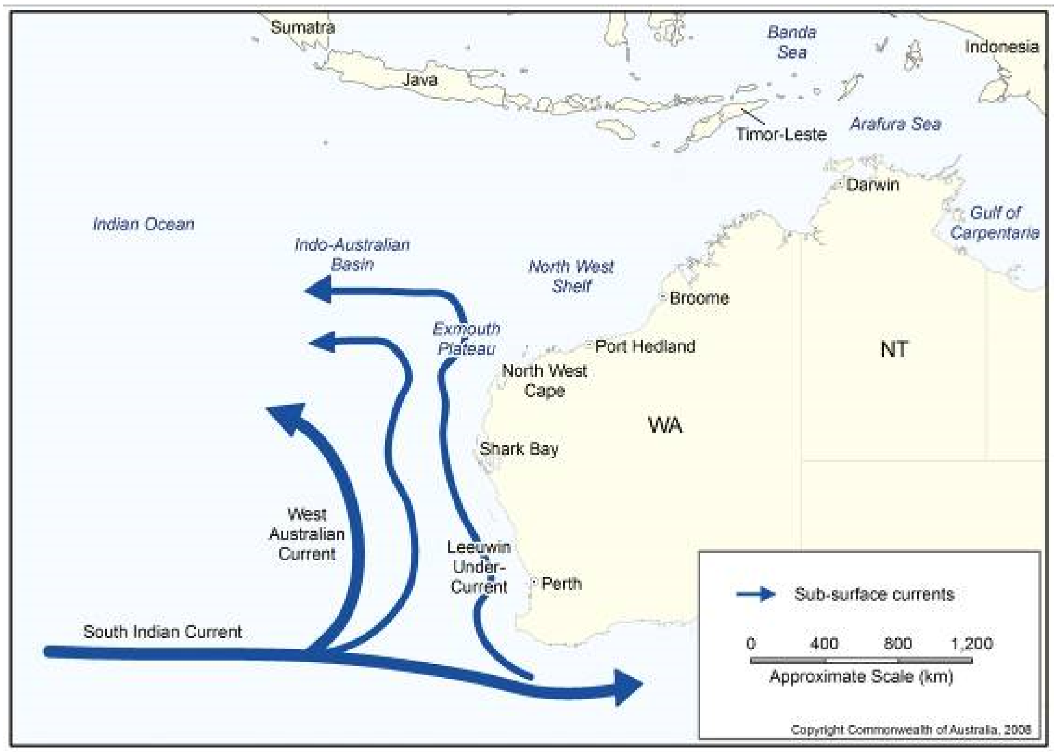


Figure 3 Schematic of ocean sub-surface currents along the northwest Australian continental shelf (Source: DEWHA, 2008).

RPS

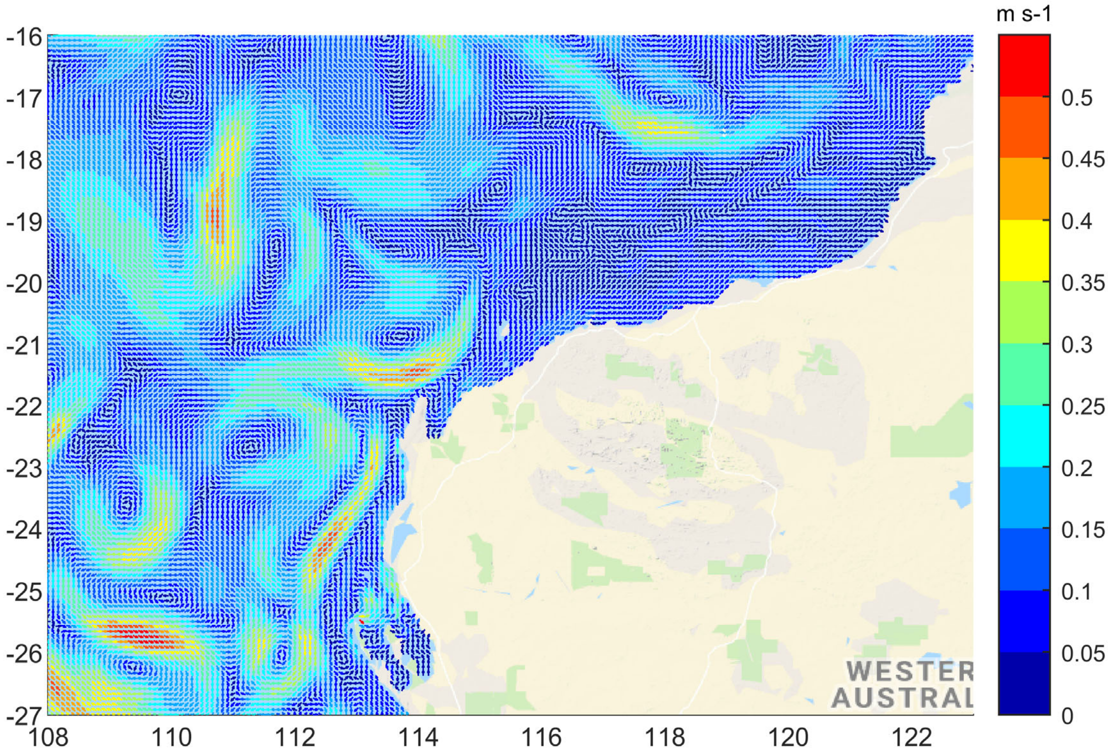


Figure 4 HYCOM surface drift conditions during summer.

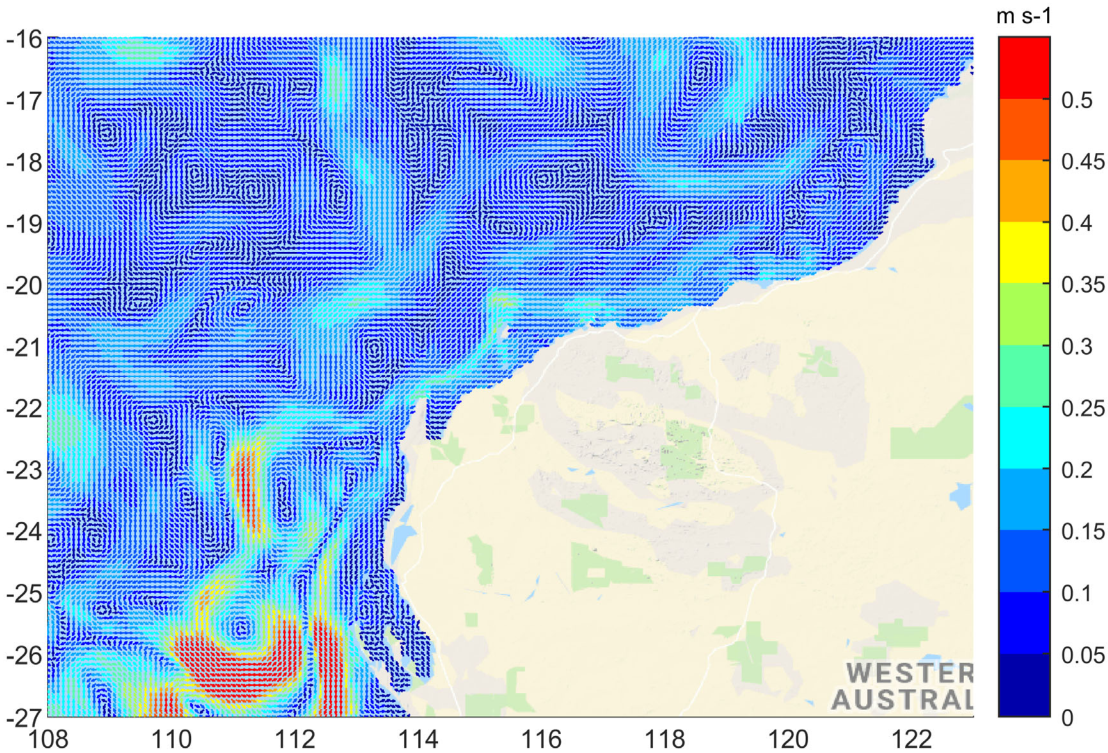


Figure 5 HYCOM surface drift conditions during winter.

RPS

3.1 Tidal Currents

Tidal current data was generated using RPS's advanced ocean/coastal model, HYDROMAP. The HYDROMAP model has been thoroughly tested and verified through field measurements throughout the world for over 30 years (Isaji and Spaulding, 1984; Isaji et al., 2001; Zigic et al., 2003). In fact, HYDROMAP tidal current data has been used as input to forecast (in the future) and hindcast (in the past) oil spills in Australian waters and forms part of the Australian National Oil Spill Emergency Response System operated by AMSA (Australian Maritime Safety Authority).

HYDROMAP employs a sophisticated sub-gridding strategy, which supports up to six levels of spatial resolution, halving the grid cell size as each level of resolution is employed. The sub-gridding allows for higher resolution of currents within areas of greater bathymetric and coastline complexity, and/or of particular interest to a study.

The numerical solution methodology follows that of Davies (1977a, 1977b) with further developments for model efficiency by Owen (1980) and Gordon (1982). A more detailed presentation of the model can be found in Isaji and Spaulding (1984) and Isaji et al. (2001).

3.1.1 Grid Setup

RPS have a seamless global 2-dimensional tidal model. The model domain is sub-gridded to a resolution of approximately 500 m for shallow and coastal regions, starting from an offshore (or deep water) resolution of approximately 8 km. The finer gridding was allocated in a step-wise fashion to more accurately resolve flows along the coastline, around islands and over more complex bathymetry. Figure 6 shows a sample of the tidal model domain, which extends over the study region.

The bathymetry in the model domain (Figure 7) consists of multiple data sources, including Geoscience Australia and digitised navigational charts.

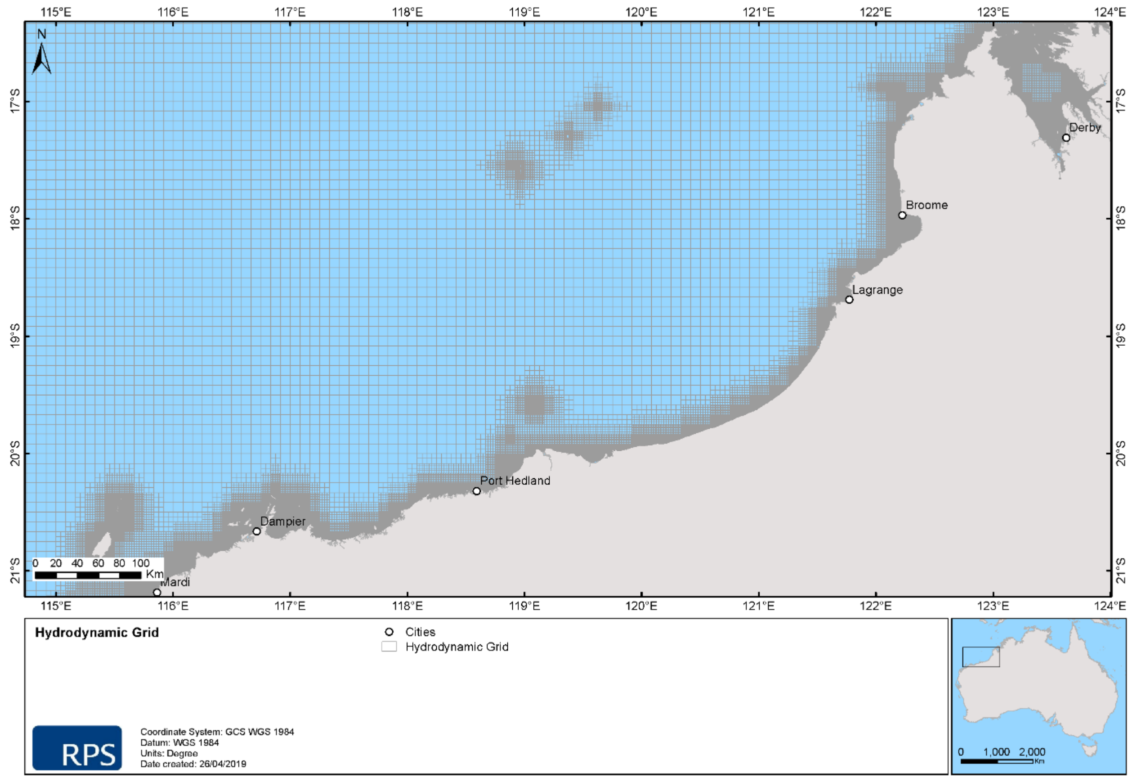


Figure 6 Sample of the model grid used to generate the tidal currents for the study region. Higher resolution areas are shown by the denser mesh.

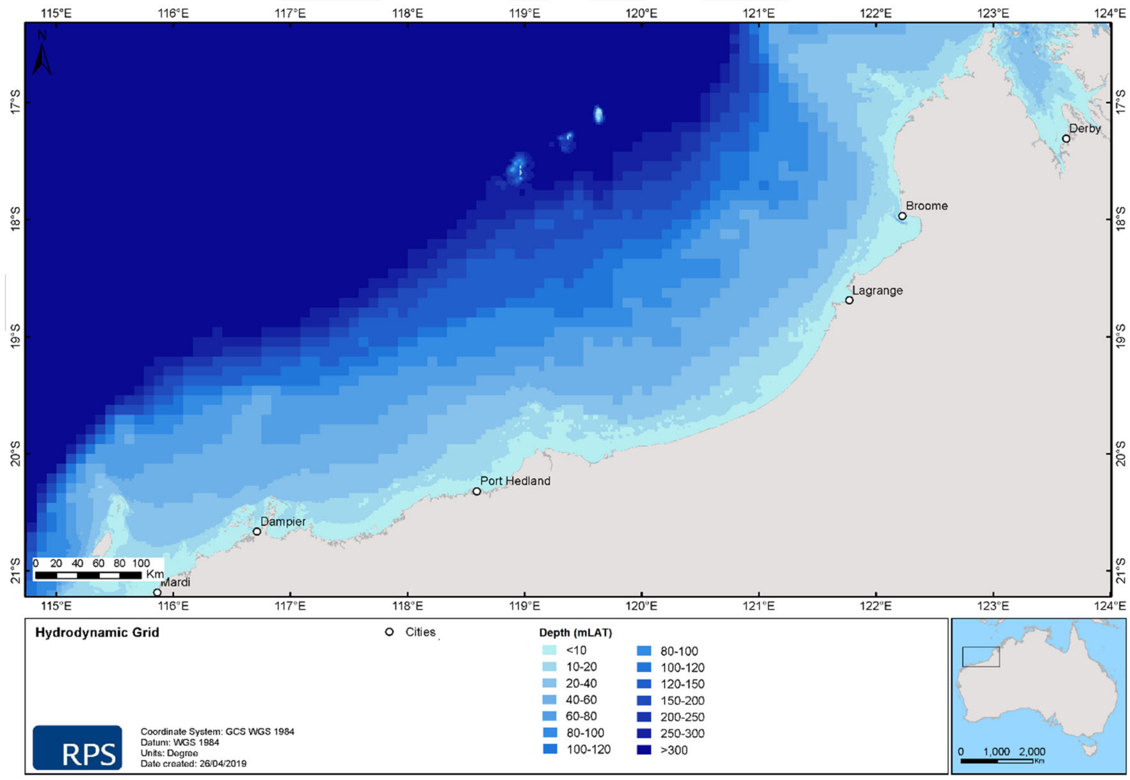


Figure 7 Sample of the bathymetry defined throughout the tidal model.

3.1.2 Tidal Conditions

The ocean boundary data for the regional model was obtained from satellite measured altimetry data (TOPEX/Poseidon 7.2) which provided estimates of the eight dominant tidal constituents at a horizontal scale of approximately 0.25 degrees. The eight major tidal constituents used were K_2, S_2, M_2, N_2, K_1, P_1, O_1 and Q_1. Using the tidal data, surface heights were firstly calculated along the open boundaries, at each time step in the model.

The Topex-Poseidon satellite data has a resolution of 0.25 degrees globally and is produced and quality controlled by NASA (National Aeronautics and Space Administration). The satellites, equipped with two highly accurate altimeters, capable of taking sea level measurements accurate to less than ± 5 cm, measured oceanic surface elevations (and the resultant tides) for over 13 years (1992–2005). In total these satellites carried out 62,000 orbits of the planet. The Topex-Poseidon tidal data has been widely used amongst the oceanographic community, being referenced in more than 2,100 research publications (e.g. Andersen, 1995; Ludicone et al., 1998; Matsumoto et al., 2000; Kostianoy et al., 2003; Yaremchuk and Tangdong, 2004; Qiu and Chen 2010). As such the Topex/Poseidon tidal data is considered suitably accurate for this study.

3.1.3 Surface Elevation Validation

To ensure that tidal predictions were accurate, predicted surface elevations were compared to data observed at five locations (see Figure 8).

Figure 9 and Figure 10 illustrate a comparison of the predicted and observed surface elevations for each location for January 2014. As shown on the graphs, the model accurately reproduced the phase and amplitudes throughout the spring and neap tidal cycles.

To provide a statistical measure of the model performance, the Index of Agreement (IOA – Willmott, 1981) and the Mean Absolute Error (MAE – Willmott, 1982; Willmott and Matsuura, 2005) were used.

The MAE is simply the average of the absolute values of the difference between the model-predicted (P) and observed (O) variables. It is a more natural measure of the average error (Willmott and Matsuura, 2005) and more readily understood.

The Mean Absolute Error (MAE) is determined by:

$$MAE = N^{-1}\sum_{i=1}^{N}|P_i - O_i|$$

The Index of Agreement (IOA) is determined by:

$$IOA = 1 - \frac{\sum|X_{model} - X_{obs}|^2}{\sum(|X_{model} - \overline{X_{obs}}| + |X_{obs} - \overline{X_{obs}}|)^2}$$

Where: X represents the variable being compared and the time mean of that variable. A perfect agreement exists between the model and field observations if the index gives an agreement value of 1 and complete disagreement will produce an index measure of 0 (Wilmott, 1981). Willmott et al. (1985) also suggests that values meaningfully larger than 0.5 represent good model performance. Clearly, a greater IOA and lower MAE represent a better model performance.

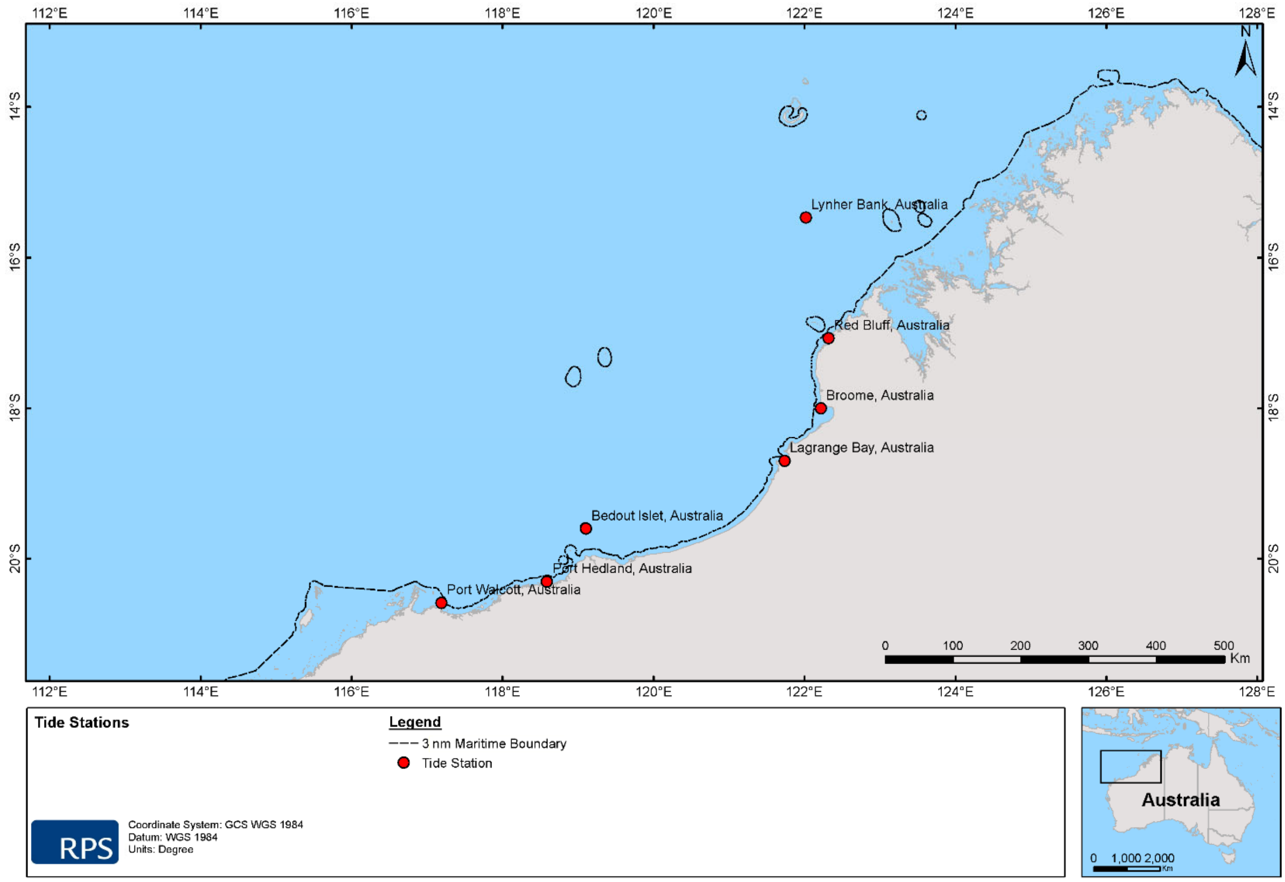
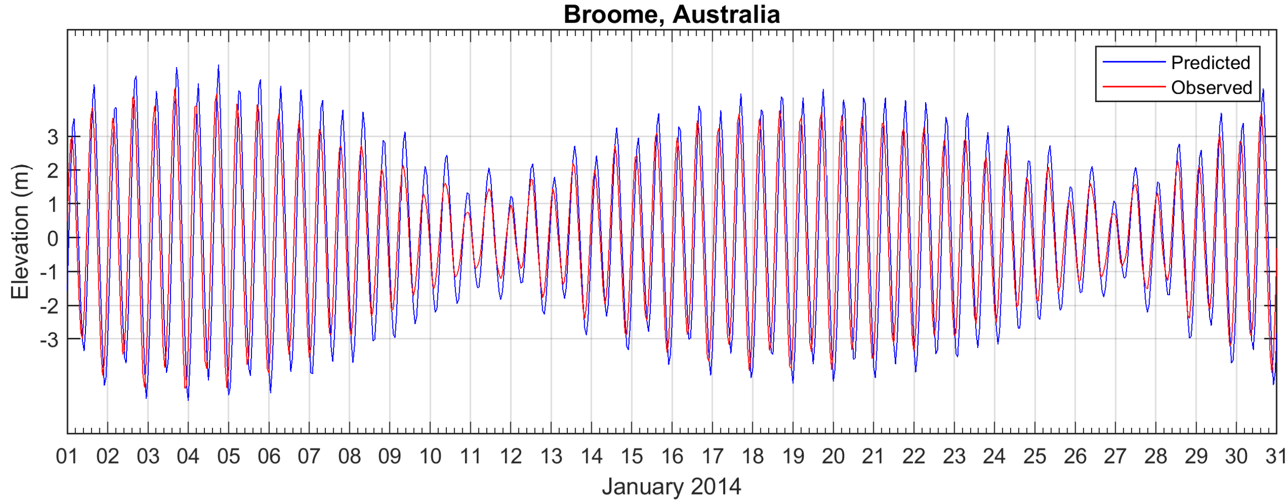
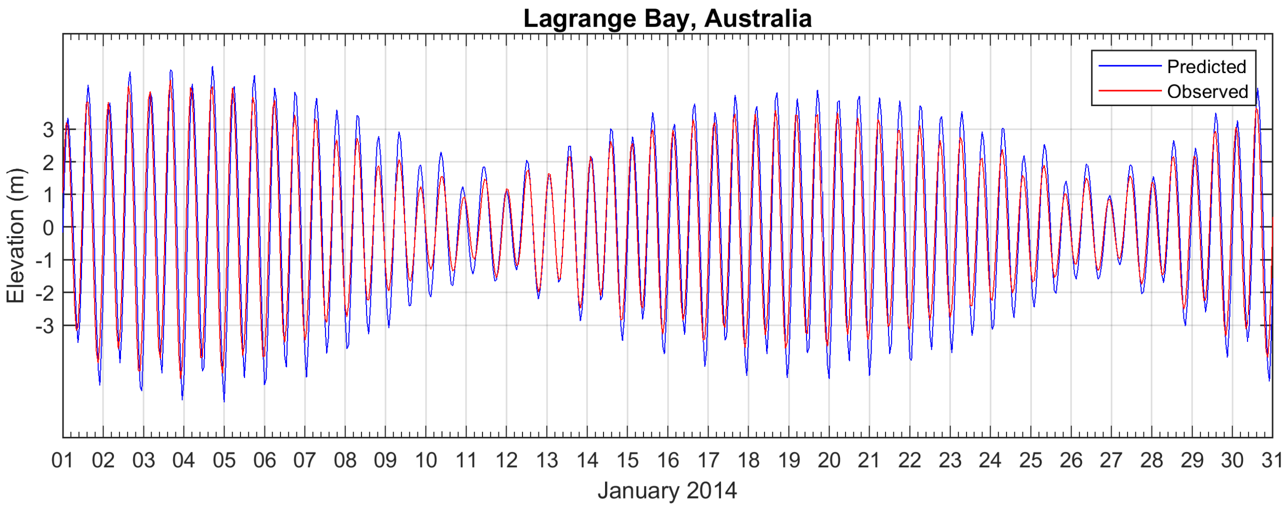


Figure 8 Tide stations used to validate surface elevation within the model.

Table 2 Statistical comparison between the observed and predicted surface elevations.

Tide Station	IOA	MAE (m)
Broome	0.90	1.11
Lagrange Bay	0.96	0.71
Lynher Bank	0.98	0.31
Port Hedland	0.98	0.33
Port Walcott	0.99	0.20
Red Bluff	0.98	0.46





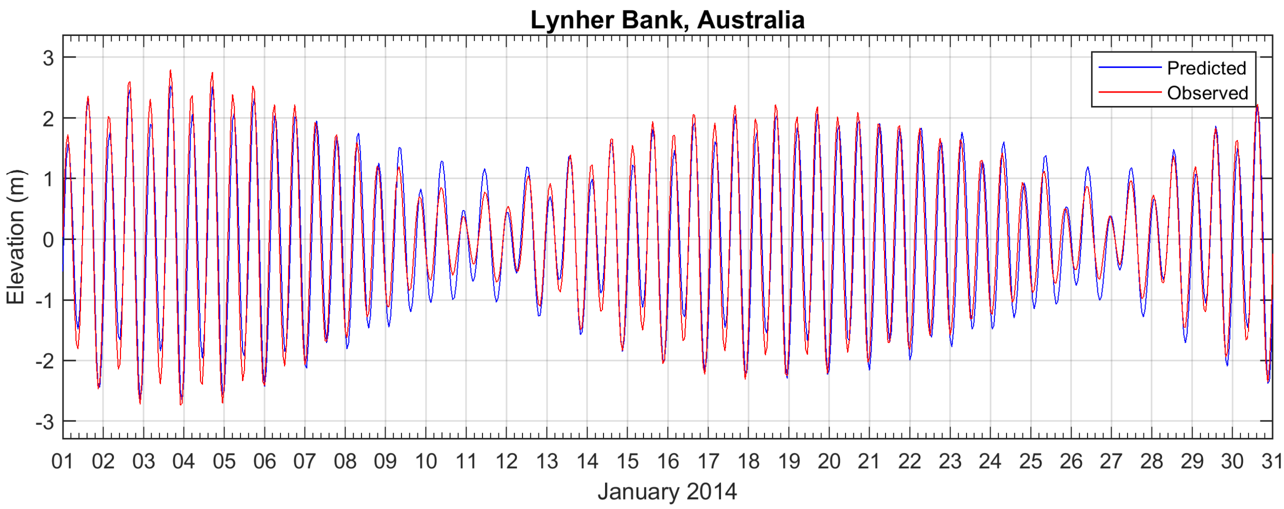


Figure 9 **Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation.**

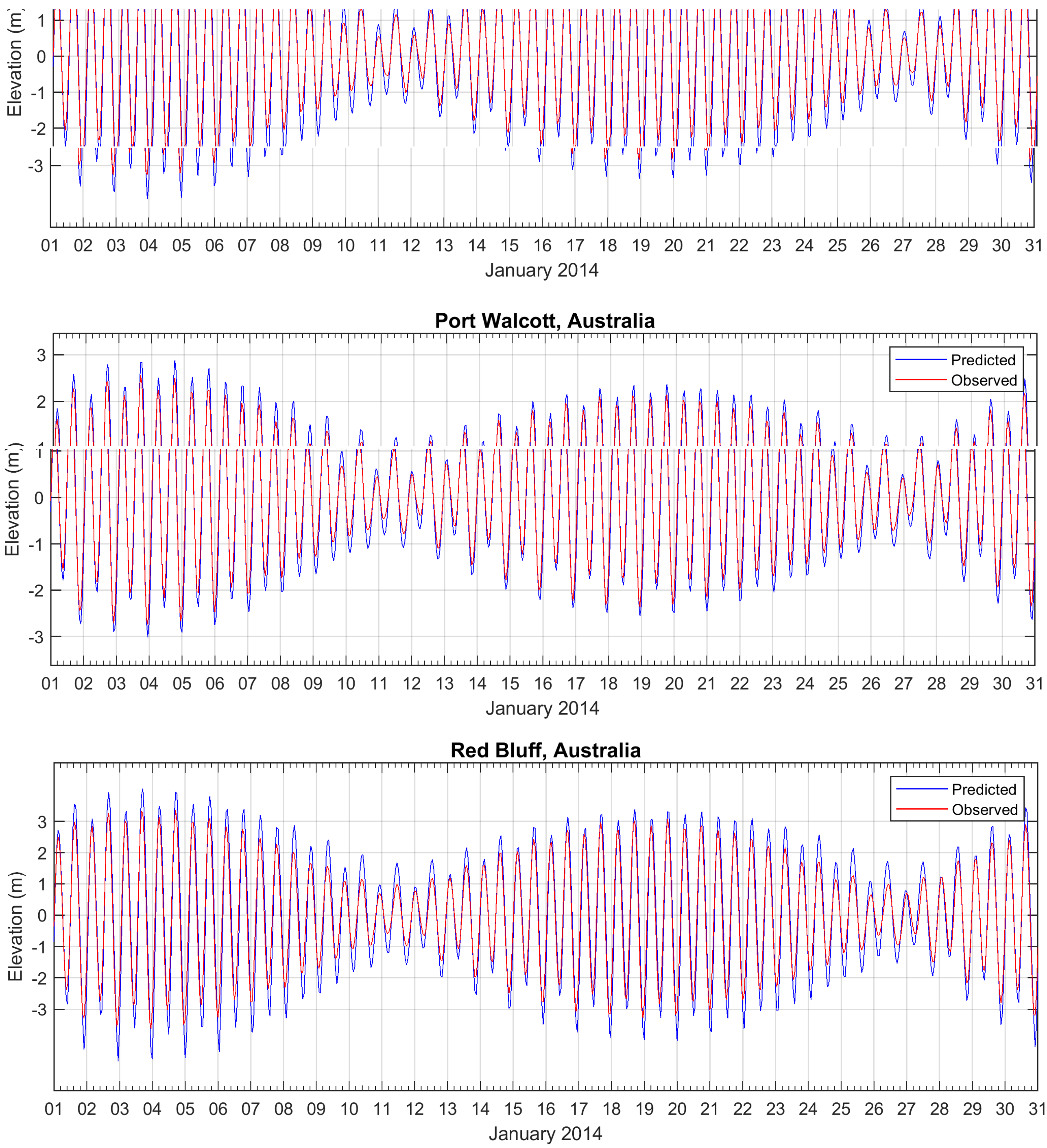


Figure 10 **Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation.**

3.2 Ocean Currents

Data describing the flow of ocean currents was obtained from HYCOM (Hybrid Coordinate Ocean Model, (Chassignet et al., 2007), which is operated by the HYCOM Consortium, sponsored by the Global Ocean Data Assimilation Experiment (GODAE). HYCOM is a data-assimilative, three-dimensional ocean model that is run as a hindcast (for a past period), assimilating time-varying observations of sea surface height, sea surface temperature and in-situ temperature and salinity measurements (Chassignet et al., 2009). The HYCOM predictions for drift currents are produced at a horizontal spatial resolution of approximately 8.25 km (1/12th of a degree) over the region, at a frequency of once per day. HYCOM uses isopycnal layers in the open, stratified ocean, but uses the layered continuity equation to make a dynamically smooth transition to a terrain following coordinate in shallow coastal regions, and to z-level coordinates in the mixed layer and/or unstratified seas.

For this study, the HYCOM hindcast currents were obtained for the years 2011 to 2015 (inclusive).

3.3 Currents at the Release Location

Table 3 displays the predicted average and maximum surface and near-seabed currents, respectively, adjacent to the release location. Figure 11 and Figure 12 present the monthly surface and near-seabed current rose distributions (2011 to 2015 inclusive) respectively, derived from HYCOM ocean current data and HYDROMAP tidal data adjacent to the release location.

Note the convention for defining current direction is the direction the current flows towards, which is used to reference current direction throughout this report. Each branch of the rose represents the currents flowing to that direction, with north to the top of the diagram. Sixteen directions are used. The branches are divided into segments of different colour, which represent the current speed ranges for each direction. Speed intervals of 0.1 m/s are predominantly used in these current roses. The length of each coloured segment is relative to the proportion of currents flowing within the corresponding speed and direction.

The combined current data demonstrated that waters at the release location tended to flow along the west–east axis. The average monthly near-seabed current speeds ranged between 0.09 and 0.10 m/s, while the maximum speeds were between 0.22 and 0.25 m/s. In comparison, the surface current speeds were faster and more varied with the monthly average speeds ranging between 0.16 and 0.27 m/s, while the maximum speeds were between 0.59 and 1.02 m/s.

RPS

Table 3 Predicted average and maximum near-seabed and surface and current speeds adjacent to the release location. Data derived by combining the HYCOM ocean data and HYDROMAP high resolution tidal data from 2011-2015 (inclusive).

Month	Quarter	Near-seabed		Surface	
		Average current speed (m/s)	Maximum current speed (m/s)	Average current speed (m/s)	Maximum current speed (m/s)
January	Q1	0.09	0.24	0.24	1.02
February		0.09	0.24	0.23	0.90
March		0.10	0.25	0.19	0.89
April	Q2	0.10	0.25	0.20	0.65
May		0.09	0.23	0..20	0.72
June		0.09	0.22	0.26	0.76
July	Q3	0.09	0.23	0.19	0.59
August		0.10	0.25	0.16	0.66
September		0.10	0.25	0.27	0.79
October	Q4	0.09	0.25	0.24	0.68
November		0.09	0.24	0.20	0.62
December		0.09	0.22	0.17	0.87
	Minimum	**0.09**	**0.22**	**0.16**	**0.59**
	Maximum	**0.10**	**0.25**	**0.27**	**1.02**

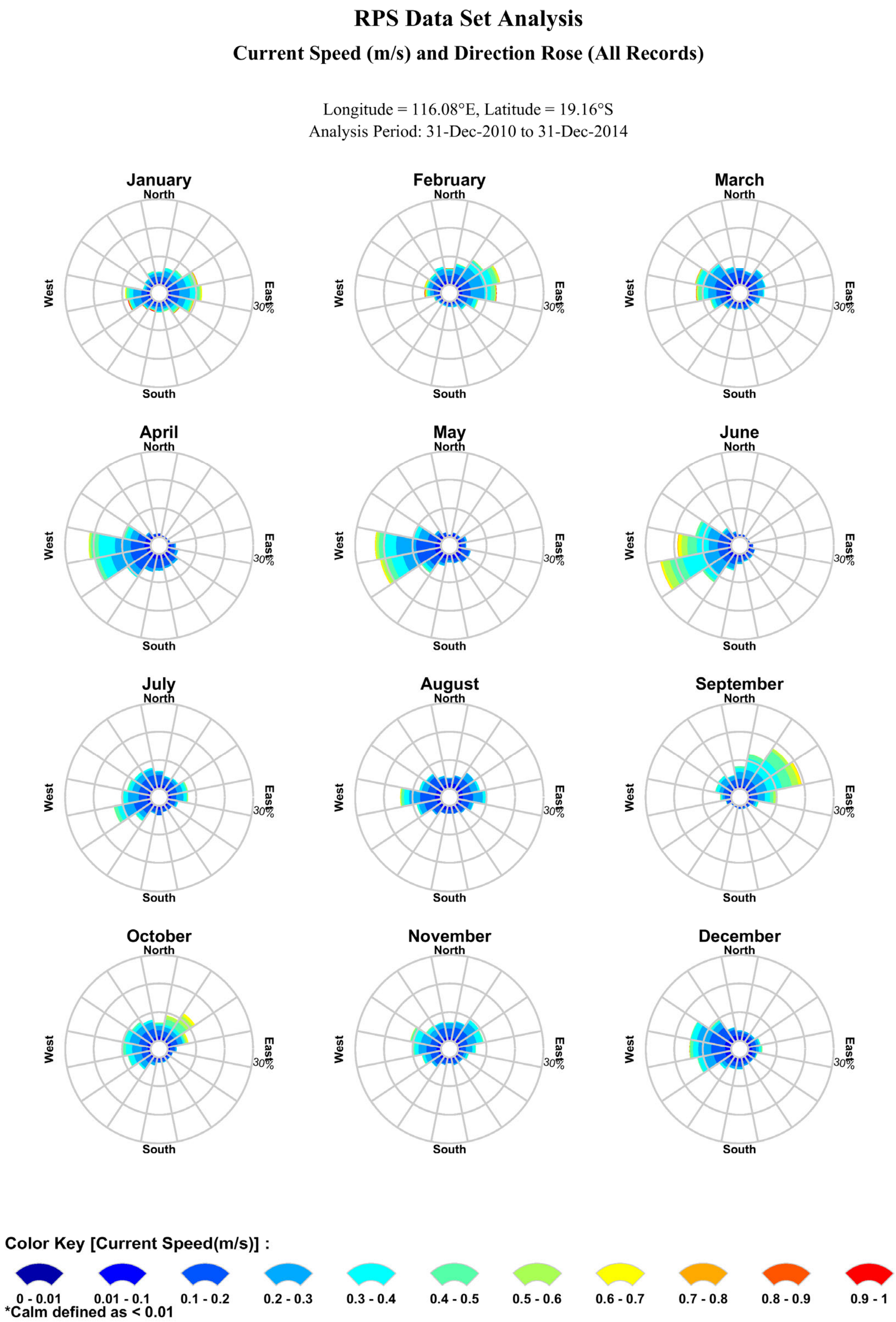


Figure 11 Monthly surface current rose plots near the Ironbark release location (derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2011 – 2015 inclusive). The colour key shows the current magnitude (m/s), the compass direction provides the current direction

flowing TOWARDS and the length of the wedge gives the percentage of the record for a particular speed and direction combination.

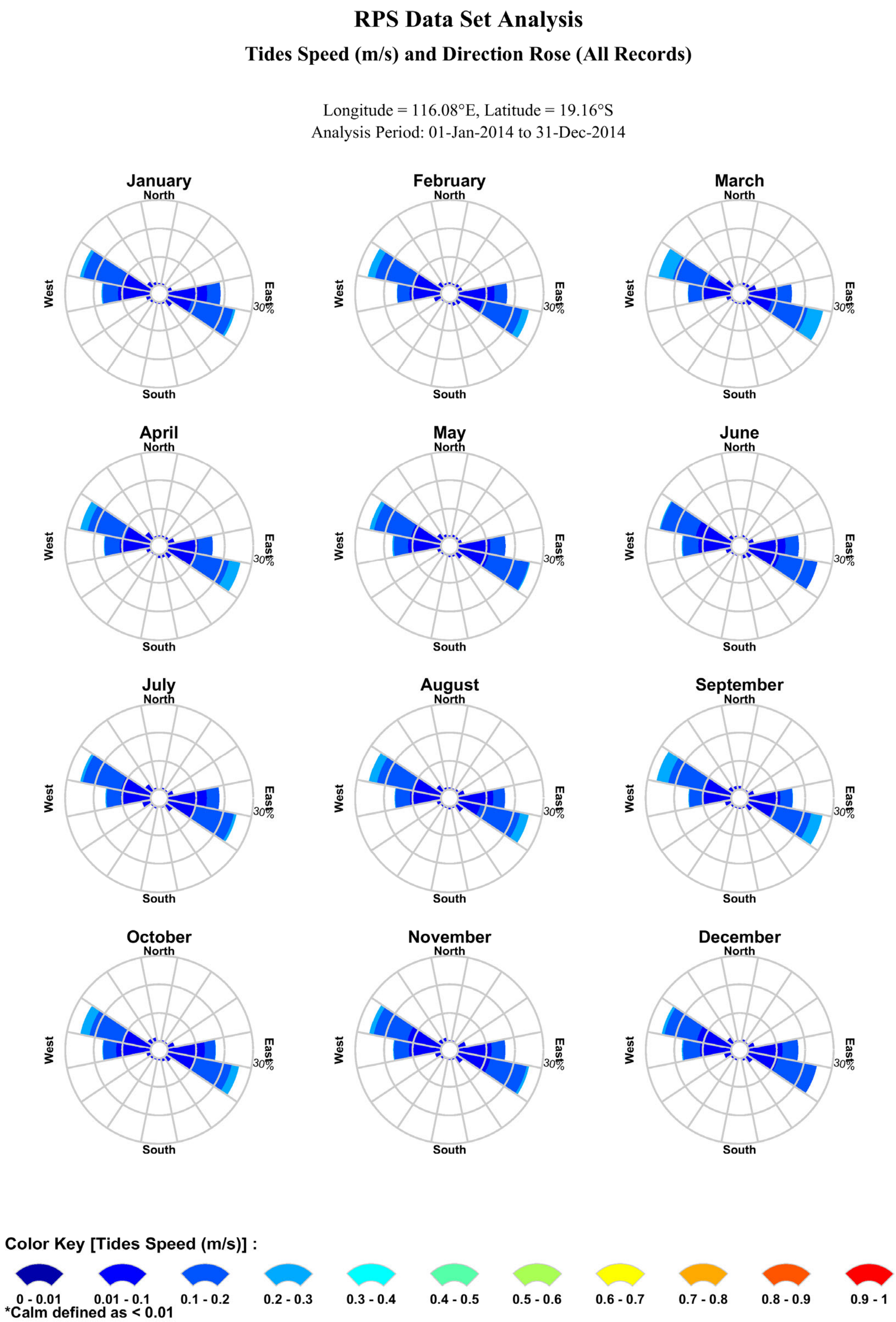


Figure 12 Monthly near-seabed current rose plots near the Ironbark release location (derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2011 – 2015 inclusive). The

colour key shows the current magnitude (m/s), the compass direction provides the current direction flowing TOWARDS and the length of the wedge gives the percentage of the record for a particular speed and direction combination.

4 Water Temperature and Salinity

To accurately represent the water column temperature and salinity at the well, the monthly temperature and salinity values was obtained from the World Ocean Atlas 2013 database produced by the National Oceanographic Data Centre (National Oceanic and Atmospheric Administration) and its co-located World Data Center for Oceanography (see Levitus et al., 2013).

Table 5 details the annual water temperature and salinity adjacent to the release location at the surface and near the seabed. The average temperature is 27.3°C at the surface and 13.0°C near the seabed. Salinity remained consistent throughout the water column at approximately 35 PSU.

Figure 13 shows the mean monthly temperature and salinity profiles for the point closest to the release location.

Table 4 Monthly averaged water temperature and salinity values at the surface and near seabed adjacent to the release location (data sourced: World Ocean Atlas, 2013).

Month	Quarter	Near-seabed		Surface	
		Water temperature (°C)	Salinity (PSU)	Water temperature (°C)	Salinity (PSU)
January	Q1	13.5	35.1	27.8	35.1
February		13.4	35.1	28.9	34.9
March		13.7	35.1	29.5	35.0
April	Q2	14.2	35.1	29.3	35.1
May		14.1	35.0	27.9	35.0
June		15.2	35.3	26.5	34.9
July	Q3	14.0	35.1	25.8	34.9
August		14.2	35.4	25.1	34.8
September		14.3	35.3	25.3	34.8
October	Q4	14.2	35.1	26.4	34.7
November		14.5	35.2	27.1	34.6
December		14.6	35.3	27.3	34.9
	Minimum	**13.4**	**35.0**	**25.1**	**34.6**
	Maximum	**15.2**	**35.4**	**29.5**	**35.1**

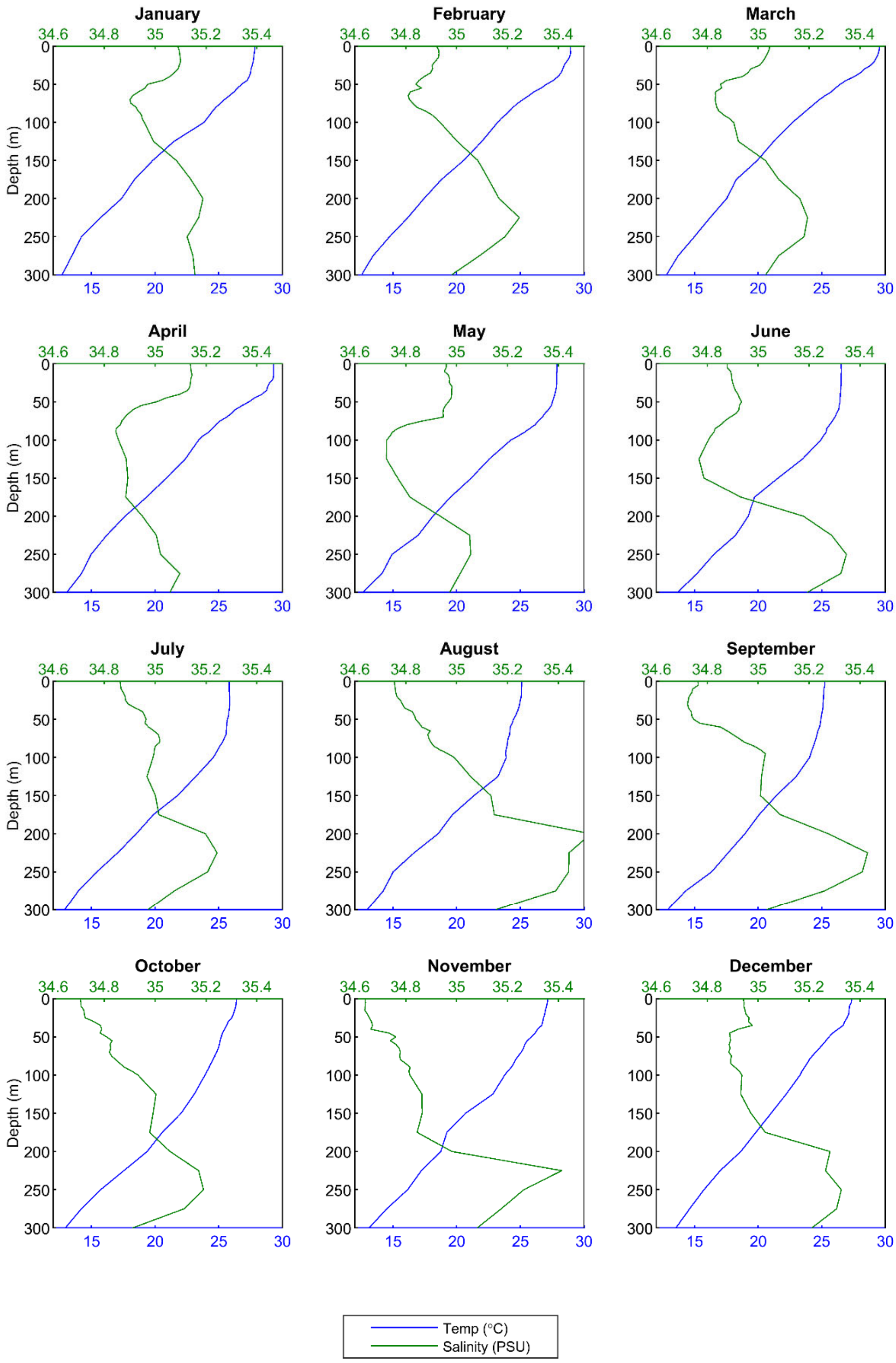


Figure 13 Monthly temperature (blue) and salinity (green) profiles adjacent to the Ironbark release location as a function of depth. Data sourced from the World Ocean Atlas (2013) database.

RPS

5 Sediment Dispersion Modelling

5.1 Model Description - MUDMAP

MUDMAP is a three-dimensional plume model used by industry and regulators to aid in assessing the potential environmental effects from operational discharges such as drill cuttings, drilling fluids and produced water. The model has been applied to hundreds of assessments in over 35 countries, including Australia.

The far-field calculation (passive dispersion stage), employs a particle-based, random walk procedure. The model predicts the dynamics of the discharge material and resulting seabed concentrations and bottom thicknesses over the near-field (i.e. the immediate area of the discharge) and the far-field (the wider region). Figure 14 shows a conceptual diagram of the dispersion and fates of drill cuttings and fluids discharge to the ocean and an idealized representation of the three discharge phases.

Settling under currents is selective for particle size, with the larger particles (rock chips to sand) tending to settle quickly, forming a pile that aligns with the predominant current axis. Smaller particles (especially silts and clays) will remain suspended for longer periods and will therefore be dispersed more widely by the ambient current conditions. Dispersion of the finer discharged material will tend to be enhanced with increased current speeds and water depth and with greater variation in current direction over time and depth.

Along with the advanced analyses tools, MUDMAP can simulate six classes of material (or 36 sub-categories), each with unique density and particle-size distribution. During the dispersion stage, the model particles are transported in three-dimensions according to the current data and horizontal and vertical mixing coefficients at each time step according to the governing equations.

MUDMAP has been extensively validated and applied for discharge operations (e.g. Burns et. al., 1999; King and McAllister, 1997, 1998; Spaulding, 1994).

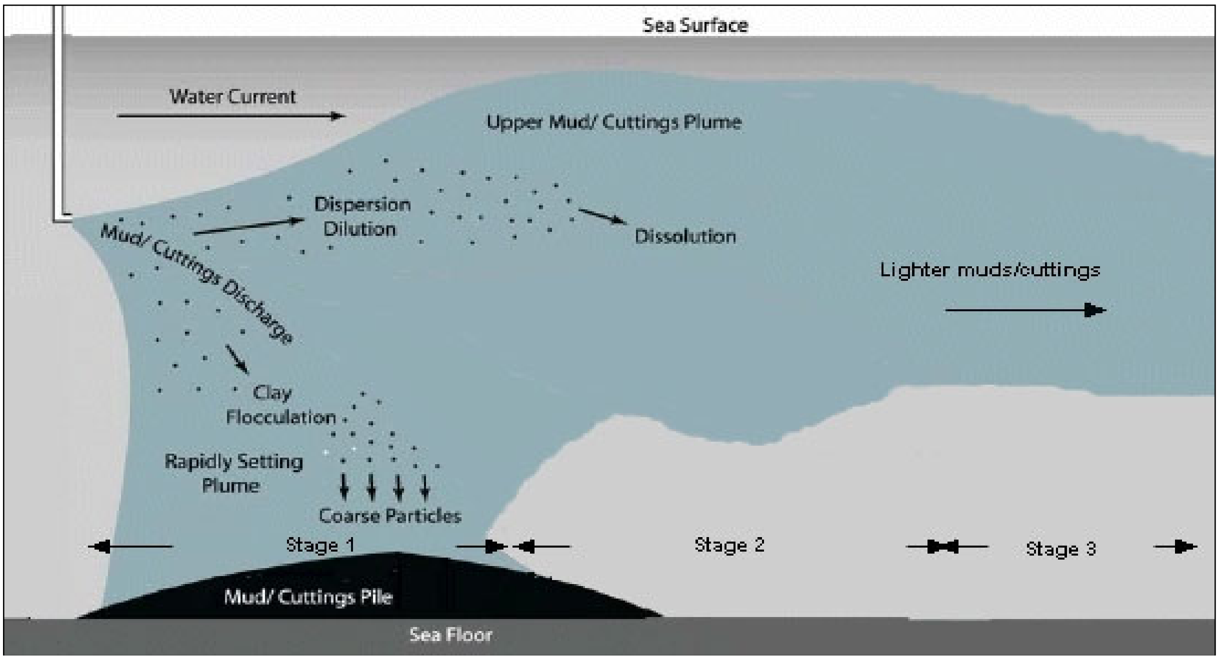


Figure 14 Conceptual diagram showing the general behaviour of cuttings and muds following the discharge to the ocean (Neff, 2005) and the idealised representation of the three discharge phases.

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5.2 Discharge Program

BP has indicated that a conventional design will be used for drilling the well in five intervals. The well will consist of 42” and 26” hole intervals to be drilled using seawater. The extracted drill cuttings from the 42” and 26” hole intervals will be discharged above the seabed. Thereafter, well intervals of 17.5 x 22” and 16.5” will be drilled using water based muds (WBM) and a 12.25” hole diameter interval drilled using synthetic based muds (SBM). The drill cuttings and muds will be brought to the rig and treated by the solids control equipment to separate the drilling muds which can be reused. The cuttings and unrecoverable muds are to be discharged from a pipe at the sea surface.

The total discharge duration of drill cuttings and muds is expected to be 7.6 days.

Table 5 presents a summary of the estimated volume of discharged drill cuttings and unrecoverable muds for each well interval and the duration. Estimates of the unrecoverable muds is based on the adherence to the cuttings.

Table 5 Summary of the estimated volume of discharged drill cuttings and unrecoverable muds for each well interval and the duration.

Hole diameter (inches)	Discharge Method	Cuttings discharged (m^3)	Muds (solids only)		Discharge duration (days)
			Type	Volume discharged (m^3)	
42	Returned directly to the seafloor	100	Sea water	4	0.3
26	Returned directly to the seafloor	535	Sea water	39	0.9
17.5 x 22	Cuttings and muds brought to drilling rig, then discharged at the surface	400	WBM	85	2.2
16.5	Cuttings and muds brought to drilling rig, then discharged at the surface	250	WBM	184	1.9
12.25	Cuttings and muds brought to drilling rig, then discharged at the surface	90	SBM	3	2.3
		1,375		315	7.6

Note: Only discharged solids used as model input.

WBM – Water Based Muds

SBM – Synthetic Based Muds.

5.3 Discharge Input Data

The input data used to setup the dispersion model included:

- Volume and discharge duration of the cuttings and unrecovered muds;
- Particle size distribution and settling velocities of discharged cuttings and unrecoverable muds;
- Bulk density of the discharged cuttings and unrecoverable muds;
- Temperature and salinity profiles of the receiving waters;
- Height/depth of the discharge point; and
- Depth-varying current data to represent local physical forcing.

Table 6 provides a summary of the discharge configuration and the estimated volume of cuttings and muds input into the discharge model. The release rates and the durations were set according to the discharge plan. The simulations were run for a longer duration to allow finer sediments to settle out of suspension or to disperse.

Table 6 Input data used for the drill cuttings and unrecoverable mud solids dispersion modelling.

Parameter/description	BP Ironbark	
Discharge height	**Near-seabed**	**Surface**
Depth of discharge	2 m above seabed	mean sea level
Volume of cuttings (m^3)	635	740
Volume of muds (m^3)	43	162
Bulk density of drill cuttings (kg/m^3)	2,650	2,650
Bulk density of drilling mud solids (kg/m^3)	4,200	4,200
Discharge duration (days) [model duration]	6.4 [20]	1.2 [4]
Sea surface discharge pipe orientation	Vertically downwards	
Model conditions	Stochastic analysis per quarter year (Quarter 1 (Q1): December–March); Quarter 2 (Q2): April–June; Quarter 3(Q3): July–September; Quarter 4 (Q4): October–December)	

Given that a conventional design will be used for drilling the well, previous studies and literature data suggests that particle sizes would be expected to vary between 0.016 mm and 6 mm in diameter. The model was set up with four main particle classes to represent large, medium and light cuttings, and drilling fluid solids (i.e. mud particles). The proportion of each size class was adjusted for each well interval according to the proposed proportion of muds and cuttings, as shown in Table 7.

It is worth noting that particle size has a greater influence on the rate of settling than density (Neff, 2005). Therefore, when setting up the material for discharge in the model, each particle size class was distributed across up to six sub-categories with specific settling velocities. The settling velocities for the various size sub-categories were derived from empirical data provided by Dyer (1986), as summarised in Table 7.

Table 7 Grain sizes, settling velocities and percentage distributions for the cuttings and muds.

Class	Grain Size (mm)	Settling velocity (cm/s)	Drilling with seawater and sweeps	Drilling with SBM
			Distribution (%)	Distribution (%)
Large cuttings	6	53.62	8.6	8.2
	5	49.46	8.6	8.2
	2	28.55	8.6	8.3
	1	12.73	5.8	5.5
	0.5	7.5	5.8	5.5
	0.45	6.6	2.9	2.8
Medium cuttings	0.4	6	2.9	2.8
	0.35	5	2.8	2.8
	0.3	4	2.8	2.8
	0.25	3.1	2.8	2.8
	0.2	2.3	2.8	2.8
	0.15	1.6	2.8	2.7
Small cuttings	0.1	0.8	2.8	2.7
	0.05	0.22	2.8	2.7
	0.04	0.15	2.9	2.7
	0.03	0.08	2.9	5.5
	0.02	0.04	2.9	0.0
Drilling fluid solids	0.063	0.34	0.4	0.0
	0.05	0.22	1.6	1.8
	0.035	0.11	3.7	4.1
	0.026	0.06	6.0	25.3
	0.02	0.038	7.4	0.0
	0.016	0.026	9.4	0.0

5.4 Grid Configuration

A grid covering an approximately 14 km (longitude, x-direction) by 14 km (latitude, y-direction) region with each grid cell being 30 m (x) x 30 m (y) was employed to calculate the thickness of deposited drill cuttings and muds on the seafloor, with vertical divisions of 30 m to allow for assessing total suspended solids in the water column.

5.5 Mixing Parameters

The horizontal and vertical dispersion coefficients are used in dispersion modelling to represent the mixing and diffusion processes caused by turbulence, which are sub-grid processes at the scale of the hydrodynamic model drivers. The dispersion coefficients are expressed in units of rate of area change (m^2/s). Increasing the horizontal dispersion coefficient will increase the horizontal spread of the discharge plume and decrease the centreline concentrations. Increasing the vertical dispersion coefficient spreads the discharge further across the vertical layers.

For discharges at the sea surface, a horizontal coefficient value of 0.01 m^2/s was used to account for the turbulence of the sediment as it is transported from the release site. A vertical coefficient value of 0.1 m^2/s was used to account for the influence of turbulence within the water column by the currents and waves. Values are based on previous studies by Copeland (1996).

For the discharge of cuttings and muds near the seabed, the horizontal dispersion coefficient was 0.25 m^2/s; however, a very low vertical parameter was set (0.0001 m^2/sec), as it is negligible near the seabed.

5.6 Stochastic Modelling

Twenty-five discharge simulations were modelled per quarter (i.e. Quarter 1 (Q1); January–March, Quarter 2 (Q2); April–June, Quarter 3 (Q3); July–September) and Quarter 4 (Q4); November–December).

Each discharge simulation had the same information (i.e. discharge volume, duration, bulk material characteristics) but different commencement times, and thus, prevailing current conditions. This approach ensured that the discharged cuttings experienced a wide range of current conditions (speeds and directions).

The results for all four quarters were combined and analysed to provide an objective indication of all locations on the seabed and water column that maybe subjected to exposure to discharged drill cuttings and muds.

5.7 Reporting Thresholds

While the model predictions can be presented to very low levels it may not be ecologically significant; therefore, thresholds were carefully selected for reporting based on available literature.

Based on available literature, thresholds of 1-10 mm and above 10 mm were used to define low and high exposure levels for this study, respectively. The thresholds are support by studies from Trannum et al. (2009) which found a significant decrease in species count, abundance of individuals, and biomass of marine animals with deposited cuttings 3-24 mm. Furthermore, a study by Kjeilen-Eilertsen et al. (2004) reports that depositional thicknesses greater than 9.6 mm are likely to cause smothering impacts on benthic ecosystems, including corals. It is also worth noting that a study by Smit et al. (2008) established that a thickness threshold of greater than 6.5 mm would be needed before potential harm to benthic macrofauna occur.

As a conservative measure, a thickness of 0.01 mm was employed as the minimum reporting threshold (or above the natural levels) for the 7.6 day discharge period (refer to Table 8).

As part of the study, it was assumed a newly settled cuttings and drilling muds will be less compact due to incorporation of water between grains, therefore a bulking factor of 2.5 was applied to predicted bottom thicknesses to account for porosity.

In addition, a reporting threshold of 5 mg/L was used for the predicted total suspended solids concentrations. Nelson et al. (2016) reports <10 mg/L as a minimal or no effect, whilst concentrations above 10 mg/L have a sublethal effect to pelagic biota. Furthermore, IOGP (2016) cite that very high concentrations (>1830 mg/L) of TSS has been shown to result in mortality of pelagic biota. Hence, a threshold range of 10-1830 mg/L and above 1,830 mg/L were used to define low and high exposure, respectively.

Table 8 Reporting thresholds for sediment thickness and TSS concentrations for the drill cuttings and muds discharge modelling

Reporting criteria	Sediment thickness (mm)	Total Suspended Solids Concentration (mg/L)
Minimum reporting threshold	0.01	5
Low exposure	1 – 10	10 – 1830
High exposure	Above 10	Above 1830

6 Results

6.1 Overview

The results for the discharge of drill cuttings and drilling muds are presented in the following sections as a series of tables and spatial maps based on the reporting thresholds as described in Section 5.7.

The predicted sediment thicknesses are presented in Section 6.2, within two further sub-sections:

- Section 6.2.1 presents the sediment thicknesses derived by overlaying the results from all 25 combined simulations with random start dates to account for the varying current conditions, for each quarter; and
- Section 6.2.2 presents the results from all 100 simulations (i.e. Q1–Q4) overlayed to assess the overall potential extent and magnitude of deposited material on an annualised basis.

The predicted TSS concentrations are presented in Section 6.3, within two further sub-sections:

- Section 6.3.1 presents the TSS concentrations derived by overlaying the results from all 25 simulations with random start dates to account for the varying current conditions, for each quarter; and
- Section 6.3.2 presents the results from all 100 simulations (i.e. Q1–Q4) overlayed to assess the overall potential extent and magnitude of TSS concentrations on an annualised basis.

6.2 Bottom Thickness

6.2.1 Quartile Modelling Results

Figure 15 to Figure 18 present the predicted coverage and sediment thickness from the combined discharges (i.e. near-seabed and surface) of drill cuttings and unrecoverable muds for Quarters 1 to 4.

In all instances the modelling results demonstrated that the settlement of the cuttings and drilling muds for thicknesses above 0.01 mm were generally spread along the east-west axis.

Table 9 provides a summary of the predicted maximum bottom thickness, total area of coverage and the maximum distance and direction to the minimum thickness threshold. The maximum bottom thicknesses ranged between 814.1 mm (Q2) and 874.6 mm (Q4), which were predicted to occur in the immediate vicinity (e.g. <30 m) from the well. The maximum distance from the well to predicted bottom thicknesses above the minimum threshold ranged from 5.17 km (Q3) to 6.09 km (Q4).

The maximum distance from the well to the low exposure threshold (1–10 mm) ranged between 1.02 km (Q4) to 1.24 km (Q1). While the maximum distance to the high exposure threshold (>10 mm) was between 0.35 km (Q2) to 0.39 km (Q3).

Table 9 Predicted maximum bottom thickness, area of coverage and maximum distance to the minimum threshold (0.01 mm) from drill cuttings and unrecoverable muds discharges commencing under Quarter 1-4 (January–December, 2011-2015) conditions. Results are derived from 25 combined discharge simulations per quarter from Ironbark-1.

Operation commencement period	Maximum stochastic bottom thickness (mm)	Total area of coverage (km^2), at or above the minimum threshold of 0.01 mm	Maximum distance (km) from the well to the minimum threshold of 0.01 mm*
Quarter 1 (Q1) (January–March)	855.3	17.3	5.64 (West)
Quarter 2 (Q2) (April–June)	814.1	15.4	5.73 (West)
Quarter 3 (Q3) (July–September)	842.1	20.1	5.17 (East-southeast)
Quarter 4 (Q4) (October–December)	874.6	20.4	6.09 (West)

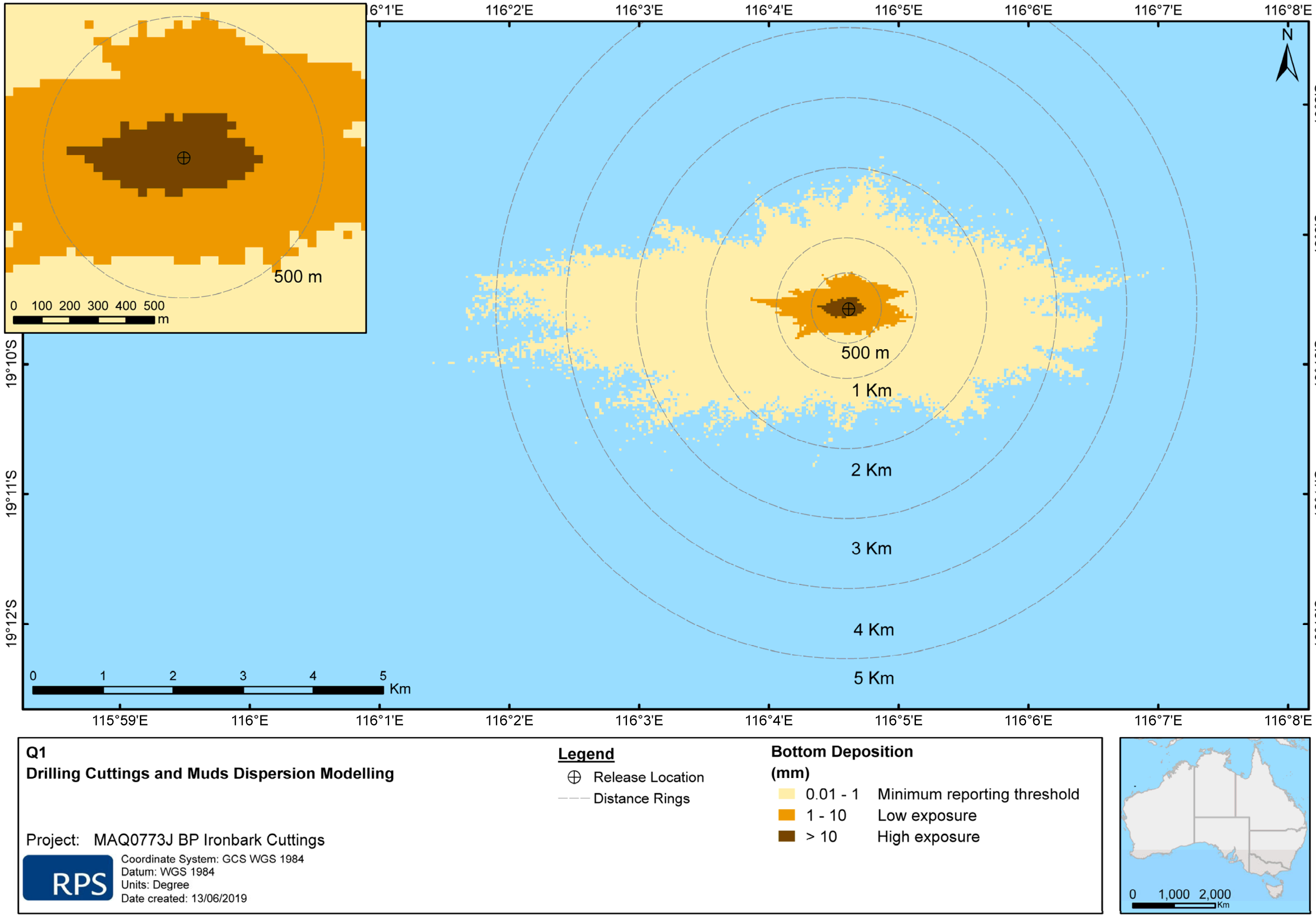

Figure 15 Predicted coverage and sediment thickness from the discharge of drill cuttings and unrecoverable muds from Ironbark-1 well during Quarter 1 conditions (January–March). Results are derived from 25 combined (near-seabed and surface) simulations.

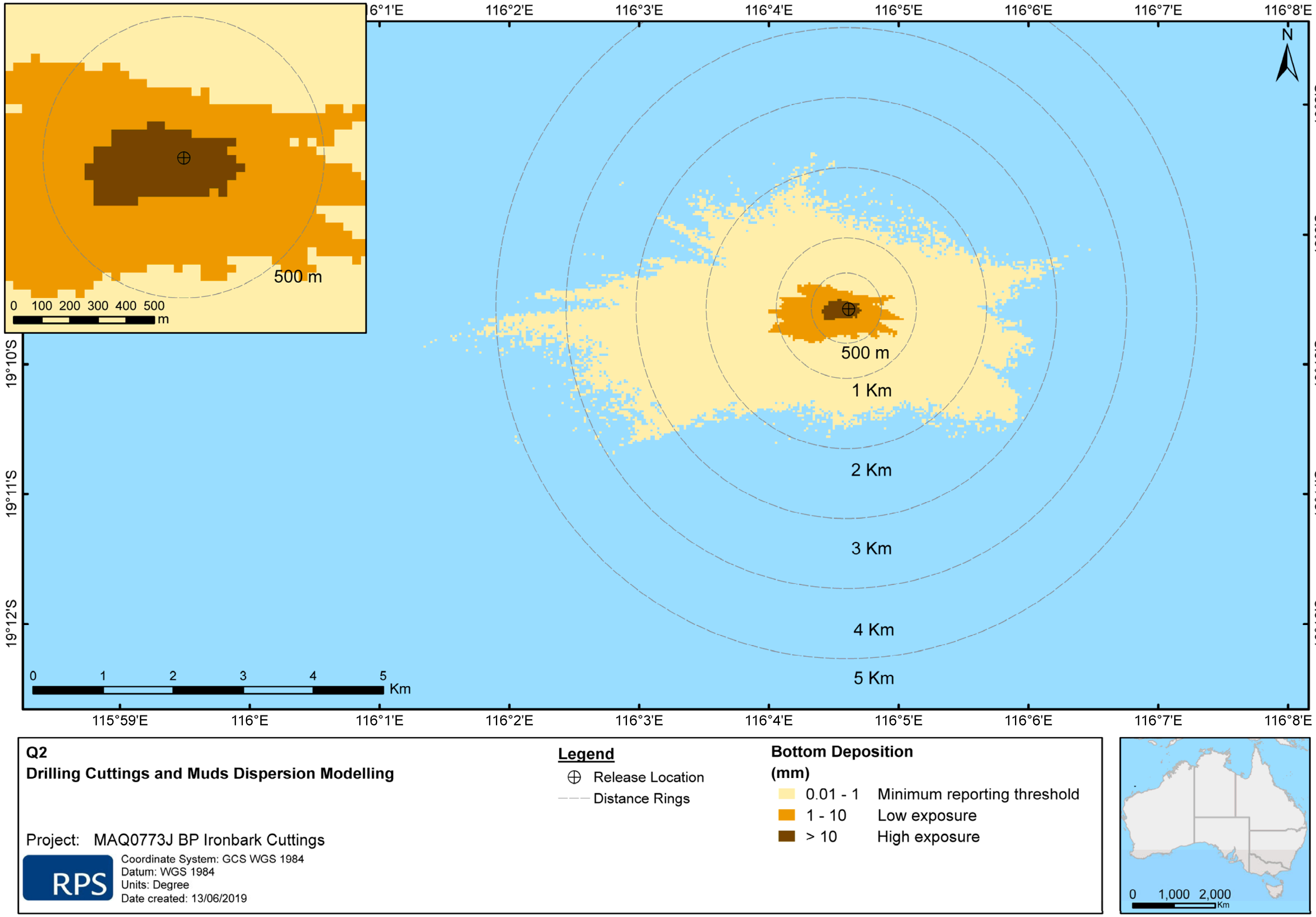

Figure 16 Predicted coverage and sediment thickness from the discharge of drill cuttings and unrecoverable muds from Ironbark-1 well during Quarter 2 conditions (April-June). Results are derived from 25 combined (near-seabed and surface) simulations.

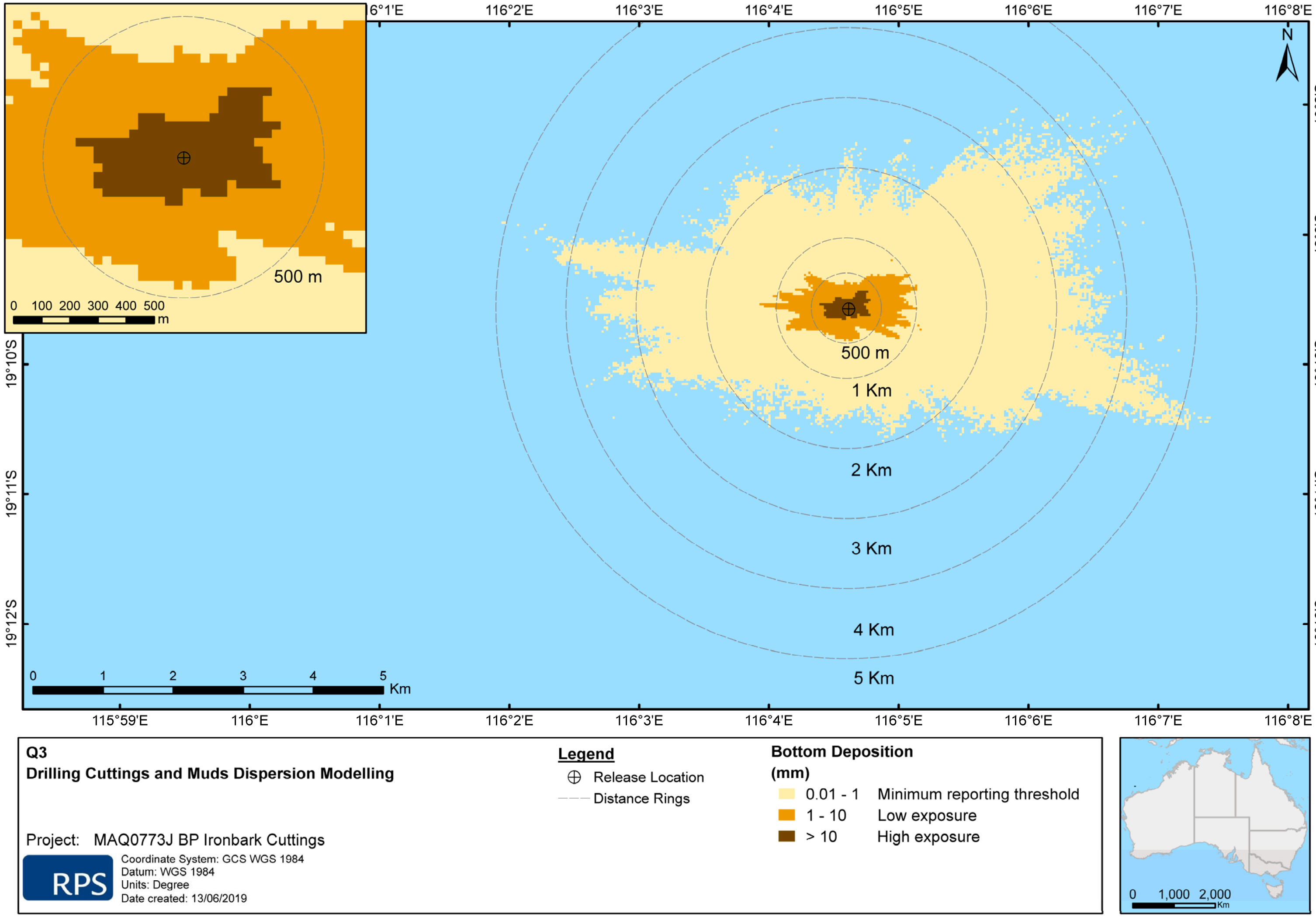

Figure 17 Predicted coverage and sediment thickness from the discharge of drill cuttings and unrecoverable muds from Ironbark-1 well during Quarter 3 conditions (July-September). Results are derived from 25 combined (near-seabed and surface) simulations.

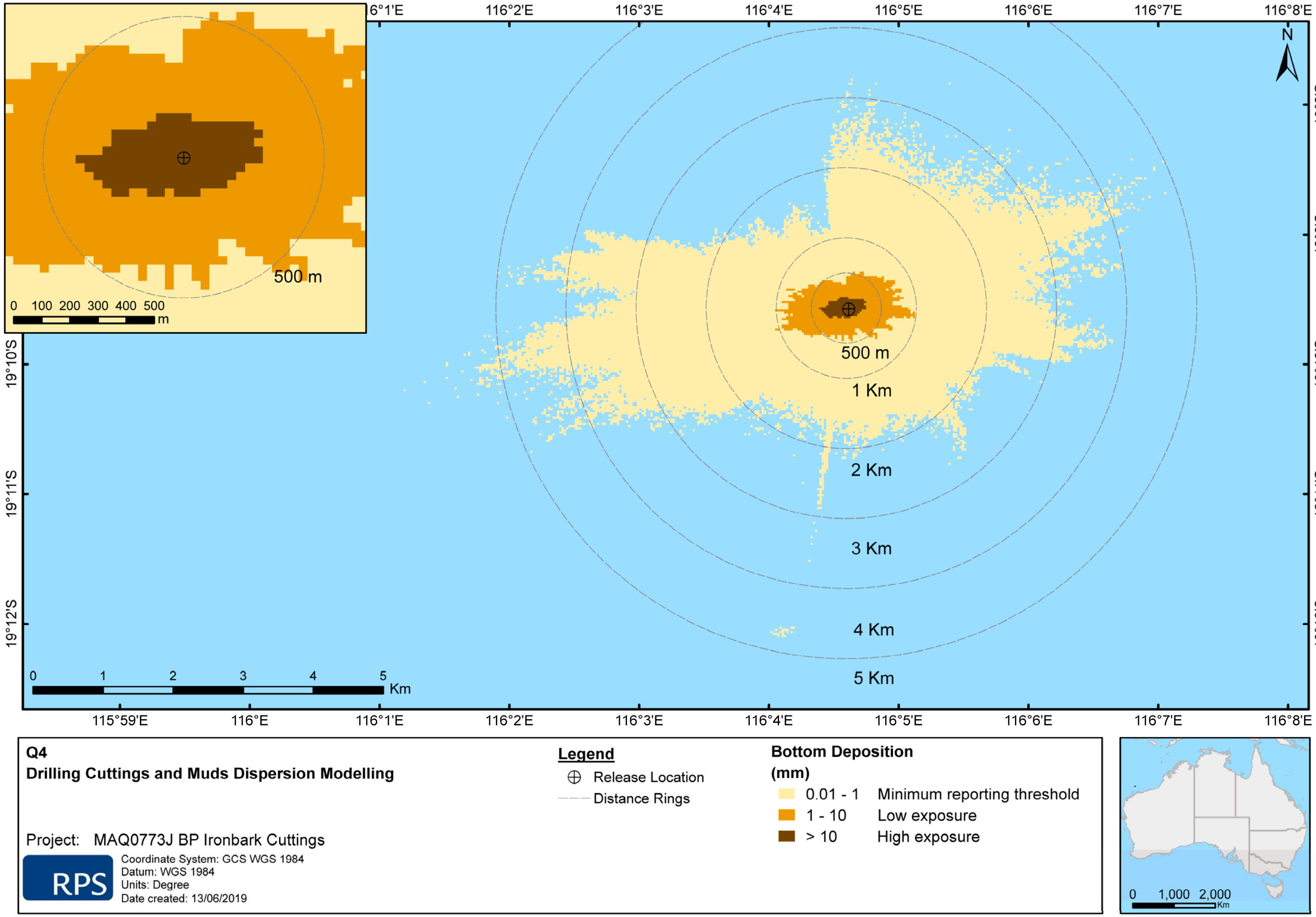

Figure 18 **Predicted coverage and sediment thickness from the discharge of drill cuttings and unrecoverable muds from Ironbark-1 well during Quarter 4 conditions (October-December). Results are derived from 25 combined (near-seabed and surface) simulations.**

Figure 19 presents cross-section views of the predicted thickness from the discharge of cuttings and unrecoverable muds during Quarter 4 conditions (October–December). Quarter 4 is shown as it was during this period that the greatest predicted thickness was recorded. The figures highlight that the thickness is greatest adjacent to the release location and significantly declines with distance from Ironbark-1. Note the vertical axis in Figure 19 are greatly exaggerated.

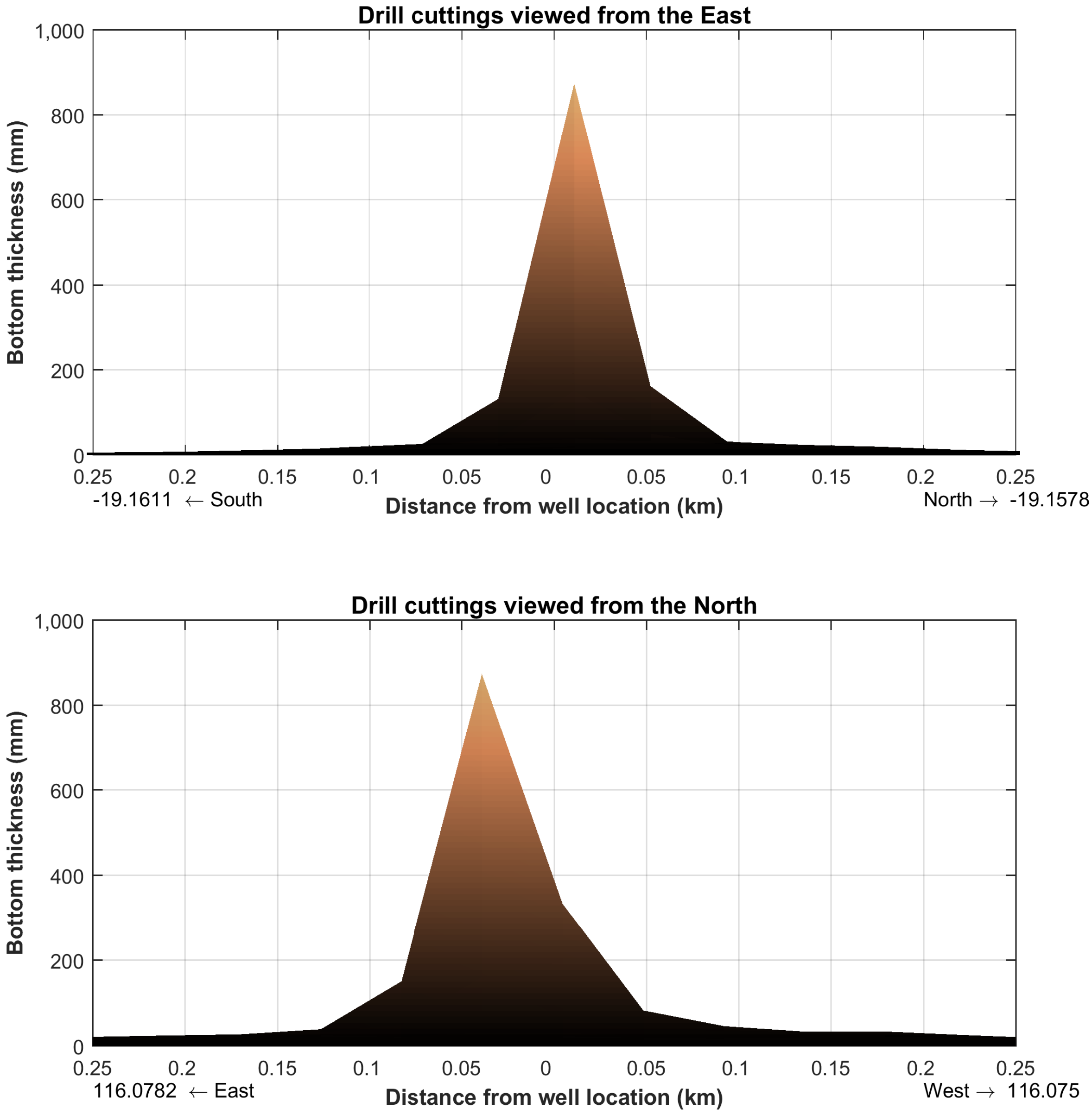

Figure 19 Cross sectional view of the predicted thicknesses on the seafloor along the north-south axis (upper image) and east-west axis (lower image). Results are derived from the combined near-seabed and surface discharges of drill cuttings and unrecoverable muds during Quarter 4 conditions (October–December). Note the vertical scale is exaggerated.

6.2.2 Integration of all Modelling Results

Figure 20 shows the maximum thickness at each grid cell from all 100 individual simulations (i.e. 25 simulations per quarter) used to objectively define all locations on the seabed that maybe exposed.

Table 10 provides a summary of the predicted maximum bottom thickness, total area of coverage and the maximum distance and direction to the minimum threshold based on all 100 simulations. The maximum bottom thickness was 874.6 mm and the total area of coverage on the seafloor above the minimum reporting threshold was 27.1 km^2. The maximum distance from the well to the minimum threshold was 6.09 km west of Ironbark-1. The maximum distance from the well to the low exposure (1–10 mm) and high exposure threshold (>10 mm) was 1.24 km and 0.40 km, respectively.

Table 10 Predicted maximum bottom thickness, area of coverage and maximum distance to the minimum threshold from all 100 individual simulations (i.e. 25 simulations per quarter) used to objectively define all locations on the seabed that maybe exposed.

Annual assessment	Maximum stochastic bottom thickness (mm)	Total stochastic area of coverage (km^2), at or above, 0.01 mm	Maximum distance (km) from the well to the minimum threshold of 0.01 mm
Quarter 1–4 (January–December)	874.6	27.1	6.09 (West)

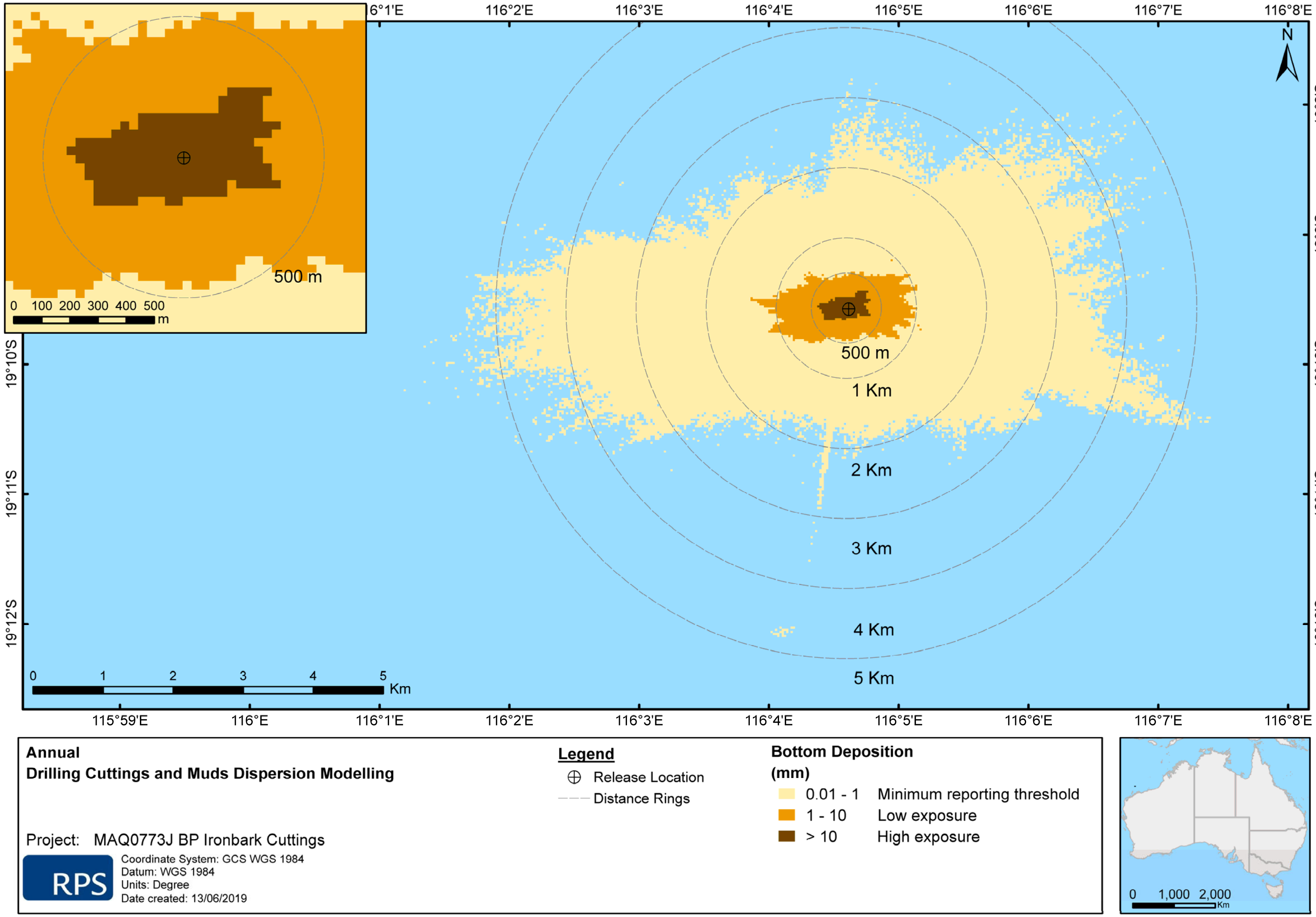

Figure 20 **Predicted maximum thickness at each grid cell from all 100 combined simulations (i.e. 25 simulations per quarter) during Q1-4 used to objectively define all locations on the seabed that maybe exposed.**

6.3 Total Suspended Solids

6.3.1 Quartile Modelling Results

Figure 21 to Figure 24 present the maximum predicted TSS concentrations from the drill cuttings and unrecoverable muds discharges for Q 1-4 based on the 100 combined discharges (i.e. near-seabed and surface) from the Ironbark-1 well.

The TSS concentrations greater than 5 mg/L tended to occur west and east of the release location.

Table 11 provides a summary of the maximum TSS concentrations, total area of coverage and the maximum distance and direction to the minimum TSS threshold. The maximum TSS concentrations ranged between 1,426.6 mg/L (Q1) to 1,631.9 (Q3), which occurred within 30 m of the discharge. This is below the high exposure threshold of 1,830 mg/L. The total area of coverage above the minimum threshold ranged between 5.0 km^2 (Q4) and 7.9 km^2 (Q2). The maximum distance from the well to TSS concentrations above the minimum threshold ranged from 5.03 km (Q4) to 6.54 km (Q3).

The maximum distance from Ironbark-1 well to concentrations greater than 10 mg/L (low exposure) ranged between 3.05 km (Q2) to 3.95 km (Q3). While the maximum distance from Ironbark-1 to concentrations greater than 100 mg/L ranged between 0.18 km (Q3) to 0.26 km (Q1).

Table 11 Predicted maximum total suspended solids concentration, area of coverage and maximum distance to the minimum threshold (5 mg/L) from drill cuttings and unrecoverable muds discharges commencing under Quarter 1-4 (January–December, 2011-2015) conditions. Results are derived from 25 discharge simulations per quarter.

Operation commencement period	Maximum stochastic TSS concentration (mg/L)	Total area of coverage (km^2), at or above the minimum threshold of 5 mg/L	Maximum distance (km) from the well to the minimum threshold of 5 mg/L
Quarter 1 (Q1) (January–March)	1,426.6	6.1	5.96 (West)
Quarter 2 (Q2) (April–June)	1,501.3	7.2	5.95 (West)
Quarter 3 (Q3) (July–September)	1,631.9	7.9	6.54 (East-southeast)
Quarter 4 (Q4) (October–December)	1,602.1	5.0	5.03 (West-southwest)

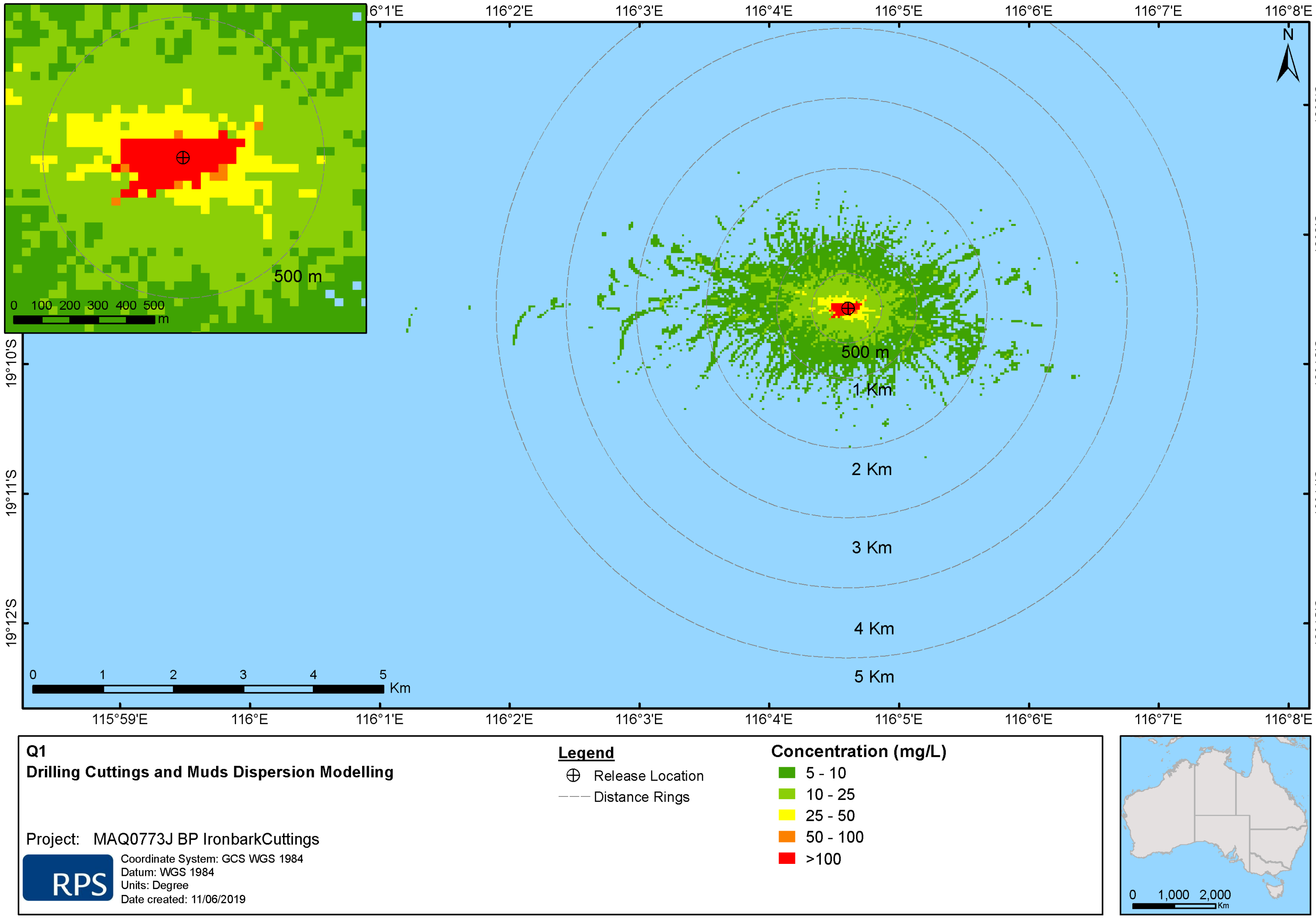

Figure 21 **Maximum predicted total suspended solids concentrations in each grid cell from the discharge of drill cuttings and unrecoverable muds from Ironbark-1 well during Quarter 1 conditions (January–March). Results are derived from 25 combined (near-seabed and surface) simulations.**

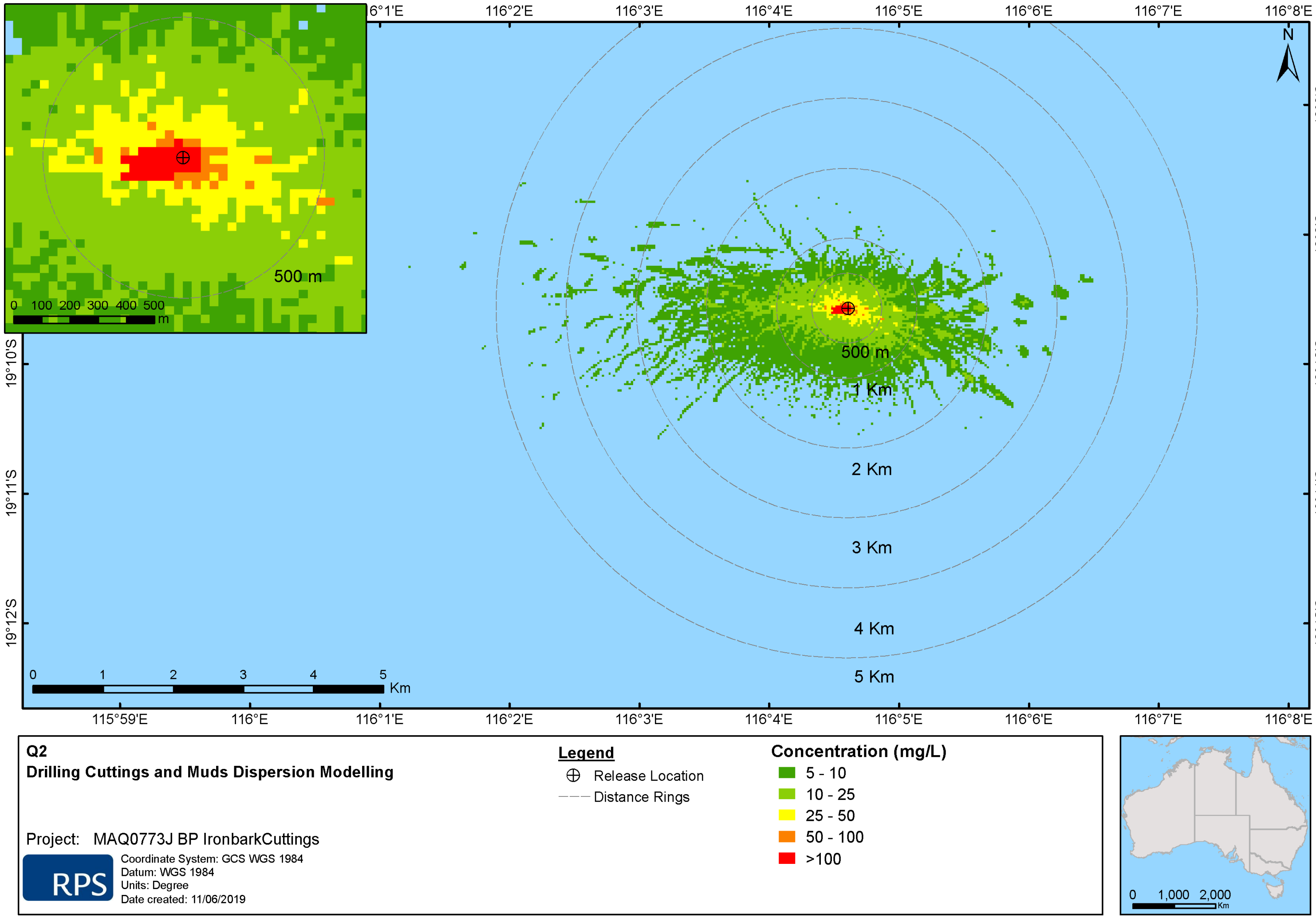

Figure 22 Maximum predicted total suspended solids concentrations in each grid cell from the discharge of drill cuttings and unrecoverable muds from Ironbark-1 well during Quarter 2 conditions (April-June). Results are derived from 25 combined (near-seabed and surface) simulations.

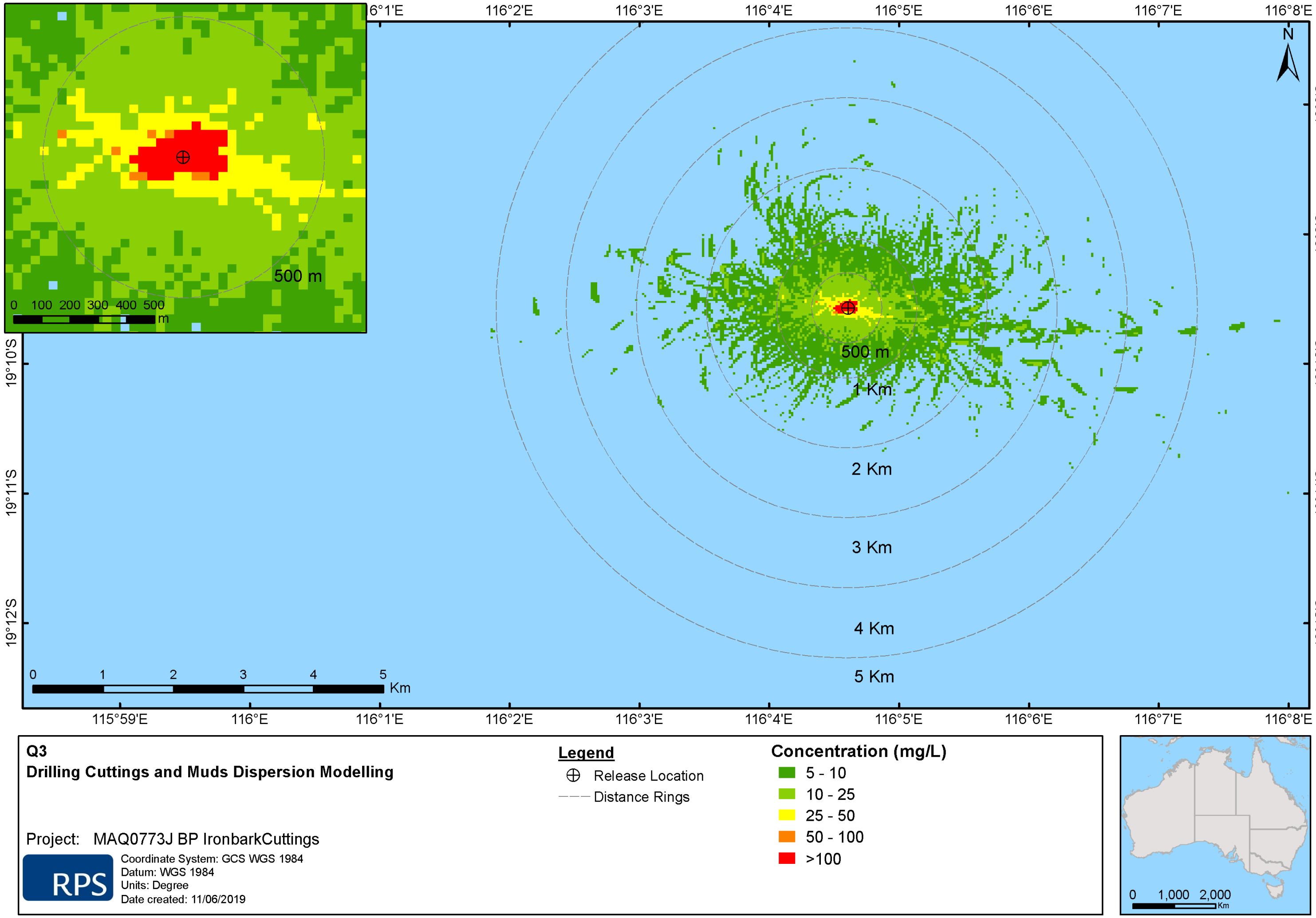

Figure 23 Maximum predicted total suspended solids concentrations in each grid cell from the discharge of drill cuttings and unrecoverable muds from Ironbark-1 well during Quarter 3 conditions (July-September). Results are derived from 25 combined (near-seabed and surface) simulations.

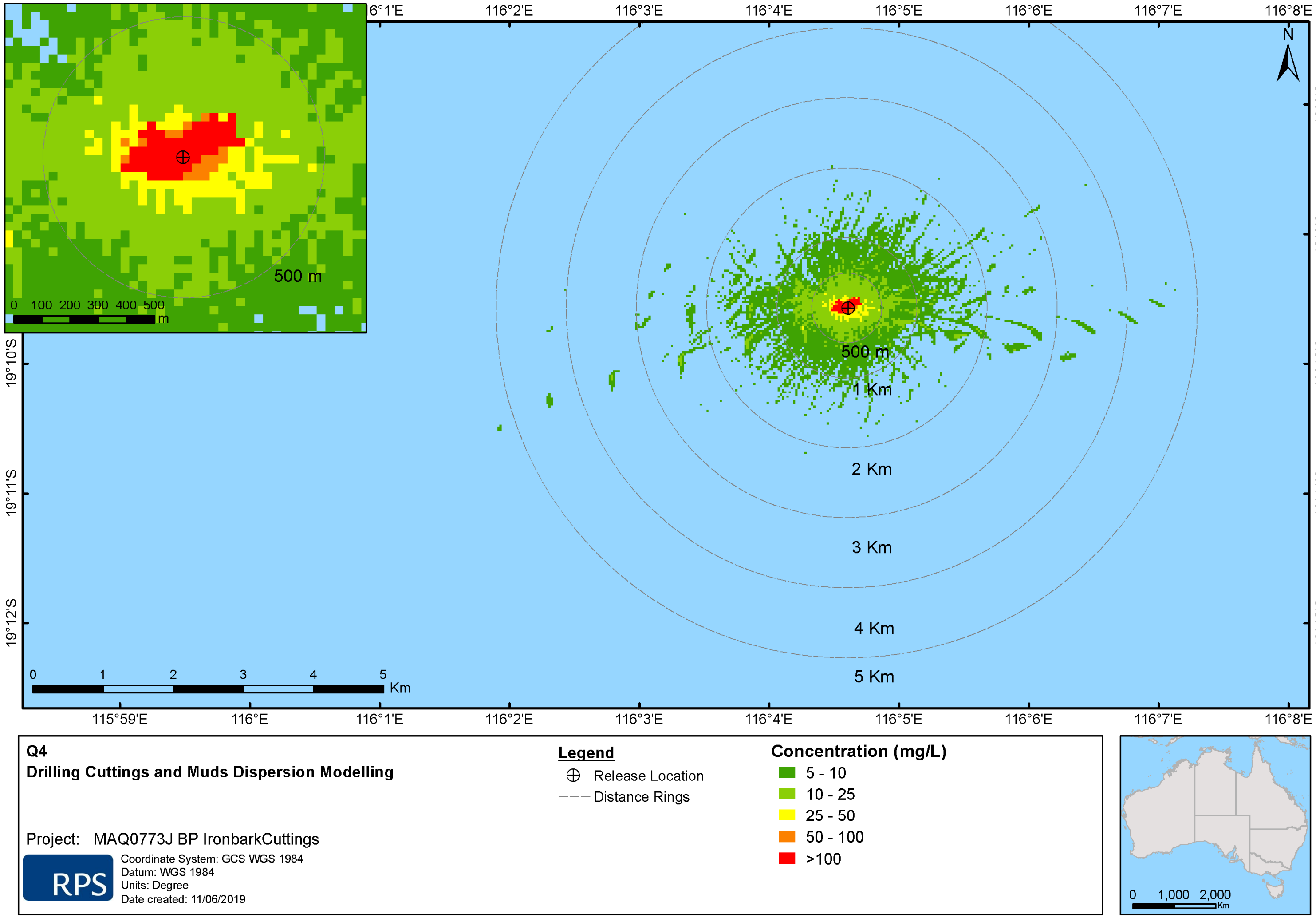

Figure 24 Maximum predicted total suspended solids concentrations in each grid cell from the discharge of drill cuttings and unrecoverable muds from Ironbark-1 well during Quarter 4 conditions (October-December). Results are derived from 25 combined (near-seabed and surface) simulations.

6.3.2 Integration of all Modelling Results

The maximum TSS concentrations for each grid cell from all 100 simulations (i.e. 25 simulations per quarter) used to objectively define potential water column exposure is shown Figure 25.

Table 12 provides a summary of the predicted TSS concentrations, total area of coverage and the maximum distance and direction to the minimum threshold based on all 100 simulations. The maximum TSS concentration was 1,631.9 mg/L. The total area of coverage above the minimum reporting threshold was 11.8 km^2. The maximum distance from the Ironbark-1 well to the minimum TSS threshold was 6.54 km east-southeast.

Table 13 presents the area of exposure and maximum distances from Ironbark-1 for a range of TSS concentrations, based on results from all 100 simulations. Concentrations above 10 mg/L (or low exposure threshold) were predicted to have an area of coverage of 2.9 km^2 (or 24% of total area of exposure), while concentrations greater than 25 mg/L covered a much smaller area (0.3 km^2 or 3% of total area of exposure). The extent of TSS concentrations greater than 10 mg/L, 25 mg/L, and 50 mg/L from the release location was 3.95 km, 1.09 km and 0.54 km, respectively. Predicted TSS concentrations greater than 100 mg/L were restricted to within 0.26 km from Ironbark-1 well.

Table 12 Predicted total suspended solids concentration, area of coverage and maximum distance to the minimum threshold from all 100 individual simulations (i.e. 25 simulations per quarter) used to objectively define potential water column exposure.

Annual assessment	Maximum stochastic TSS concentration (mm)	Area of coverage (km^2), at or above, 5 mg/L	Maximum distance (km) from the well to the minimum threshold of 5 mg/L
Quarter 1–4 (January–December)	1,631.9	11.8	6.54 (East-southeast)

Table 13 Predicted area of coverage and maximum distances from Ironbark-1 from all 100 individual simulations used to objectively define potential water column exposure.

TSS concentration (mg/L)	Area of coverage (km^2)	Maximum distance (km) from the well to concentration
>5	11.8	6.54 (East-southeast)
>10	2.9	3.95 (East)
>25	0.3	1.09 (East)
>50	0.1	0.54 (East-southeast)
>100	<0.1	0.26 (West-southwest)

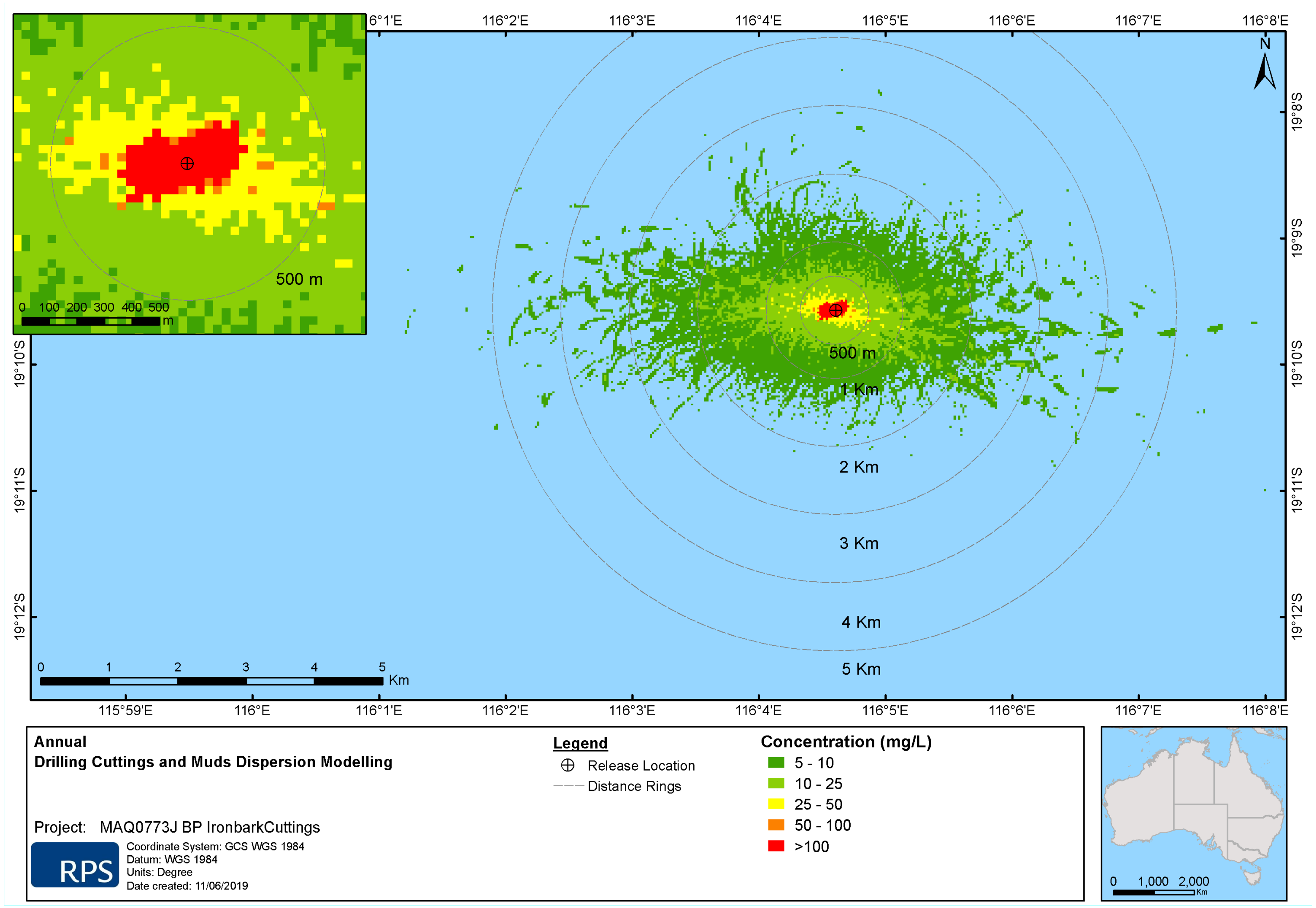

Figure 25 Maximum TSS concentrations for each grid cell from all 100 simulations (i.e. 25 simulations per quarter) used to objectively define potential water column exposure.

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Appendix C

Oil Spill Modelling

Report

4 OCTOBER 2019

BP Developments Australia Ironbark Block WA-359-P

Oil Spill Modelling

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Approval for issue

Name	Signature	Date
Dr Sasha Zigic		4/9/2019

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TERMS AND ABBREVIATIONS

°	Degrees
‘	Minutes
“	Seconds
AMP	Australian marine parks
AMSA	Australian Maritime Safety Authority
API	American Petroleum Institute gravity (A measure of how heavy or light a petroleum liquid in comparison to water)
ASTM	American Society for Testing and Materials
bbl	barrel
BP	BP Exploration Limited
°C	Degree Celsius (unit of temperature)
cP	Centipoise (unit of viscosity)
CFSR	Climate Forecast System Reanalysis
cm	Centimetre (unit of length)
Decay	The process where oil components are changed either chemically or biologically (biodegradation) to another compound. It includes breakdown to simpler organic carbon compounds by bacteria and other organisms, photo-oxidation by solar energy, and other chemical reactions
Dissolved hydrocarbons	Dissolved hydrocarbons within the water column with alternating double and single bonds between carbon atoms forming rings, containing at least one six-membered benzene ring
g/m^2	Grams per square meter (unit of surface or area density)
EIA	Environmental impact assessment
Entrained oil	Droplets or globules of oil that are physically mixed (but not dissolved) into the water column. Physical entrainment can occur either during pressurised release from a subsurface location, or through the action of breaking waves (>12 knots)
EP	Environmental plan
EEZ	Exclusive Economic Zone
Evaporation	The process whereby components of the oil mixture are transferred from the sea-surface to the atmosphere
GODAE	Global Ocean Data Assimilation Experiment
HYCOM	Hybrid Coordinate Ocean Model is a data-assimilative, three-dimensional ocean model
HYDROMAP	Advanced ocean/coastal tidal model used to predict tidal water levels, current speed and current direction
IOA	Index of Agreement gives a non-dimensional measure of model accuracy or performance
Isopycnal layers	Water column layers with corresponding water densities
ITOPF	The International Tanker Owners Pollution Federation
KEF	Key Ecological Feature
km	Kilometre (unit of length)
km^2	Square Kilometres (unit of area)
Knot	unit of wind speed (1 knot = 0.514 m/s)
LGA	Local Government Area
m	Meters (unit of length)

m^2	Meters squared (unit of area)
m^3	Meters cubed (unit of volume)
m/s	Meters per Second (unit of speed)
MAE	Mean Absolute Error is the average of the absolute values of the difference between model predicted and observed data (e.g. surface elevations)
MB	Marine boundary
MDO	Marine Diesel Oil
MMscf	Millions of standard cubic feet
MMstb	Million stock tank barrels
MNP	Marine National Park
RSB	Reefs, Shoals and Banks
MS	Marine Sanctuary
NASA	National Aeronautics and Space Administration
NCEP	National Centres for Environmental Prediction
NOAA	National Oceanic and Atmospheric Administration
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
nm	nautical mile (unit of distance; 1 nm = 1.852 km)
NP	National Parks
Ocean current	Large scale and continuous movement of seawater generated by forces such as breaking waves, wind, the Coriolis effect, and temperature and salinity gradients. It is the main flow of ocean waters
ppb	Parts per billion (concentration)
psia	Pounds per square inch absolute
PSU	Practical salinity units
Ramsar site	A wetland site designated of international importance under the Ramsar Convention
RAMSAR Convention	The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.
Sea surface exposure	Floating oil on the sea surface equal to or above reporting threshold (e.g. 0.5 g/m^2)
Shoreline contact	Stranded oil on the shoreline equal to or above reporting threshold (e.g. 10 g/m^2)
SIMAP	Spill Impact Mapping Analysis Program
Visible oil	Floating oil on the sea surface equal to or above reporting threshold (e.g. 0.5 g/m^2)

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EXECUTIVE SUMMARY

Background

BP Exploration Limited (BP) is planning on drilling the Ironbark exploration well in 297 m of water in permit area WA-359-P, offshore Carnarvon Basin, Western Australia. To support the environmental plan (EP), whilst also supporting the oil spill response strategies to be outlined in BP's oil pollution emergency plan (OPEP), an oil spill modelling study had been commissioned, which examined two hypothetical scenarios applicable to the operation:

- 250 m^3 surface release of marine diesel over 6 hours in the event of a vessel collision at the Ironbark well; and
- 9.016 MMstb (1,433,544 m^3) subsea release of condensate over 103 days to represent a loss of well control event from the Ironbark well.

SIMAP's stochastic model was used to quantify the probability of exposure to the sea surface and in-water and probability of shoreline contact from hypothetical spill scenarios. The SIMAP system, the methods and analysis presented herein use modelling algorithms which have been anonymously peer reviewed and published in international journals. Further, RPS warrants that this work meets and exceeds the ASTM Standard F2067-13 "*Standard Practice for Development and Use of Oil Spill Models*".

Methodology

The modelling study was carried out in several stages. Firstly, a five-year current dataset (2011–2015) that includes the combined influence of three-dimensional ocean and tidal currents was developed. Secondly, the currents, spatial winds and then detailed hydrocarbon properties were used as inputs in the oil spill model to simulate the drift, spread, weathering, entrainment and fate of the spilled hydrocarbons.

As spills can occur during any set of wind and current conditions, a total of 100 spill trajectories per hypothetical spill scenario per season (summer, transitional and winter) were initiated at random times within a 5-year period (2011–2015) to enable a robust statistical analysis.

Each simulation was configurated with the same spill information (i.e. spill volume, duration and oil type) except for the start time and date which in turns, ensures that the predicted transport and weathering of an oil slick is subject to a wide range of current and wind conditions.

Oil Properties

Marine Diesel Oil (MDO), used in scenario 1, is a light-persistent fuel oil used in the maritime industry. It has a density of 829.1 kg/m^3 (API of 37.6) and a low pour point (-14^{o}C). According to the International Tanker Owners Pollution Federation classification scheme (ITOPF, 2014) the MDO is classified as a Group II light persistent oil. The classification is based on the specific gravity of hydrocarbons in combination with relevant boiling point ranges.

Goodwyn condensate was used as a proxy for the loss of well control scenario. The condensate has an API of 51.5, a density of 773.1 kg/m3 (at 25ºC) with a low pour point of -30^{o}C and a viscosity of 0.912 cP (at 21.1^{o}C), classifying it as a Group I non-persistent oil.

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Key Findings

Scenario: 250 m³ surface release of marine diesel oil

Sea surface exposure

- No shoreline contact above the minimum threshold (>10 g/m²) was predicted for any of the seasons modelled.
- The maximum distance the low (1 – 10 g/m²) exposure surface hydrocarbons occurred from the release location ranged from 97 km and 166 km during winter and transitional conditions, respectively. Additionally, the maximum distance of sea surface exposure was predicted to occur from the release location at the moderate and high zones of exposure ranged from 45 km (summer) to 54 km (transitional) and 5 km (winter) to 27 km (summer), respectively.
- The maximum probability of sea surface exposure to any given receptor was 2% predicted during summer conditions above the Ancient coastline KEF at 125 m depth with a corresponding minimum time before exposure of 1.2 days.
- No sea surface exposure at the moderate or high exposure thresholds was predicted for any receptor during any of the seasons modelled.

Dissolved hydrocarbon exposure

- Based on the 1 hour exposure window, the Continental Slope Demersal Fish Communities KEF receptor recorded the greatest dissolved hydrocarbon concentration of 15.4 ppb during winter in the 0-10 m depth layer.
- During the transitional conditions the Continental Slope Demersal Fish Communities KEF recorded a dissolved hydrocarbon concentration of 11.0 ppb in the 0-10 m depth layer.
- No dissolved hydrocarbon exposure based on a 48-hour window was predicted for any of the assessed receptors during any of the seasons modelled.

Entrained hydrocarbon exposure

- At the depth of 0-10 m for the 48 hour time-averaged exposure window, maximum dissolved hydrocarbons were greatest at the Ancient coastline KEF at 125 m depth contour and Continental Slope Demersal Fish Communities KEF. The maximum 48 hour time-averaged concentrations at the Ancient coastline KEF at 125 m depth contour ranged between 47.0 ppb (transitional) and 59.8 ppb (summer). Additionally, the Maximum concentrations at the Continental Slope Demersal Fish Communities KEF ranged between 53.9 ppb (transitional) and 103.7 ppb (winter).
- Within the 0-10 m depth layer during summer conditions, the probability of low (10 ppb) exposure ranged from 1% (Gascoyne and Montebello AMPs) to 6% (Continental Slope Demersal Fish Communities KEF). During transitional conditions, the probability of low exposure ranged from 2% (Gascoyne AMP, Ningaloo MP and Ningaloo Reef RSB) to 12% (Continental Slope Demersal Fish Communities KEF). During winter conditions, the probability of low exposure ranged from 1% (Mermaid Reef and Montebello AMPs, Mermaid Reef RSB, and Mermaid Reef and Commonwealth waters surrounding Rowley Shoals and Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEFS) to 14% (Continental Slope Demersal Fish Communities KEF).

Scenario: 9.016 MMstb subsea release of condensate over 103 days

Sea surface exposure

- No shoreline contact above the minimum threshold (>10 g/m^2) was predicted for any of the seasons modelled.
- The maximum distance for low exposure from the release location ranged from 374 km and 575 km during summer and transitional conditions. Additionally, the maximum distance from the release location at the moderate and high zones of exposure ranged from 174 km (transitional) to 180 km (winter) and 70 km (summer) to 115 km (winter), respectively.
- Probabilities of low exposure on the sea surface, at or above, the low threshold under summer conditions ranged from 1% (KEF, RSB, and MP) to 71% (KEF – Continental Slope Demersal Fish Communities).
- During each of the seasons modelled the Continental Slope Demersal Fish Communities KEF was predicted to have the greatest probability of sea surface (68% for transitional and 77% for winter) exposure with corresponding minimum times to (low) exposure ranging from 2 days (transitional) to 5 days (summer).

Dissolved hydrocarbon exposure

- For the 48-hour time-averaged exposure window, the greatest predicted concentration at a receptor was 306 ppb (IMCRA – Northwest Shelf) under winter conditions. The maximum (48 hour) time-averaged concentrations at the IMCRA Northwest Shelf KEF under summer and transitional conditions was 220 ppb and 173 ppb, respectively.
- Based on the 1-hour exposure window, the IMCRA Northwest Shelf receptor recorded the greatest dissolved hydrocarbon concentration of 2,129 ppb during winter. The probability of dissolved hydrocarbon exposure at the IMCRA Northwest Shelf ranged between 78% (transitional) and 97% (winter) at low exposure threshold, 49% (transitional) and 78% (winter) at the moderate exposure threshold and 3% (transitional) and 7% (summer and winter) at the high exposure threshold.

Entrained hydrocarbon exposure

- For the 48 hour time-averaged exposure window, maximum entrained hydrocarbons were greatest at the IMCRA - Northwest Shelf. The maximum 48 hour time-averaged concentrations at the IMCRA Northwest Shelf ranged between 6,067 ppb (summer) and 3,445 ppb (winter).
- The analysis for the entrained hydrocarbons over a 1 hour window showed that the maximum exposure was 12,087 ppb (IMCRA – Northwest Shelf) during transitional conditions, 12,045 for summer conditions and 8,619 ppb for winter conditions.

1 INTRODUCTION

BP Exploration Limited (BP) is intending to drill the Ironbark-1 exploration well in 298 m of water, permit area WA-359-P, offshore Carnarvon Basin, Western Australia. In order to support the environmental plan (EP), whilst also supporting the oil spill response strategies to be outlined in BP's oil pollution emergency plan (OPEP), Green Light Environmental on behalf of BP commissioned RPS to undertake an oil spill modelling study. The study examined two hypothetical scenarios applicable to the operation:

- 250 m^3 surface release of marine diesel over 6 hours in the event of a vessel collision at the Ironbark well location; and
- 9.016 MMstb subsea release of condensate over 103 days to represent a loss of well control event from the Ironbark well location.

Figure 1 and Table 1 present the location and coordinate of Ironbark which was used as the release location for the two scenarios.

The potential risk of exposure to surrounding waters and shorelines was assessed for three distinct seasons; (i) summer (January to March and October to December), (ii) transitional (April and September) and (iii) winter (May to August).

Note that the oil spill model, the method and analysis presented herein uses modelling algorithms which have been anonymously peer reviewed and published in international journals. Furthermore, RPS warrants that this work meets and exceeds the American Society for Testing and Materials (ASTM) Standard F2067-13 “Standard Practice for Development and Use of Oil Spill Models”.

Table 1 Coordinates for Ironbark-1 exploration well used as the release location for the oil spill modelling study.

Location	Latitude	Longitude	Water depth (m)
Ironbark-1	19º 9’ 33.84” S	116º 4’ 35.76” E	298

The WGS84 Geographic projection was used throughout the report

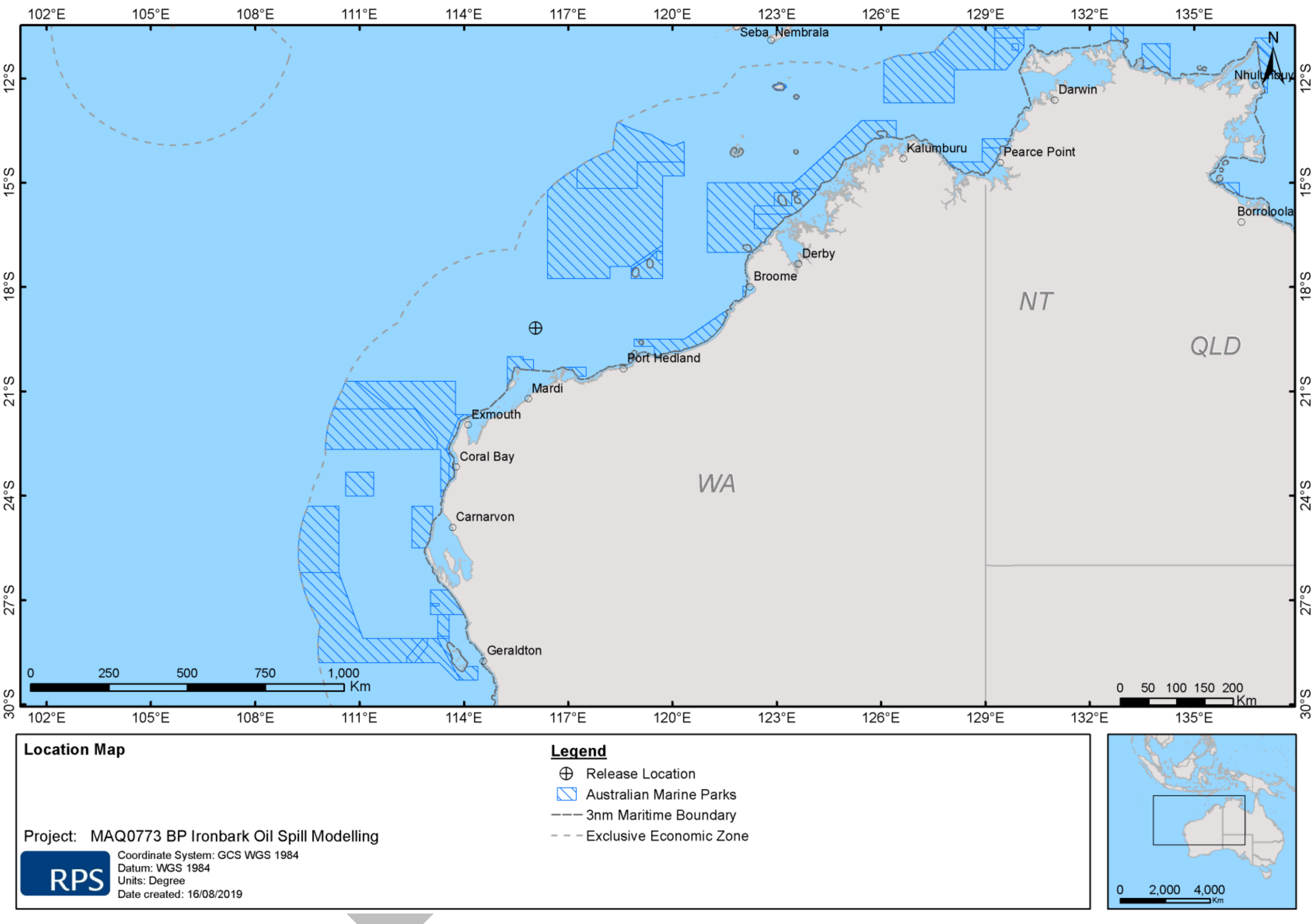

Figure 1 Map of the Ironbark-1 exploration well used as the release location for the oil spill modelling study.

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2 SCOPE OF WORK

The scope of work included the following components:

- Generate tidal current patterns of the region using the ocean/coastal model, HYDROMAP;
- Use HYCOM (Hybrid Coordinate Ocean Model) ocean currents combined with HYDROMAP tidal currents over a 5-year period (2011 to 2015) to account for large scale flows offshore and tidal flows nearshore;
- Use 5 years of high-resolution wind, aggregated current data and site-specific oil characteristics as input into the 3-dimensional oil spill model SIMAP to represent the movement, spreading, entrainment, weathering of the oil over time; and
- Use SIMAP's stochastic model (also known as a probability model) to calculate exposure to surrounding waters (sea surface and water column) and shorelines.

3 REGIONAL CURRENTS

The waters surrounding the Ironbark site would be affected by the Leeuwin current, a warm ocean current that flows strongly southwards along the Western Australian coastline (Holloway, 1993; Holloway and Nye, 1985; Godfrey and Ridgeway, 1985), and associated eddies and counter-currents (Figure 2).

The strength of the current is known to vary through the year, with the weakest southwards flow occurring from November to April (Sampey et al., 2004), when the winds tend to blow strongly northwards. Maximum flow velocities are generally experienced during autumn and winter when wind directions do not oppose the current. Typical current speeds in the Leeuwin Current (and its eddies) are approximately 0.5 m/s, although speeds of 1 m/s are common. Additionally, inter-annual variations in the strength of the currents are affected by El Niño - Southern Oscillation events (Pearce and Griffith, 1991). A comprehensive description of the circulation patterns of the Northwest Shelf is provided in a review by Condie and Andrewartha (2008).

The Leeuwin Undercurrent and other sub-surface currents have been observed to flow westwards (away from the coastline) offshore from the Exmouth plateau (Figure 3).

While the tidal currents are generally weaker in the deeper waters, their influence is greatest along the near shore, coastal passage regions and, in and around islands. Therefore, to accurately describe the variability in currents between the inshore and offshore region, a hybrid regional dataset was developed by combining ocean predictions obtained from HYCOM (Hybrid Coordinate Ocean Model) with 2-dimensional tidal currents developed by RPS. The following sections provide a summary of the hybrid regional data set.

Figure 4 and Figure 5 present the dominant (i.e. most frequently occurring) current conditions based on summer and winter HYCOM datasets within the region.

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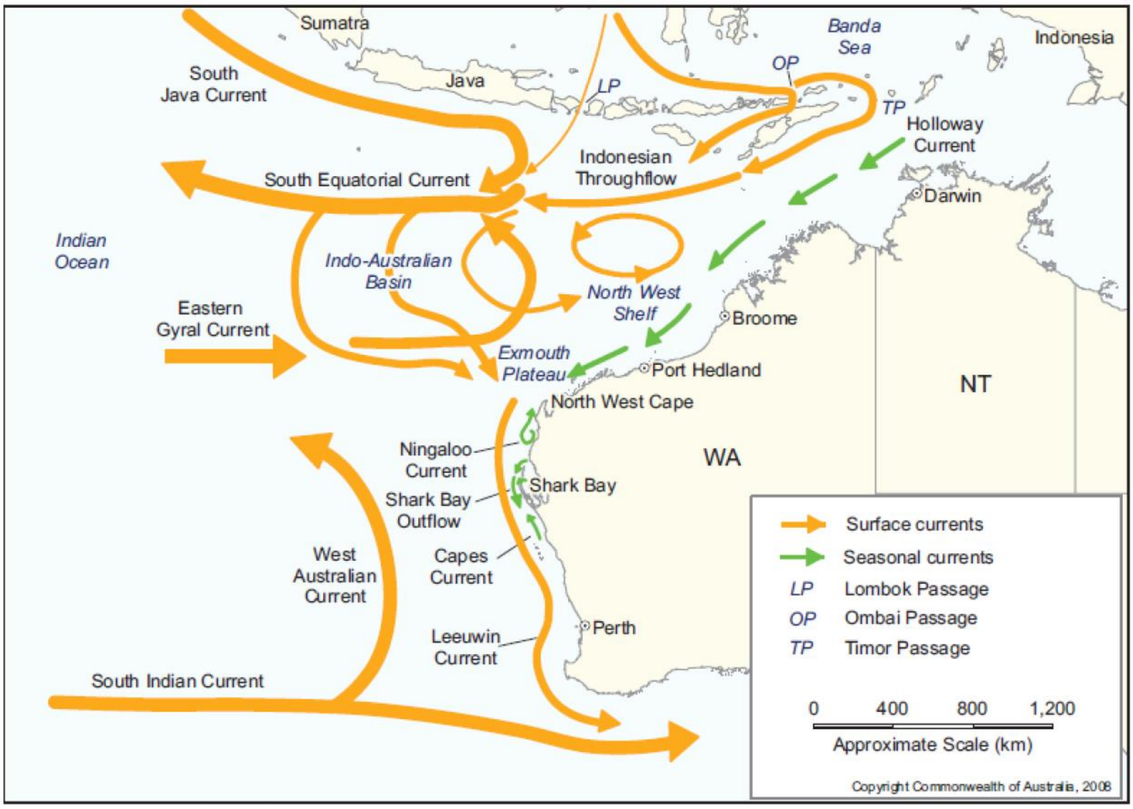

Figure 2 Schematic of ocean currents along the northwest Australian continental shelf (Source: DEWHA, 2008).

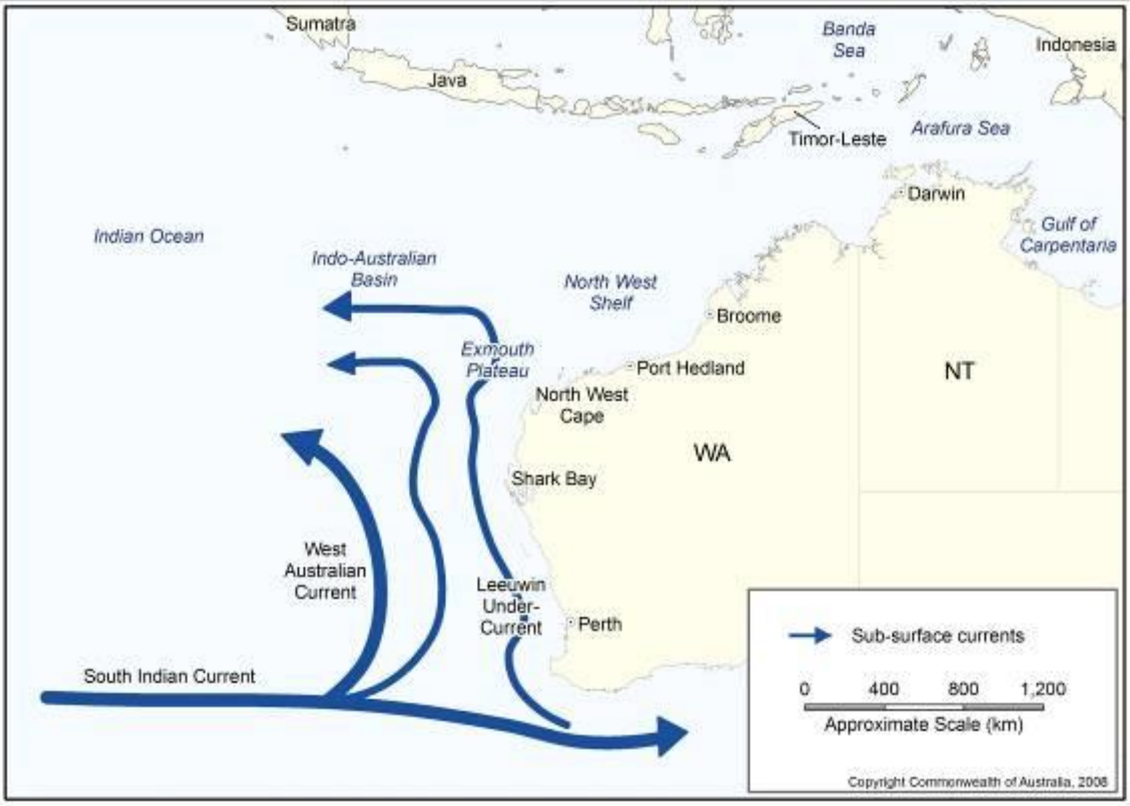

Figure 3 Schematic of ocean sub-surface currents along the northwest Australian continental shelf (Source: DEWHA, 2008).

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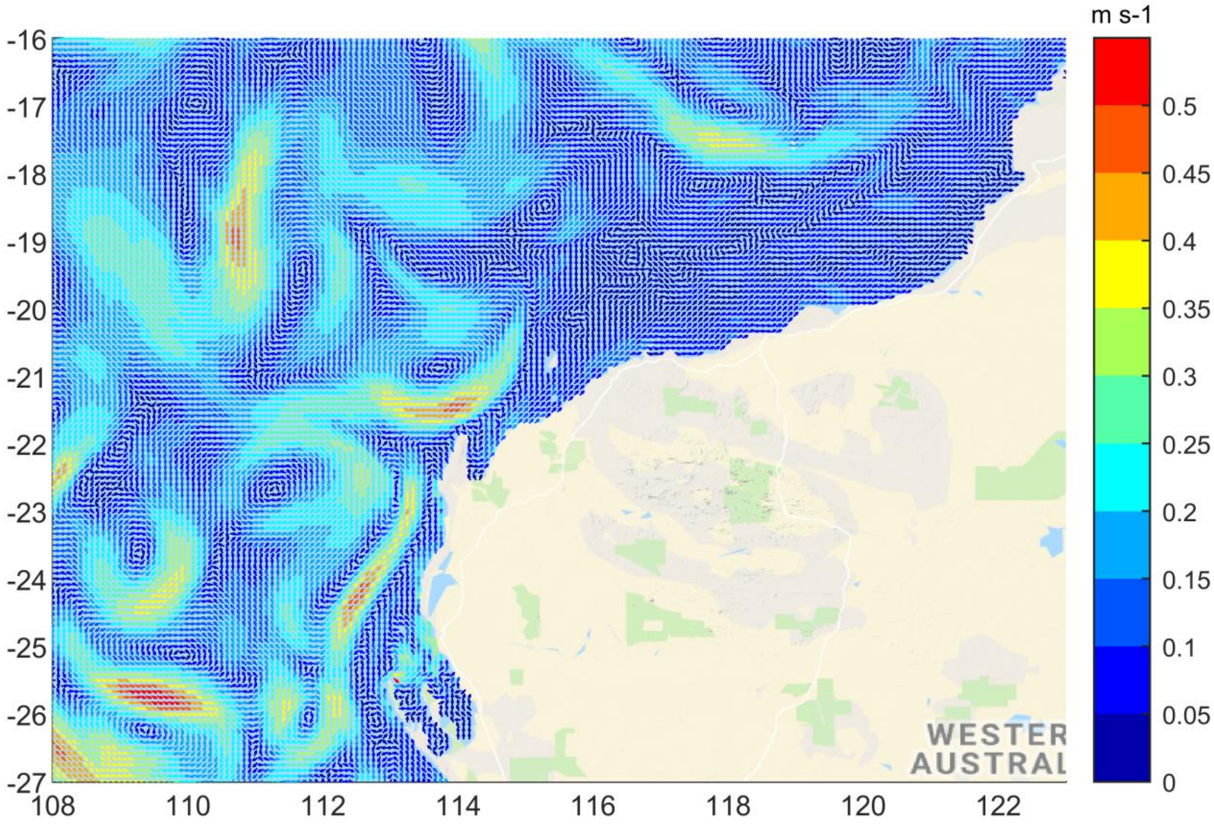

Figure 4 HYCOM surface drift conditions during summer.

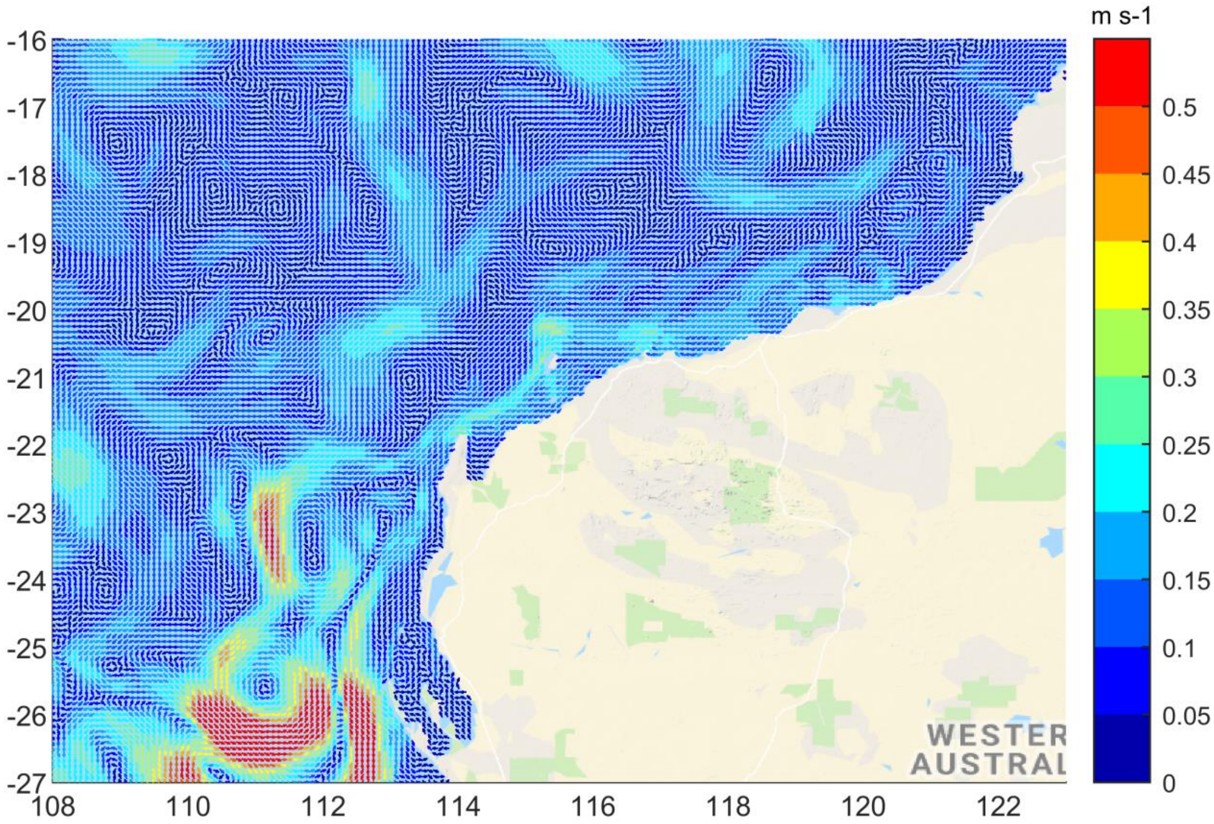

Figure 5 HYCOM surface drift conditions during winter.

3.1 Tidal Currents

Tidal current data was generated using RPS's advanced ocean/coastal model, HYDROMAP. The HYDROMAP model has been thoroughly tested and verified through field measurements throughout the world for over 30 years (Isaji and Spaulding, 1984; Isaji et al., 2001; Zigic et al., 2003). In fact, HYDROMAP tidal current data has been used as input to forecast (in the future) and hindcast (in the past) oil spills in Australian waters and forms part of the Australian National Oil Spill Emergency Response System operated by AMSA (Australian Maritime Safety Authority).

HYDROMAP employs a sophisticated sub-gridding strategy, which supports up to six levels of spatial resolution, halving the grid cell size as each level of resolution is employed. The sub-gridding allows for higher resolution of currents within areas of greater bathymetric and coastline complexity, and/or of particular interest to a study.

The numerical solution methodology follows that of Davies (1977a, 1977b) with further developments for model efficiency by Owen (1980) and Gordon (1982). A more detailed presentation of the model can be found in Isaji and Spaulding (1984) and Isaji et al. (2001).

3.1.1 Grid Setup

RPS have a seamless global 2-dimensional tidal model. The model domain is sub-gridded to a resolution of approximately 500 m for shallow and coastal regions, starting from an offshore (or deep water) resolution of approximately 8 km. The finer gridding was allocated in a step-wise fashion to more accurately resolve flows along the coastline, around islands and over more complex bathymetry. Figure 6 shows a sample of the tidal model domain, which extends over the study region.

The bathymetry in the model domain (Figure 7) consists of multiple data sources, including Geoscience Australia and digitised navigational charts.

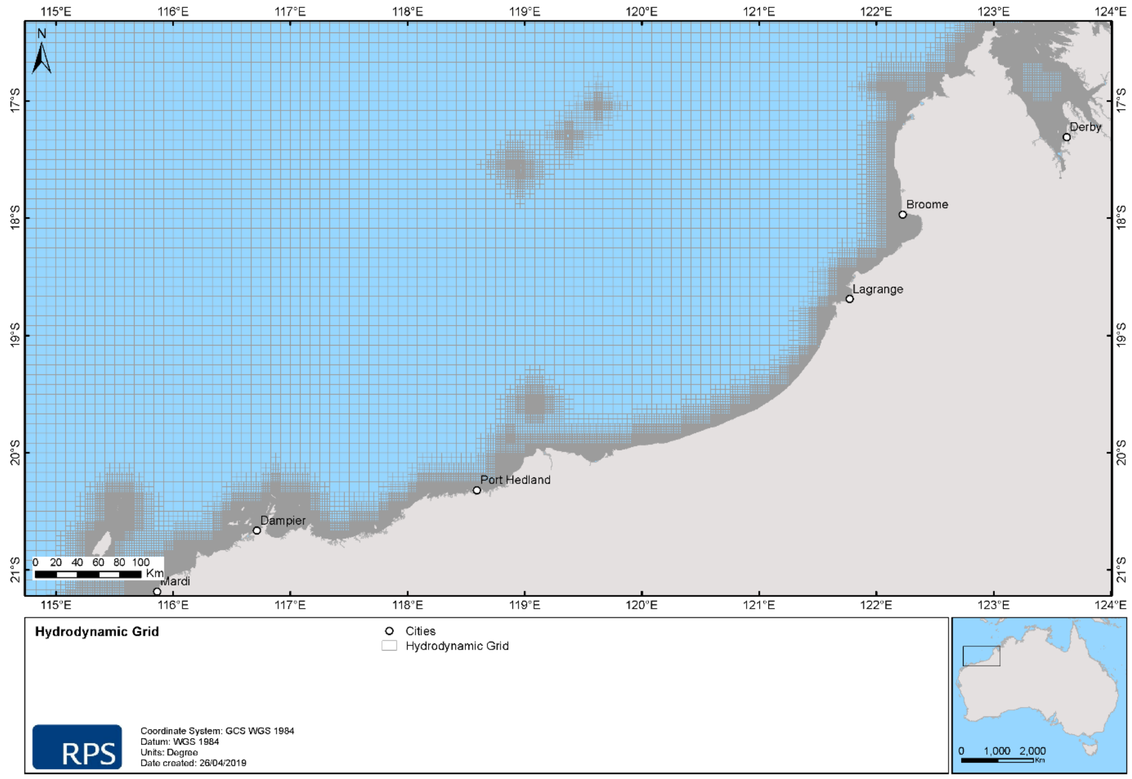

Figure 6 Sample of the model grid used to generate the tidal currents for the study region. Higher resolution areas are shown by the denser mesh.

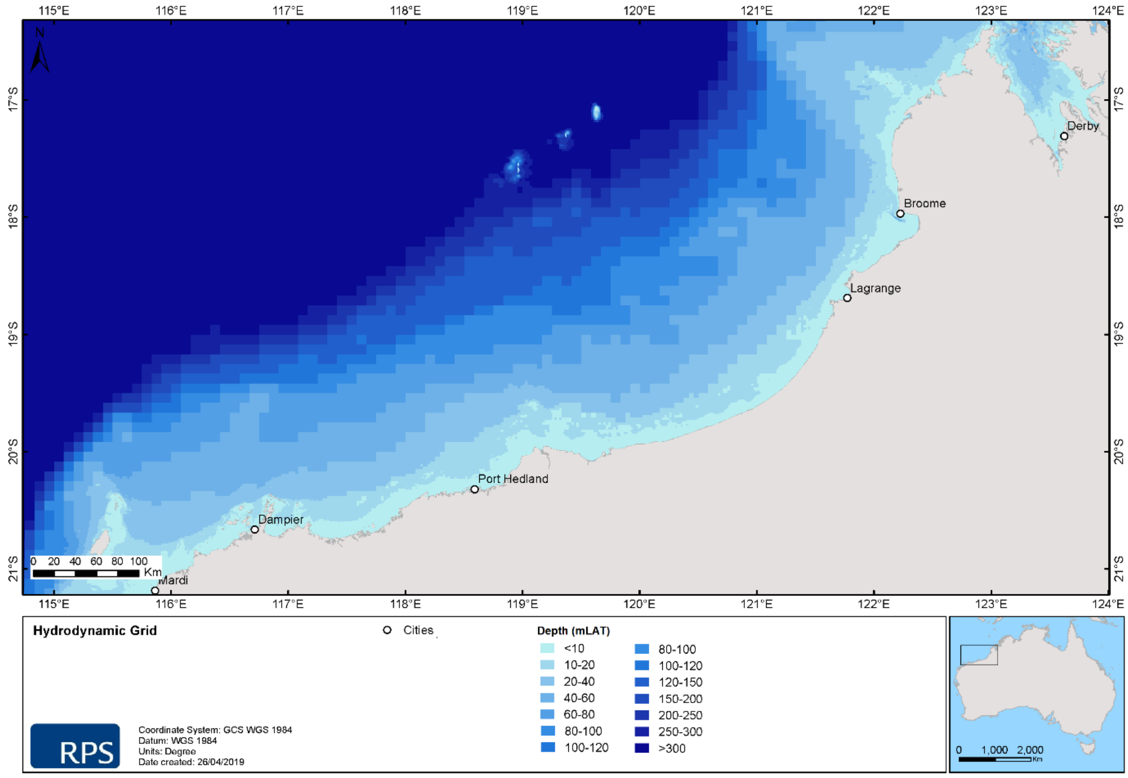

Figure 7 Sample of the Bathymetry defined throughout the tidal model.

3.1.2 Tidal Conditions

The ocean boundary data for the regional model was obtained from satellite measured altimetry data (TOPEX/Poseidon 7.2) which provided estimates of the eight dominant tidal constituents at a horizontal scale of approximately 0.25 degrees. The eight major tidal constituents used were K_2, S_2, M_2, N_2, K_1, P_1, O_1 and Q_1. Using the tidal data, surface heights were firstly calculated along the open boundaries, at each time step in the model.

The Topex-Poseidon satellite data has a resolution of 0.25 degrees globally and is produced and quality controlled by NASA (National Aeronautics and Space Administration). The satellites, equipped with two highly accurate altimeters, capable of taking sea level measurements accurate to less than ± 5 cm, measured oceanic surface elevations (and the resultant tides) for over 13 years (1992–2005). In total these satellites carried out 62,000 orbits of the planet. The Topex-Poseidon tidal data has been widely used amongst the oceanographic community, being referenced in more than 2,100 research publications (e.g. Andersen, 1995; Ludicone et al., 1998; Matsumoto et al., 2000; Kostianoy et al., 2003; Yaremchuk and Tangdong, 2004; Qiu and Chen 2010). As such the Topex/Poseidon tidal data is considered suitably accurate for this study.

3.1.3 Surface Elevation Validation

To ensure that tidal predictions were accurate, predicted surface elevations were compared to data observed at five locations (see Figure 8).

Figure 9 and Figure 10 illustrate a comparison of the predicted and observed surface elevations for each location for January 2014. As shown on the graphs, the model accurately reproduced the phase and amplitudes throughout the spring and neap tidal cycles.

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To provide a statistical measure of the model performance, the Index of Agreement (IOA – Willmott, 1981) and the Mean Absolute Error (MAE – Willmott, 1982; Willmott and Matsuura, 2005) were used.

The MAE is simply the average of the absolute values of the difference between the model-predicted (P) and observed (O) variables. It is a more natural measure of the average error (Willmott and Matsuura, 2005) and more readily understood.

$$MAE = N^{-1}\sum_{i=1}^{N}|P_i - O_i|$$

The Index of Agreement (IOA) is determined by:

$$IOA = 1 - \frac{\sum|X_{model} - X_{obs}|^2}{\sum(|X_{model} - \overline{X_{obs}}| + |X_{obs} - \overline{X_{obs}}|)^2}$$

Where: X represents the variable being compared and the time mean of that variable. A perfect agreement exists between the model and field observations if the index gives an agreement value of 1 and complete disagreement will produce an index measure of 0 (Willmott, 1981). Willmott et al. (1985) also suggests that values meaningfully larger than 0.5 represent good model performance. Clearly, a greater IOA and lower MAE represent a better model performance.

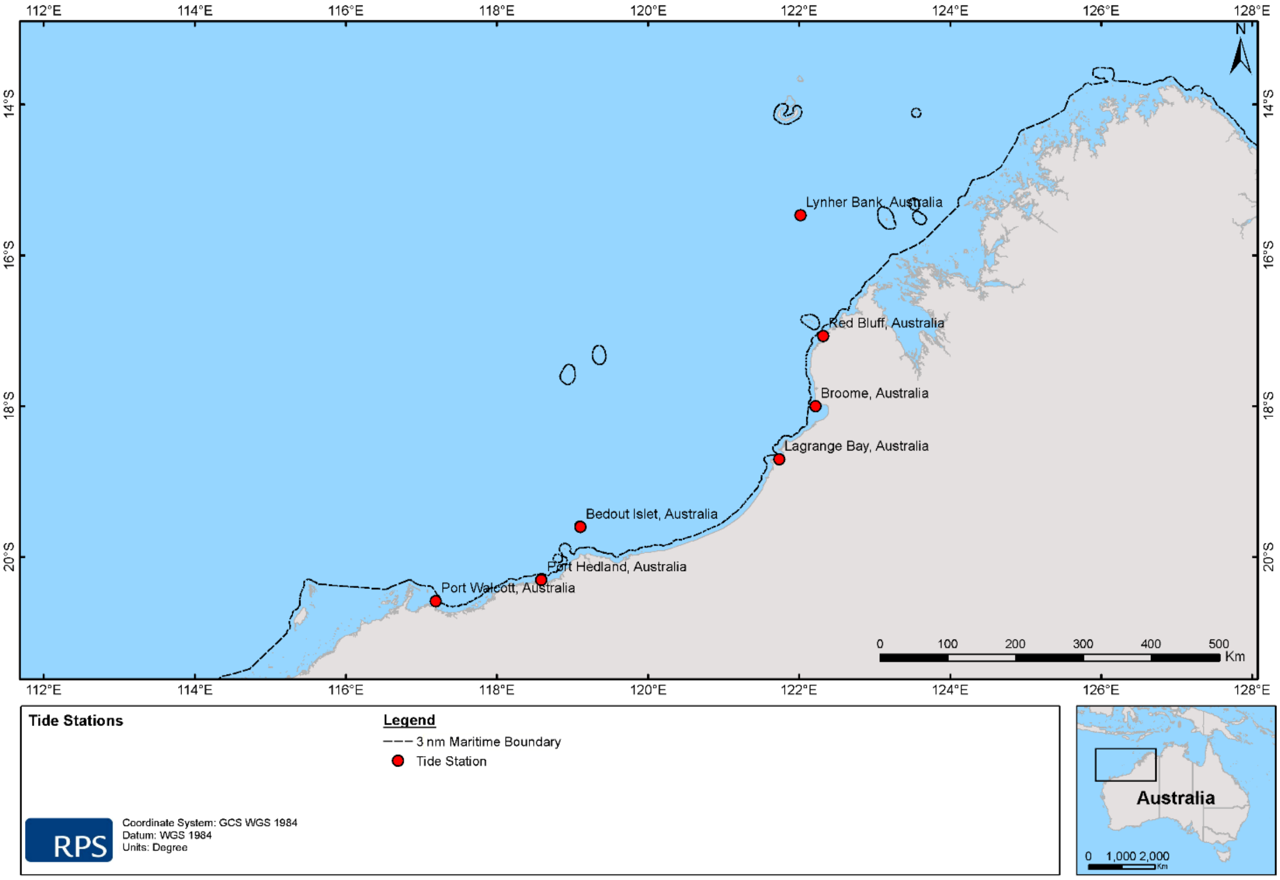

Figure 8 Tide stations used to validate surface elevation within the model.

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Table 2 Statistical comparison between the observed and predicted surface elevations.

Tide Station	IOA	MAE (m)
Broome	0.90	1.11
Lagrange Bay	0.96	0.71
Lynher Bank	0.98	0.31
Port Hedland	0.98	0.33
Port Walcott	0.99	0.20
Red Bluff	0.98	0.46

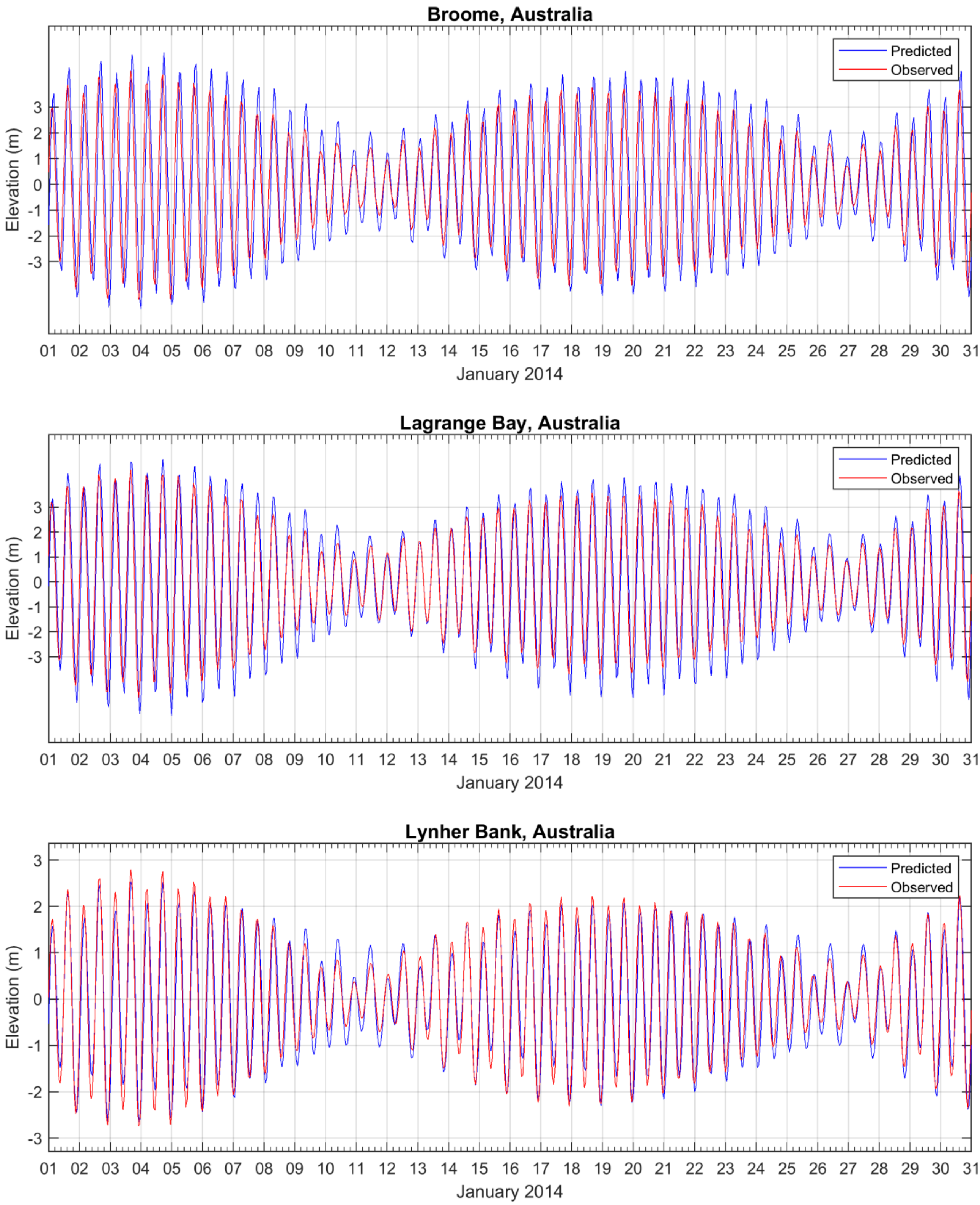

Figure 9 Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation.

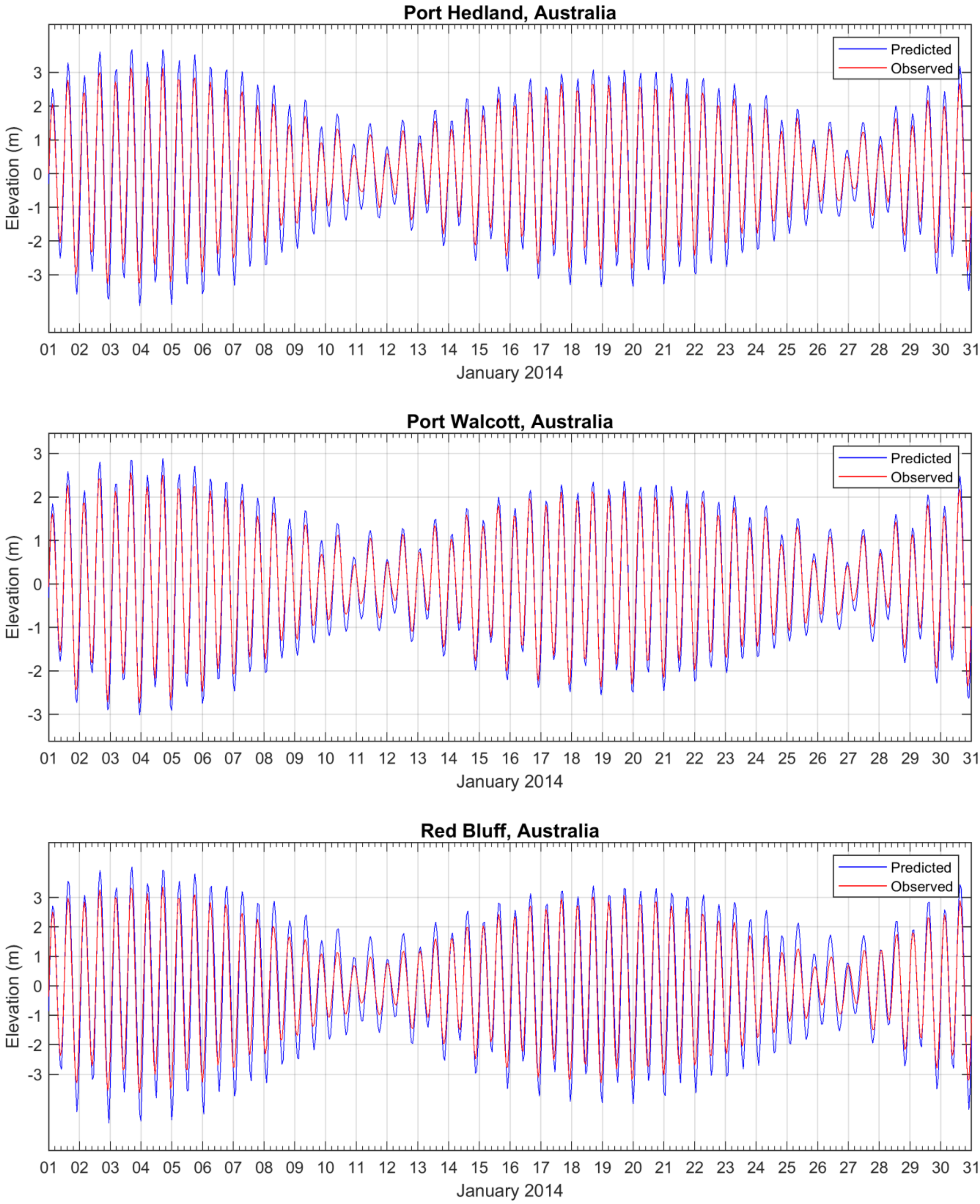

Figure 10 Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation.

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3.2 Ocean Currents

Data describing the flow of ocean currents was obtained from HYCOM (Hybrid Coordinate Ocean Model, (Chassignet et al., 2007), which is operated by the HYCOM Consortium, sponsored by the Global Ocean Data Assimilation Experiment (GODAE). HYCOM is a data-assimilative, three-dimensional ocean model that is run as a hindcast (for a past period), assimilating time-varying observations of sea surface height, sea surface temperature and in-situ temperature and salinity measurements (Chassignet et al., 2009). The HYCOM predictions for drift currents are produced at a horizontal spatial resolution of approximately 8.25 km (1/12th of a degree) over the region, at a frequency of once per day. HYCOM uses isopycnal layers in the open, stratified ocean, but uses the layered continuity equation to make a dynamically smooth transition to a terrain following coordinate in shallow coastal regions, and to z-level coordinates in the mixed layer and/or unstratified seas.

For this study, the HYCOM hindcast currents were obtained for the years 2011 to 2015 (inclusive).

3.3 Surface Currents at the release site

Table 3 displays the predicted average and maximum surface current near the release site.

Figure 11 and Figure 12 show the monthly and seasonal combined current rose distributions (2011-2015 inclusive) derived from HYCOM ocean current data and HYDROMAP tidal data near the release location, respectively.

Note the convention for defining current direction is the direction the current flows towards, which is used to reference current direction throughout this report. Each branch of the rose represents the currents flowing to that direction, with north to the top of the diagram. Sixteen directions are used. The branches are divided into segments of different colour, which represent the current speed ranges for each direction. Speed intervals of 0.1 m/s are predominantly used in these current roses. The length of each coloured segment is relative to the proportion of currents flowing within the corresponding speed and direction.

The combined current data (ocean plus tides) showed that waters nearby the release site flowed predominantly in an east-northeast and west-southwest direction (Figure 11 and Figure 12). Average monthly surface current speeds ranged between was 0.17 and 0.25 m/s. Additionally, the maximum surface current speeds ranged between 0.56 and 1.03 m/s nearby the Ironbark release location.

RPS

Table 3 Predicted average and maximum surface current speed near the Ironbark release location. Data derived by combining the HYCOM ocean data and HYDROMAP high resolution tidal data from 2011-2015 (inclusive).

Season	Month	Average current speed (m/s)	Maximum current speed (m/s)	General Direction (Towards)
Summer	January	0.23	1.03	East – West
	February	0.22	0.89	East
	March	0.19	0.88	West
Transitional	April	0.22	0.81	West
Winter	May	0.21	0.79	West
	June	0.25	0.76	West-southwest
	July	0.20	0.58	West
	August	0.17	0.17	East – West
Transitional	September	0.17	0.17	East-northeast
Summer	October	0.23	0.23	Variable
	November	0.20	0.20	Variable
	December	0.18	0.18	West
	Minimum	**0.17**	**0.56**	
	Maximum	**0.25**	**1.03**	

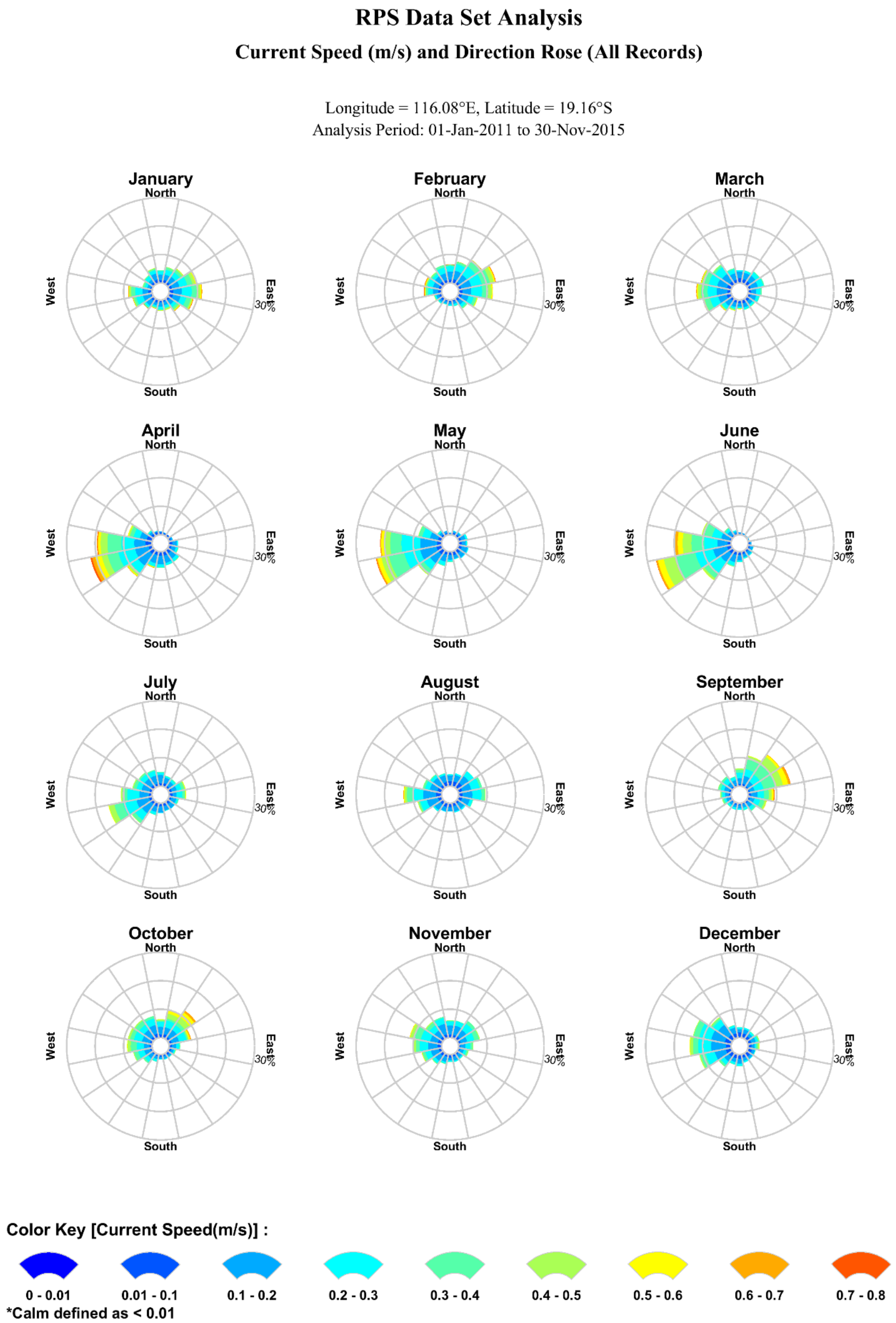

Figure 11 Monthly surface current rose plots near the Ironbark release location (derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2011 – 2015 inclusive). The colour key shows the current magnitude (m/s), the compass direction provides the current direction flowing TOWARDS and the length of the wedge gives the percentage of the record for a particular speed and direction combination.

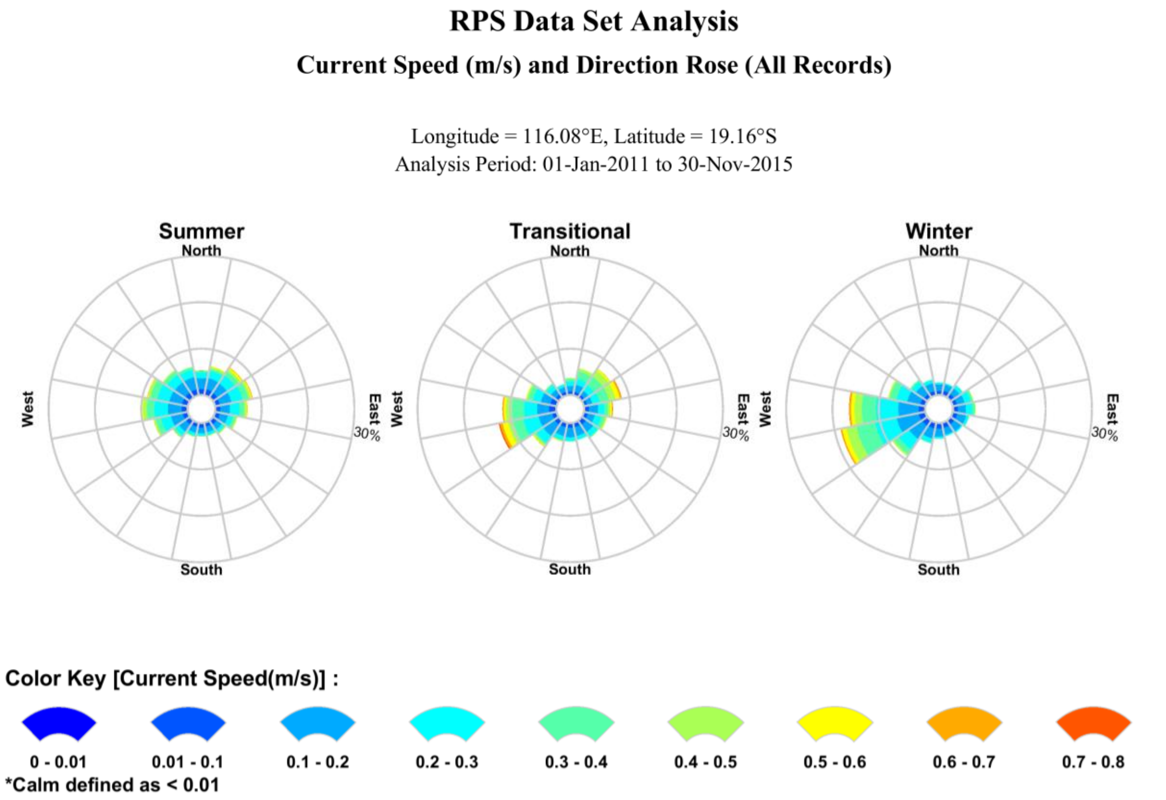

Figure 12 Seasonal combined current rose plot near the Ironbark release location (derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2011 – 2015 inclusive). The colour key shows the current magnitude (m/s), the compass direction provides the current direction flowing TOWARDS and the length of the wedge gives the percentage of the record for a particular speed and direction combination.

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4 WIND DATA

High resolution wind data from 2011 to 2015 (inclusive) was sourced from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR; see Saha et al., 2010). The CFSR wind model includes observations from many data sources; surface observations, upper-atmosphere air balloon observations, aircraft observations and satellite observations. The model is capable of accurately representing the interaction between the earth’s oceans, land and atmosphere. The gridded wind data output is available at ¼ of a degree resolution (~33 km) and 1-hourly time intervals. Figure 13 displays the spatial resolution of the wind field used as input into the oil spill model and the station used to create the wind roses. Table 4 shows the monthly average and maximum winds derived from the CFSR station located within the operational area. Figure 14 and Figure 15 illustrates the monthly and annual wind rose distributions.

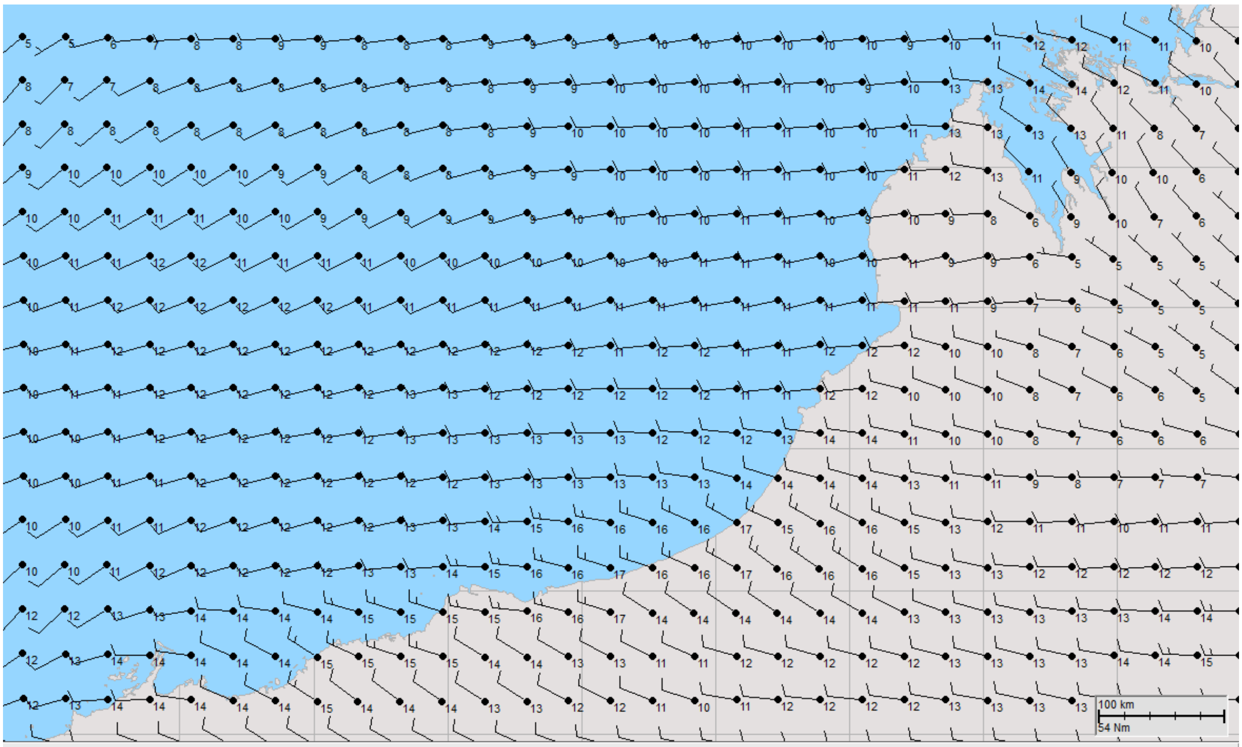

Figure 13 Sample of the CFSR modelled wind data.

Note that the atmospheric convention for defining wind direction, that is, the direction the wind blows from, is used to reference wind direction throughout this report. Each branch of the rose represents wind coming from that direction, with north to the top of the diagram. Sixteen directions are used. The branches are divided into segments of different colour, which represent wind speed ranges from that direction. Speed ranges of 3 knot intervals, excluding the calm and near calm conditions are used in these wind roses. The length of each segment within a branch is proportional to the frequency of winds blowing within the corresponding range of speeds from that direction.

The data indicated that the winds across the region are relatively weak (monthly average wind speeds varied slightly from 9 knots to 15 knots). Maximum wind speeds ranged between 23 and 46 knots. Winds were shown to be variable in direction however they predominantly occurred from the south-southwest (January–March, September–December) and east (May–August).

RPS

Table 4 Predicted average and maximum winds for the wind station closest to the Ironbark release site. Data derived from CFSR hindcast model from 2011-2015 (inclusive).

Season	Month	Average wind speed (Knots)	Maximum wind speed (Knots)	General Direction (From)
Summer	January	12	40	Southwest
	February	11	41	Southwest
	March	10	46	Southwest
Transitional	April	9	23	Variable
Winter	May	13	34	East-Southeast
	June	15	34	East-Southeast
	July	13	36	East-Southeast
	August	10	28	East
Transitional	September	12	30	South-southwest
Summer	October	12	24	South-southwest
	November	11	23	South-southwest
	December	10	31	Southwest
	Minimum	**9**	**23**	
	Maximum	**15**	**46**	

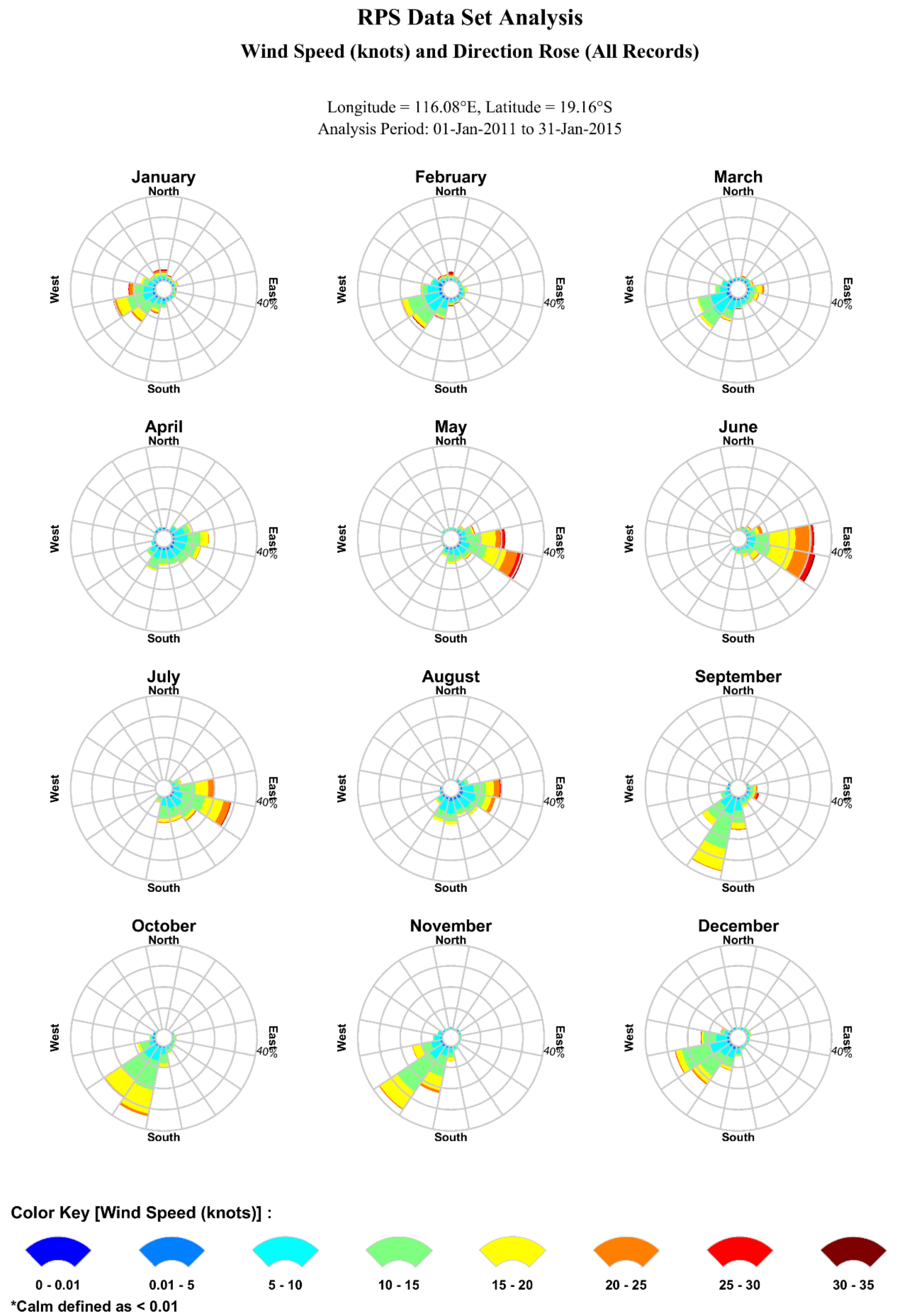

Figure 14 Modelled monthly wind rose distributions from 2011–2015 (inclusive), for the wind station closest to the Ironbark release site. The colour key shows the wind magnitude, the compass direction provides the direction FROM and the length of the wedge gives the percentage of the record for a particular speed and direction combination.

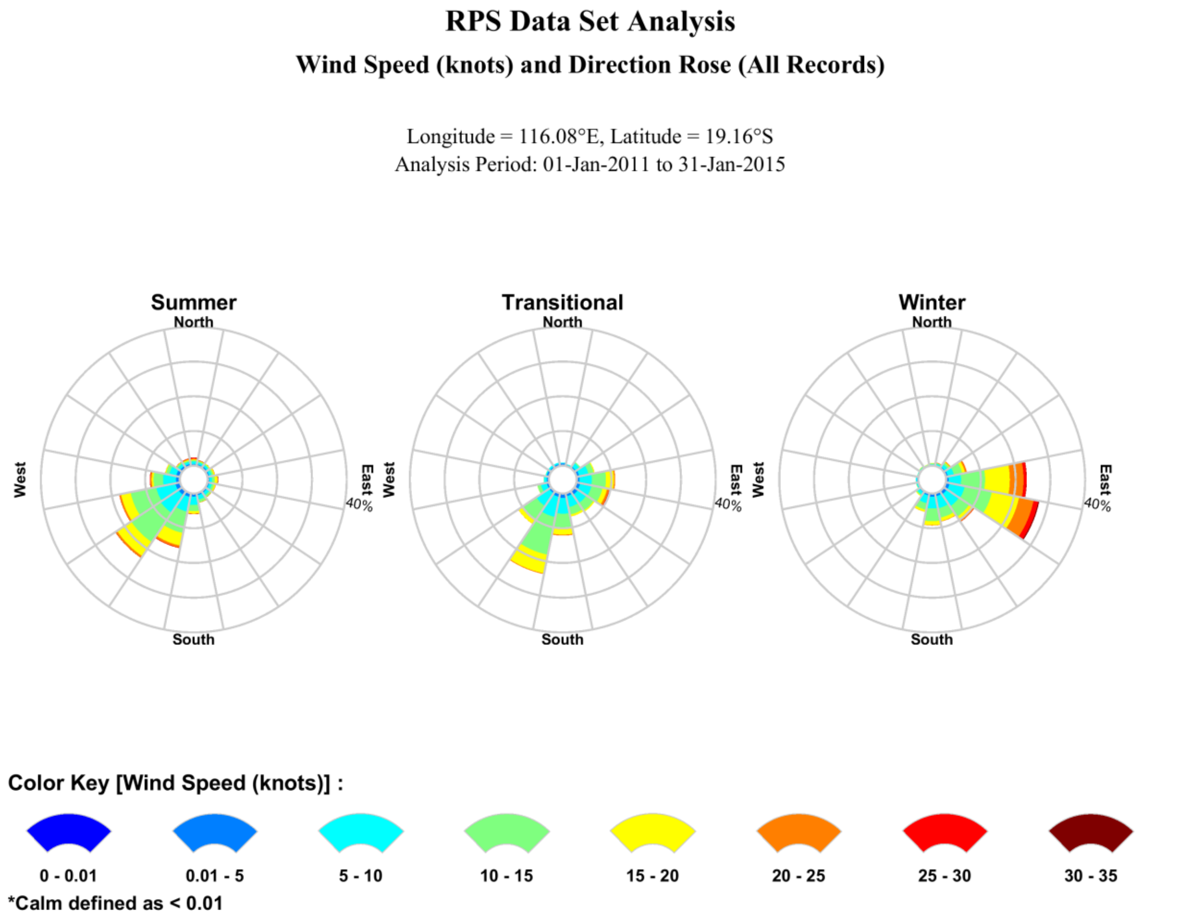

Figure 15 Modelled seasonal wind rose distributions from 2011–2015 (inclusive), for the wind station closest to the Ironbark release site. The colour key shows the wind magnitude, the compass direction provides the direction FROM and the length of the wedge gives the percentage of the record for a particular speed and direction combination.

5 WATER TEMPERATURE AND SALINITY

The monthly depth-varying water temperature and salinity profiles at 5 m intervals through the water column adjacent to the release location (refer to Figure 16) was obtained from the World Ocean Atlas 2013 database produced by the National Oceanic and Atmospheric Administration's (NOAA) National Centers for Environmental Information (formerly the National Oceanographic Data Centre) (see Levitus et al., 2013). The data is used to inform the weathering, movement and evaporative loss of hydrocarbon spills in the surface and subsurface layers.

Table 5 details the annual water temperature and salinity adjacent to the release location as a function of depth. The annual temperature for the surface waters is 27.3°C and 13.0°C near the seabed. Salinity remained consistent throughout the water column at approximately 35 psu.

Table 5 Annual water temperature and salinity adjacent to the release location as a function of depth (data sourced: World Ocean Atlas (2013) database).

Depth	Annual Mean Water Temperature	Annual Mean Salinity
	(°C)	(psu)
0	27.3	34.9
5	27.3	34.9
10	27.2	34.9
25	27.0	34.9
50	26.1	34.9
75	25.0	34.9
100	23.8	35.0
150	21.0	35.2
250	15.4	35.2
Bottom (300 m)	13.0	35.2

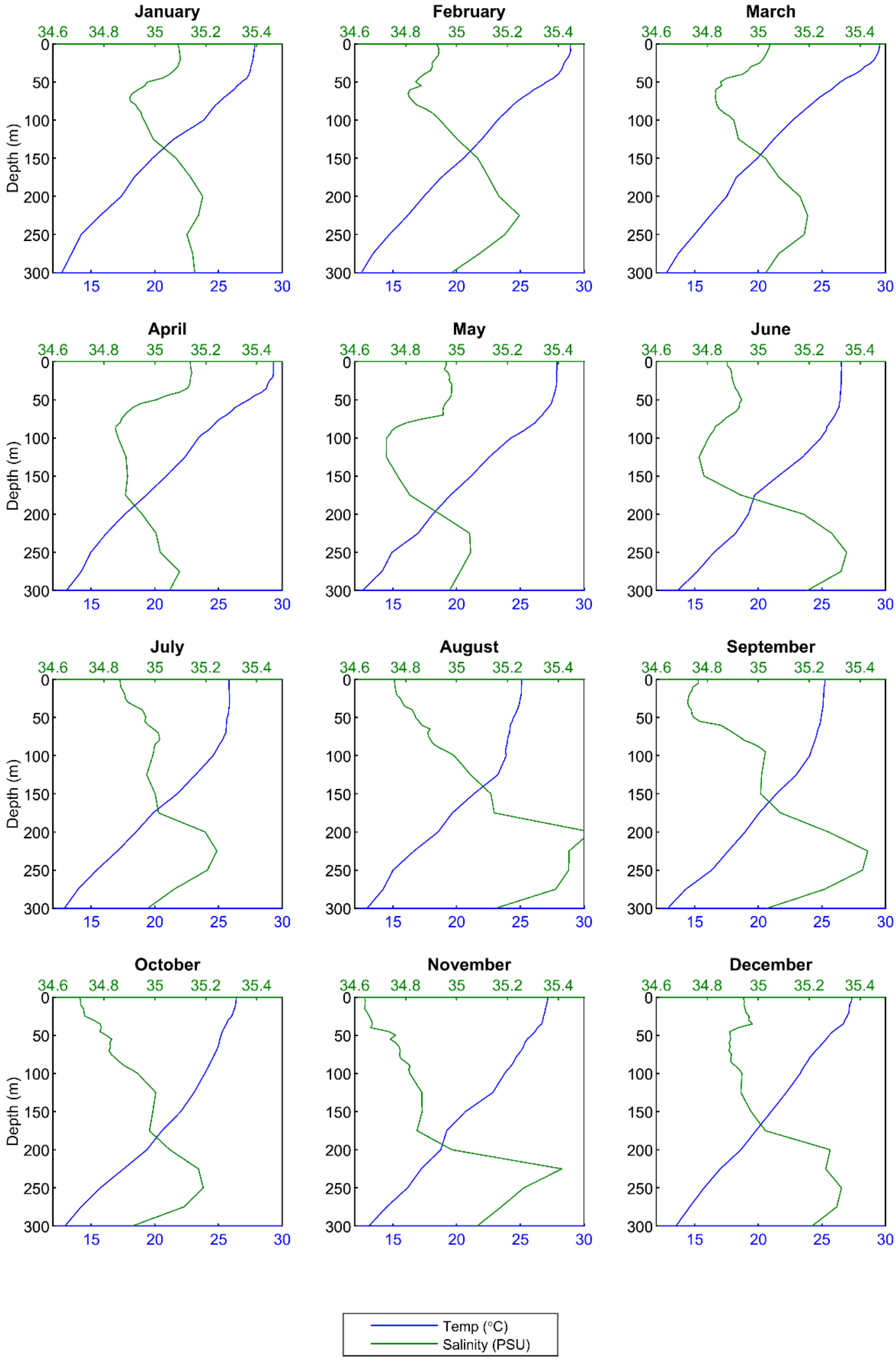

Figure 16 Monthly temperature (blue) and salinity (green) profiles adjacent to the Ironbark release locations as a function of depth. Data sourced from the World Ocean Atlas (2013) database.

6 NEAR-FIELD MODEL – OILMAPDEEP

Near-field modelling was carried out for the loss of well control scenario to better understand the plume dynamics due to the amalgamation of condensate and gas at the seabed using the advanced OILMAPDEEP blowout model. OILMAPDEEP was developed by RPS and designed to provide the near-field behaviour of multi-phase gas-condensate plumes during subsurface blowout releases.

The model simulates the plume rise dynamics in two phases, the initial jet phase and the buoyant plume phase. The initial jet phase governs the plume dynamics directly above the subsea release location and is predominantly driven by the exit velocity. During this phase, the condensate droplet size and distribution are calculated. Next, the rise dynamics are dominated by the buoyant nature of the plume until the termination of the plume phase (known as the trapping depth). At this point, the results from OILMAPDEEP (including plume trapping depth, plume diameter and droplet size distribution) are integrated into the far-field model SIMAP to simulate the rise and dispersion of the condensate droplets.

More details on the OILMAPDEEP model, can be found in Spaulding et al. (2015). The model has been validated against observations from Deepwater Horizon as well as small and large-scale laboratory studies on subsurface oil releases (Brandvik et al 2013, 2014; Belore 2014; Spaulding et al. 2015; Li et al. 2017a, 2017b).

Figure 17 illustrates the various stages of an example blowout plume.

Table 6 provides a summary of the input data used for the subsea near-field plume modelling for Scenario 2. Note that a depleting release rate illustrated in Figure 18 was used for the scenario, starting from 91,793 bbl/day (14,595 m^3/day) on day 1 and decreasing to 83,565 bbl/day (13,301 m^3/day) on day 103. Droplet sizes ranged between 128 and 442 µm.

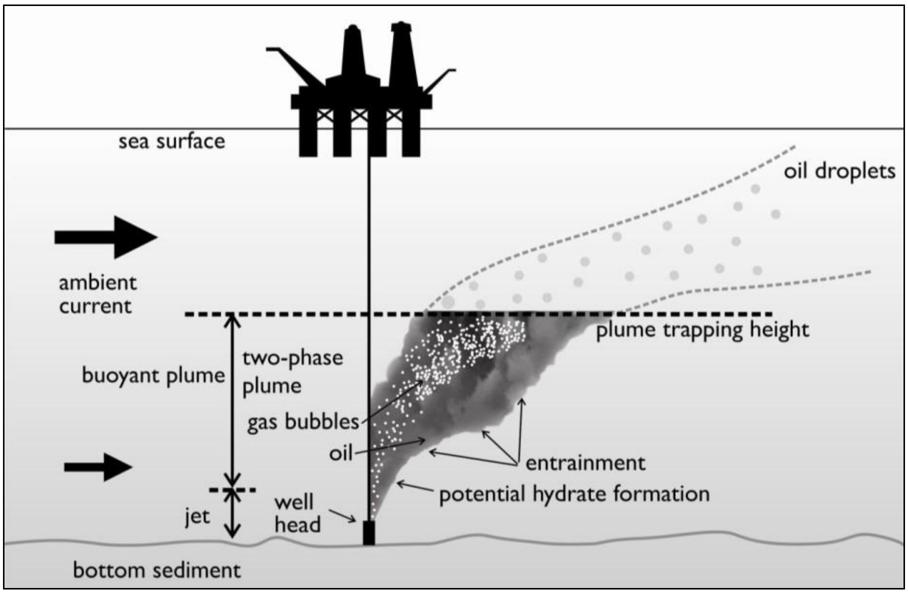

Figure 17 Example of a blowout plume illustrating the various stages of the plume in the water column (Source: Applied Science Associates, 2011).

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Table 6 Input characteristics for modelling the near-field behaviour of a well blowout.

Input Variable	Value
Scenario	103-day loss of well control
Water depth (m)	298
Tubing diameter (inch)	12.25
Condensate Rate (stb/day)	91,793 bbl (day 1) depleting to 83,565 bbl (day 103)
Water Rate (stb/day)	11,504 bbl (day 1) depleting to 11,364 bbl (day 103)
Gas Rate (scf/day)	1,541 MMscf (day 1) depleting to 1,456 MMscf (day 103)
Gas to Condensate ratio (scf/bbl)	15,131 (average)
Gas to Total Liquids ratio (scf/bbl)	2,695 (average)
Reservoir temperature (°C)	145
Release Pressure (psia)	~10,000
Key Results	
Plume execution depth (m)	Plume ruptures the sea surface
Droplet Sizes (µm)	128 – 442

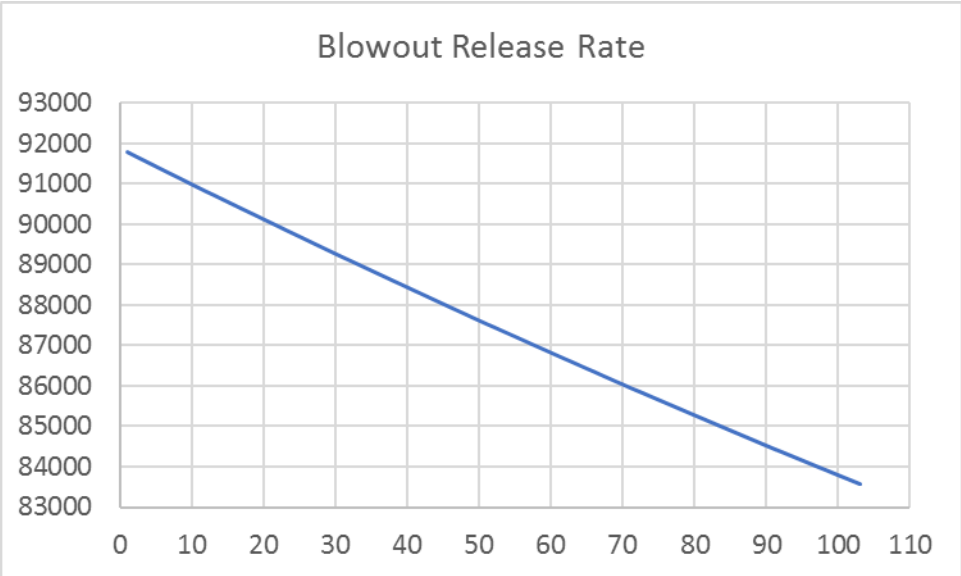

Figure 18 Depleting release rate used for the scenario

7 SPILL MODEL – SIMAP

Modelling of the fate of oil was performed using SIMAP. SIMAP is designed to simulate the fate and effects of spilled hydrocarbons for both the surface and subsurface releases (Spaulding et al. 1994; French et al. 1999; French-McCay, 2003, 2004; French-McCay et al. 2004).

SIMAP has been used to predict the weathering and fate of oil spills during and after major incidents including: Montara (Australia) well blowout August 2009 in the Timor Sea (Asia-Pacific ASA, 2010); Macondo (USA) well blowout April 2010 in the Gulf of Mexico; Bohai Bay (China) oil spill August 2011; and the pipeline oil spill July 2013 in the Gulf of Thailand

The SIMAP model calculates the transport, spreading, entrainment, evaporation and decay of surface hydrocarbon slicks as well as the entrained and dissolved oil components in the water column, either from surface slicks or from oil discharged subsea. The movement and weathering of the spilled oil is calculated for specific oil types. Input specifications for oil mixtures include the density, viscosity, pour point, distillation curve (volume lost versus temperature) and the aromatic/aliphatic component ratios within given boiling point ranges.

SIMAP is a 3D model that allows for various response actions to be modelled including oil removal from skimming, burning, or collection booms, and surface and subsurface dispersant application.

The SIMAP oil spill model includes advanced weathering algorithms, specifically focussed on unique oils that tend to form emulsions and/or tar balls. The weathering algorithms are based on 5 years of extensive research conducted in response to the Deepwater Horizon oil spill in the Gulf of Mexico (French et al., 2015).

Biodegradation is included in the oil spill model. In the model, SIMAP, degradation is calculated for the surface slick, deposited oil on the shore, the entrained oil and dissolved constituents in the water column, and oil in the sediments. For surface oil, water column oil, and sedimented oil a first order degradation rate is specified. Biodegradation rates are relatively high for hydrocarbons in dissolved state or in dispersed small droplets.

7.1 Stochastic Modelling

Stochastic oil spill modelling is created by overlaying a great number (often 100 hundred) simulated hypothetical oil spills (Figure 19). Stochastic modelling involves running numerous individual oil spill simulations using a range of prevailing wind and current conditions that are historically representative of the season and location of where the spill event may occur.

For the stochastic modelling presented herein, **100 oil spills** were simulated for each season for each scenario using the same spill information (release location, spill volume, duration and oil type) but with varied start dates and times corresponding to the period represented by the available wind and current data. During each simulation, the model records whether any grid cells are exposed to any oil concentrations, the concentrations involved and the elapsed time before exposure. The results of all 100 oil spill simulations were analysed to determine the following seasonal statistics for every grid cell:

- Exposure load (concentrations and volumes);
- Minimum time before exposure;
- Probability of contact above defined concentrations;
- Volume of oil that may strand on shorelines from any single simulation;
- Concentration that might occur on sections of individual shorelines;

- Exposure (concentration x duration of exposure) to dissolved hydrocarbons in the water column; and
- Exposure (concentration x duration of exposure) to entrained hydrocarbons in the water column.

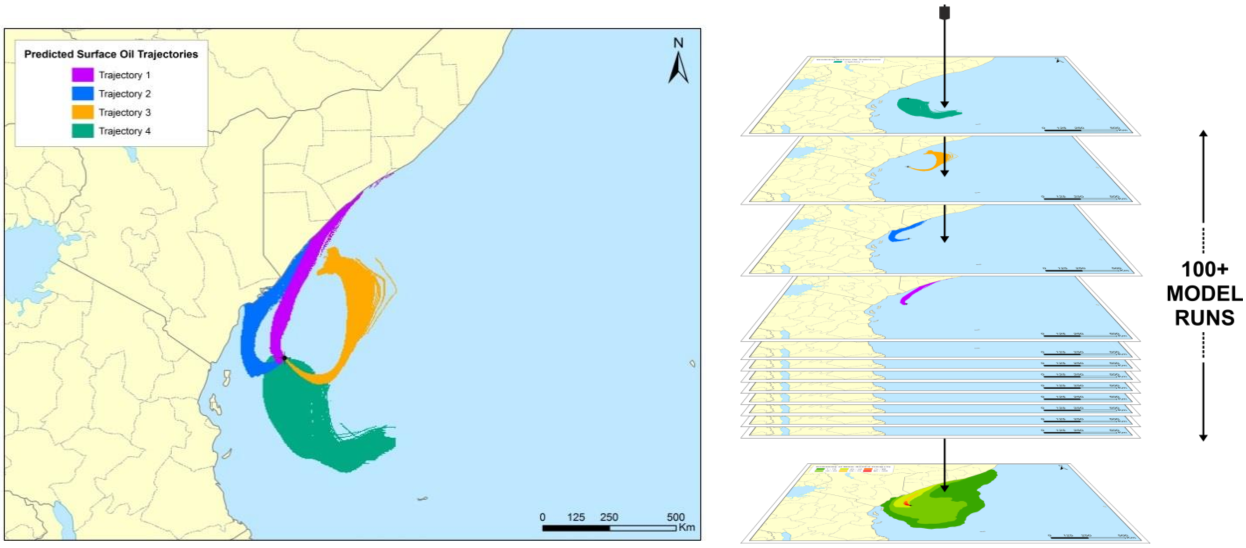

Figure 19 Predicted movement of four single oil spill simulations by SIMAP for the same scenario (Left image). All model runs are overlain (shown as the stacked runs on the right) and the number of times that trajectories contact a given location at a concentration is used to calculate the probability (Source: NOPSEMA, 2018).

7.2 Sea Surface, Shoreline and Water Column Thresholds

Table 7 shows the sea surface, shoreline and water column exposure thresholds used to assess and present the oil spill modelling results, which are based on the commonly used exposure values for oil spill modelling and the NOPSEMA recommended thresholds (NOPSEMA, 2019).

Table 7 Sea surface, shoreline and water column exposure thresholds.

Level	Sea Surface Exposure (g/m^2)	Shoreline Contact (g/m^2)	Dissolved Hydrocarbon Concentration (ppb)#	Entrained Hydrocarbon Concentrations (ppb)#
Low	1	10	10	10
Moderate	10	100	50	N/A
High	50	1,000	400	100

#These threshold values refer to a) instantaneous concentrations (i.e. exposure over a 1-hour timestep) and b) time-averaged exposure over a 48-hour window. Both sets of results are provided in the Result Section(s).

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7.3 Oil Properties

7.3.1 Marine Diesel Oil

The marine diesel oil (MDO) used in Scenario 1 is a light-persistent fuel oil used in the maritime industry. It has a density of 829.1 kg/m^3 (API of 37.6) and a low pour point (-14ºC). The low viscosity (4 cP) indicates that this oil will spread quickly when released and will form a thin to low thickness film on the sea surface, increasing the rate of evaporation. According to the International Tanker Owners Pollution Federation classification scheme (ITOPF, 2014) the MDO is classified as a Group II light persistent oil. The classification is based on the specific gravity of hydrocarbons in combination with relevant boiling point ranges.

Table 8 details the physical properties of MDO, while Table 9 presents the boiling point ranges of the MDO used in this study.

Figure 20 illustrates the weathering graph for a 250 m^3 release of MDO over 6 hours during three wind speeds. The 5, 10 and 15 knot wind speeds were selected given that breaking waves and in turn entrainment takes place between 10 – 12 knots. The results illustrate that the prevailing wind speeds can and do influence the weathering and fate of the MDO. Under lower wind-speeds (5 knots), the MDO will remain on the surface longer, spread quicker, and in turn greater evaporation. Conversely, sustained stronger winds (>15 knots) will generate breaking waves at the surface, causing a higher amount of MDO to be entrained into the water column and reducing the amount available to evaporate.

7.3.2 Goodwyn Condensate

Goodwyn condensate was used as a proxy for the loss of well control scenario. The condensate has an API of 51.5, a density of 773.1 kg/m3 (at 25ºC) with a low pour point of -30ºC and a viscosity of 0.912 cP (at 21.1ºC) (refer to Table 8), classifying it as a Group I non persistent oil according to the International Tankers Owners Pollution Federation classification scheme (ITOPF, 2014). The condensate comprises of a significant portion of volatiles and semi to low volatiles (97.6% total) with very little residual components (2.4%) (refer to Table 9). This means that the condensate will evaporate readily when on the water surface, with a very small volume of persistent components to remain on the water surface over time.

Figure 21 illustrates the weathering graph for a 92,000 bbl (14,628 m^3) subsea release of Goodwyn Condensate over 24 hours during three wind speeds. Weathering shows rapid evaporation occurs while the condensate is still being released during all three wind speeds. Goodwyn condensate is predicted to readily entrain into the water column under the higher wind speeds (10 and 15 knots). Due to the high volatility of the condensate, little is predicted to remain on the water surface after the spill ceases.

Table 8 Physical properties for the MDO and Goodwyn condensate used for the Ironbark oil spill modelling study.

Properties	MDO	Goodwyn condensate
Density (kg/m^3)	829.1	773.1 kg/m3 (at 25ºC)
API	37.6	51.5
Dynamic Viscosity (cP)	4	0.912 cP (at 21.1°C)
Wax content (%)	1	4.8
Pour point (ºC)	-14	-30
Oil Property Category	Group II	Group I
Oil Property Classification	Light-Persistent	Non-persistent hydrocarbon

Table 9 Boiling point ranges for the MDO and Goodwyn condensate used for the Ironbark oil spill modelling study.

Characteristic	Volatiles (%)	Semi-volatiles (%)	Low Volatiles (%)	Residual (%)
Boiling point (ºC)	<180	180–265	265–380	>380
		Non-persistent		Persistent
MDO	6.0	34.6	54.4	5.0
Goodwyn condensate	62.0	22.0	13.6	2.4

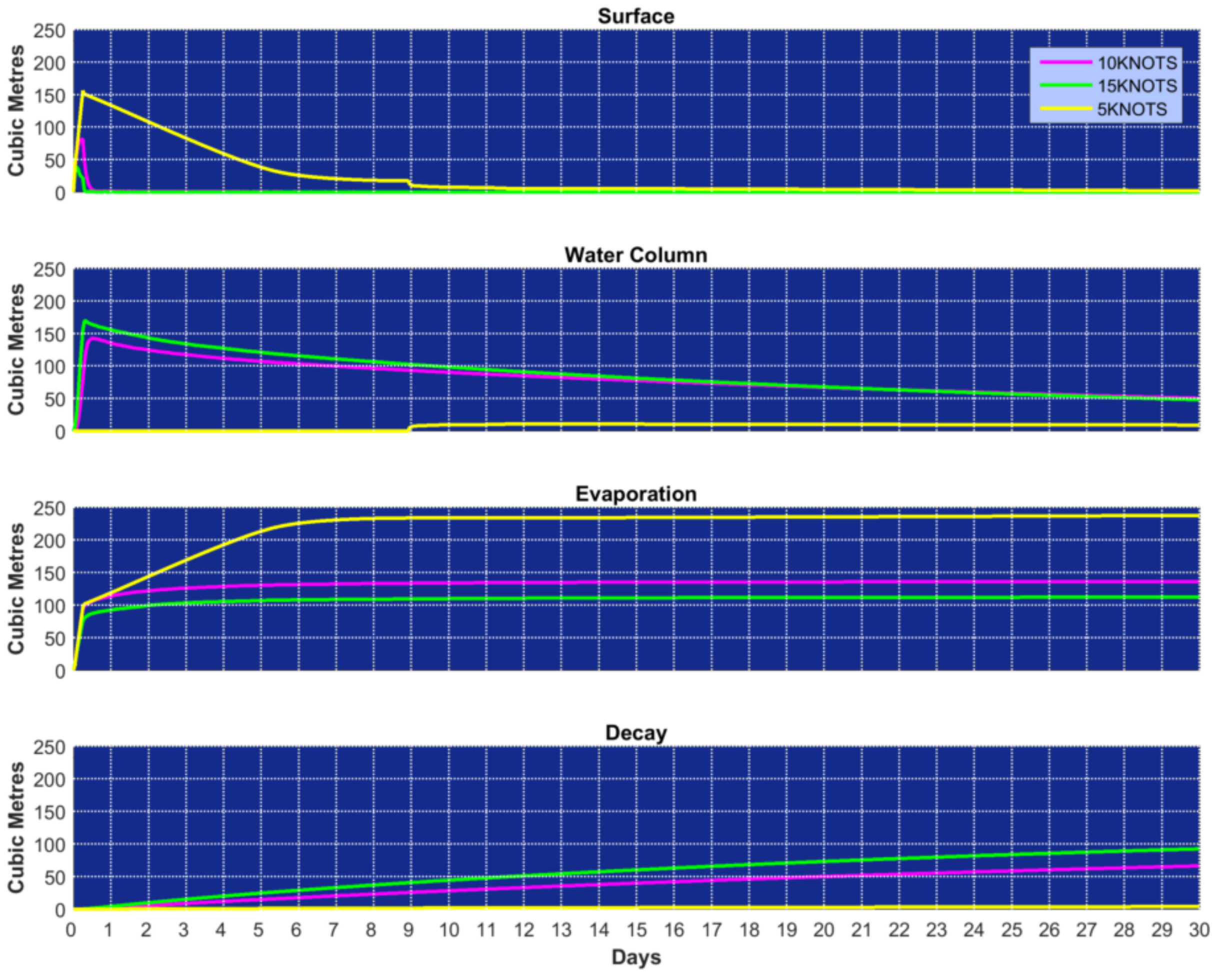

Figure 20 Weathering of MDO under three static winds conditions (5, 10 and 15 knots). The results are based on a 250 m^3 surface release of MDO over 6 hours and tracked for 30 days.

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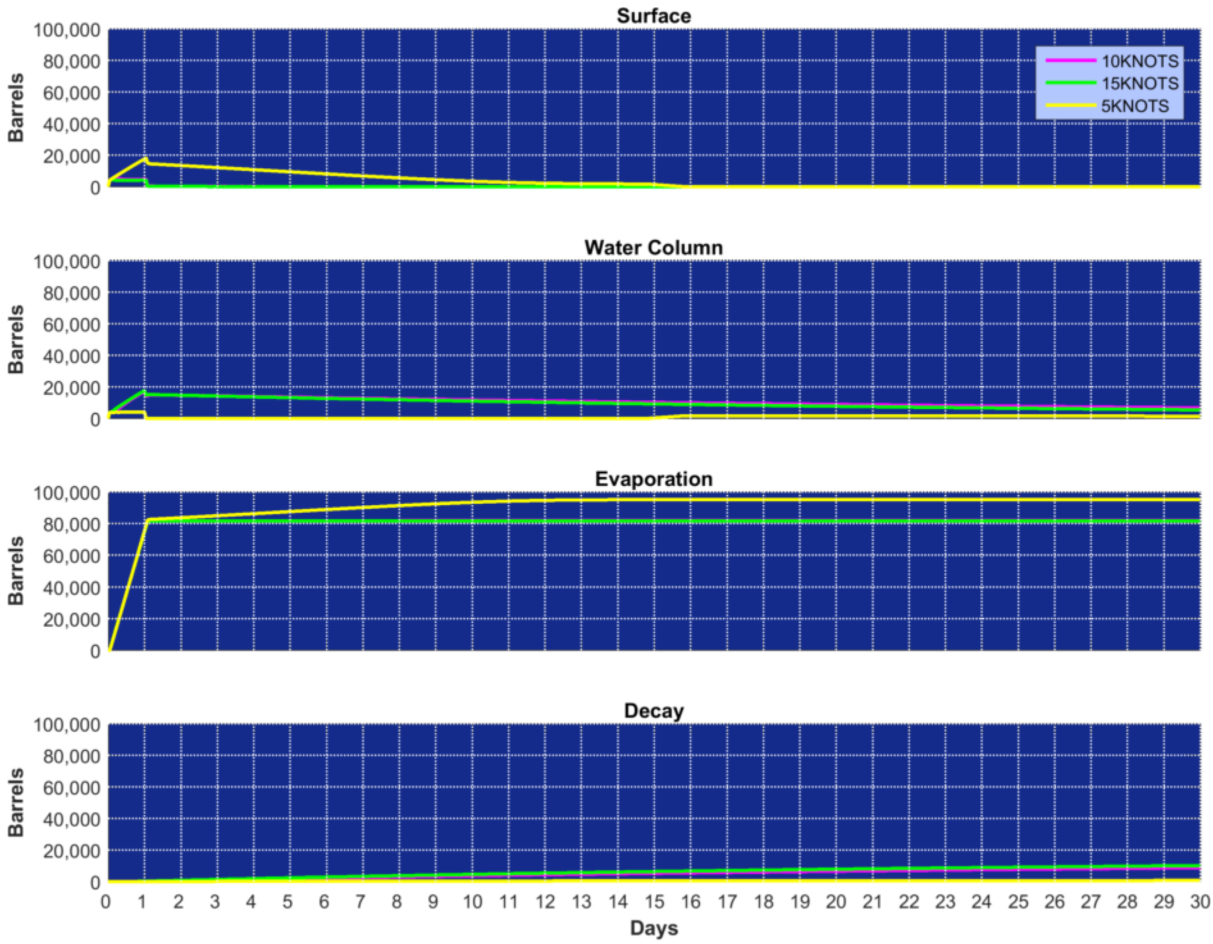

Figure 21 Weathering of Goodwyn condensate under three static winds conditions (5, 10 and 15 knots). The results are based on a of 92,000 bbl (14,628 m^3) subsea release over 24 hours and tracked for 30 days.

7.4 Model Settings

The modelling study assessed the following two scenarios:

- 250 m3 surface release of MDO over 6 hours in the event of a vessel collision at the Ironbark well location; and
- 9.016 MMstb subsea release of condensate over 103 days to represent a loss of well control event from the Ironbark well location.

The potential risk of exposure to surrounding waters and shorelines was assessed for three distinct seasons; (i) summer (November to March), (ii) transitional (April and September) and (iii) winter (May to September).

Table 10 provides a summary of the oil spill model settings used and assumptions for the two scenarios. The table also shows the thresholds that were used. It should be noted that concentrations above 10 g/m^2 on the sea surface (or moderate threshold) is considered the lower threshold, whereby oil may be thick enough for containment and recovery as well as surface dispersant treatment (AMSA, 2015).

The simulation lengths were carefully selected based on extensive sensitivity testing. During the sensitivity testing process, sample spill simulations were run for longer than intended durations. Upon completion of the spill simulations, the results were carefully assessed to examine the persistence of the hydrocarbons (i.e. whether the maximum evaporative loss has been achieved for the period of time modelled; and whether a substantial volume of hydrocarbons remain in the water column (if any)) in conjunction with the extent of sea surface exposure based on reporting thresholds. Once there was agreement between the two factors (i.e. the final fate of the hydrocarbon is accounted for and the full exposure area is identified) the simulation length was deemed appropriate.

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Table 10 Summary of the oil spill model settings for the Ironbark oil spill modelling study.

Data Input Parameters	Scenario 1	Scenario 2
Scenario description	A loss following a vessel collision causing a surface release	A subsea well blowout
Location Name	Ironbark Well	Ironbark Well
Geographic Location	19º 9’ 33.84” S 116º 4’ 35.76” E	
Number of seasons assessed per scenario	3	3
Number of randomly selected spill start times per season	100	100
Total number of randomly selected spill start times per scenario	300	300
Hydrocarbon type	Marine Diesel Oil	Condensate
Total volume released	250 m^3	9.016 MMstb (1,433,544 m^3)
Release duration (days)	0.25 (6 hours)	103
Oil to gas ratio (scf/stb)	N/A	15,131
Exit hole size (inches)		12 ¼
Simulation length (days)	30	133
Seasons assessed	(i) summer (November to March), (ii) transitional (April and September) and (iii) winter (May to September)	
Reporting surface oil exposure thresholds (g/m^2)	1 (low exposure), 10 (moderate exposure) and 50 (high exposure)	
Reporting shoreline contact thresholds (g/m^2)	10 (low contact), 100 (moderate contact) and 1,000 (high contact)	
Dissolved hydrocarbons thresholds (ppb). *These thresholds were assessed for 1 hour and 48-hour exposure windows.*	10 (potential low exposure), 50 (potential moderate exposure) and 400 (potential high exposure)	
Entrained hydrocarbon thresholds (ppb). *These thresholds were assessed for 1 hour and 48-hour exposure windows.*	10 (potential low exposure) and 100 (potential high exposure)	

8 PRESENTATION AND INTERPRETATION OF MODEL RESULTS

The results from the modelling study are presented in a number of statistical tables, which aim to provide a comprehensive understanding of the predicted sea-surface and water column (subsurface) exposure and shoreline contact (if predicted).

8.1 Seasonal Analysis

The stochastic analysis (or seasonal analysis) provides a summary, based on the collective behaviour of all 100 spill simulations, for each of the three seasonal periods modelled. The results from the modelling study are presented in a number of tables and figures, which aim to provide an understanding of both the predicted sea surface exposure, shoreline and water column exposure for each scenario and each season.

The figures are based on the following principles:

- The ***potential zones of exposure (surface hydrocarbon, entrained and dissolved hydrocarbons)*** – is determined by identifying the maximum loading (surface) or concentration/dosage (subsea) within a grid cell and is then classified according to identified surface or subsea thresholds.

- The ***minimum time before hydrocarbon exposure on the sea surface*** – is determined by recording the elapsed time before sea surface exposure to a grid cell, at a specified threshold.

- The ***probability of exposure/contact (surface and shoreline hydrocarbon, entrained and dissolved hydrocarbons)*** – is calculated by dividing the number of spill trajectories passing over that given cell (surface, shoreline or subsea) by the total number of spill trajectories, above the specified threshold value.

- ***Maximum potential shoreline loading*** – is determined by identifying the maximum loading within a shoreline cell and is then classified according to the identified thresholds (i.e. 10, 100 and 1,000 g/m^2).

- The ***instantaneous dissolved and entrained hydrocarbon concentration*** – is determined by recording the maximum instantaneous concentrations (i.e. exposure over the model 1-hour timestep) at each grid cell.

- The ***time-averaged dissolved and entrained hydrocarbon exposure*** – reporting of the highest concentration at each grid cell by applying a 48-hour time-based averaging at each grid cell.

The statistics are based on the following principles:

- The ***greatest distance travelled by a spill trajectory*** – is determined by: a) recording the maximum distance travelled by a single trajectory, within a scenario, from the release site to the identified exposure thresholds.

- The ***probability of shoreline contact*** – is determined by recording to the number of spill trajectories to contact the shoreline, at a specific threshold, divided by the total number of spill trajectories within that scenario.

- The ***minimum time before oil exposure*** – is determined by recording the minimum time for a grid cell to record exposure, at a specific threshold.

- The ***average volume ashore for a single spill*** – is determined by calculating the average hydrocarbon volume ashore of all the single spill trajectories which were predicted to make shoreline contact within a scenario.

- The ***maximum volume ashore from a single spill trajectory*** – is determined by identifying the single spill trajectory within a scenario/season, that recorded the maximum volume of oil to come ashore and presenting that value.

- The ***average length of shoreline contacted by hydrocarbons*** – is determined by calculating the average of the length of shoreline (measured as grid cells) contacted by oil above a specified threshold.

- The ***maximum length of shoreline contacted by hydrocarbons*** – is determined by recording the maximum length of shoreline (measured as grid cells) contacted by oil above a specified threshold.

- The ***probability of oil exposure to a receptor*** – is determined by recording the number of spill trajectories to reach a specified sea surface or subsea threshold within a receptor polygon, divided by the total number of spill trajectories within that scenario.

- The ***minimum time before exposure to a receptor*** – is determined by ranking the elapsed time before sea surface exposure, at a specified threshold, to grid cells within a receptor polygon and recording the minimum value.

- The ***probability of hydrocarbon contact to a receptor*** – is determined by recording the number of spill trajectories to reach a specified shoreline contact threshold within a receptor polygon, divided by the total number of spill trajectories within that scenario.

- The ***minimum time before shoreline contact to a receptor*** – is determined by ranking the elapsed time before shoreline contact, at a specified threshold, to grid cells within a receptor polygon and recording the minimum value.

- The ***average potential loading within a receptor*** – is determined taking the average of the maximum loading to any grid cell within a polygon, for all simulations within a scenario/season, that recorded shoreline.

- The ***maximum potential loading within a receptor*** – is determined by identifying the maximum loading to any grid cell within a receptor polygon, for a scenario.

- The ***average volume ashore within a receptor*** – is determined by calculating the average volume of oil to come ashore within a receptor polygon, from all the single spill trajectories which were predicted to make shoreline contact within a scenario.

- The ***maximum volume ashore within a receptor*** – is determined by recording the maximum volume of oil to come ashore within a receptor polygon, from all the single spill trajectories which were predicted to make shoreline contact within a scenario.

- The ***average length of shoreline contacted within a receptor*** – is determined by calculating the average of the length of shoreline (measured as grid cells) contacted by oil within a receptor polygon, at a specified threshold, from all the single spill trajectories which were predicted to make shoreline contact within a scenario.

- The ***maximum length of shoreline contacted*** – is determined by recording the maximum length of shoreline (measured as grid cells) contacted by oil within a receptor polygon, at a specified threshold, from all the single spill trajectories which were predicted to make shoreline contact within a scenario.

- The ***instantaneous dissolved and entrained hydrocarbon concentration*** – is determined by recording the maximum instantaneous concentrations (i.e. exposure over the model 1-hour timestep).
- The ***time-averaged dissolved and entrained hydrocarbon exposure*** – reporting of the highest concentration at each grid cell by applying a 48-hour time-based averaging.

8.2 Receptors Assessed

A range of environmental receptors and biological receptors and shorelines were assessed for sea surface exposure, shoreline contact and water column exposure as part of the study (Table 11). The receptors are presented graphically in Figure 22 to Figure 25.

Table 11 Summary of receptors used to assess surface, shoreline and in-water exposure to hydrocarbons.

Receptor Category	Acronym	Hydrocarbon Exposure Assessment		
		Water Column	Sea Surface	Shoreline
Marine National Park	MNP	✓	✓	✗
Australian Marine Park	AMP	✓	✓	✗
National Park	NP	✓	✓	✗
Integrated Marine and Coastal Regionalisation of Australia	IMCRA	✓	✓	✗
Interim Biogeographic Regionalisation of Australia	IBRA	✓	✓	✓
Key Ecological Feature	KEF	✓	✓	✗
Reefs, Shoals and Banks	RSB	✓	✓	✗
Ramsar	Ramsar	✓	✓	✓
State Waters	State Waters	✓	✓	✗
Local Government Areas	LGA	✓	✓	✓
Sub-Local Government Areas	Sub-LGA	✓	✓	✓

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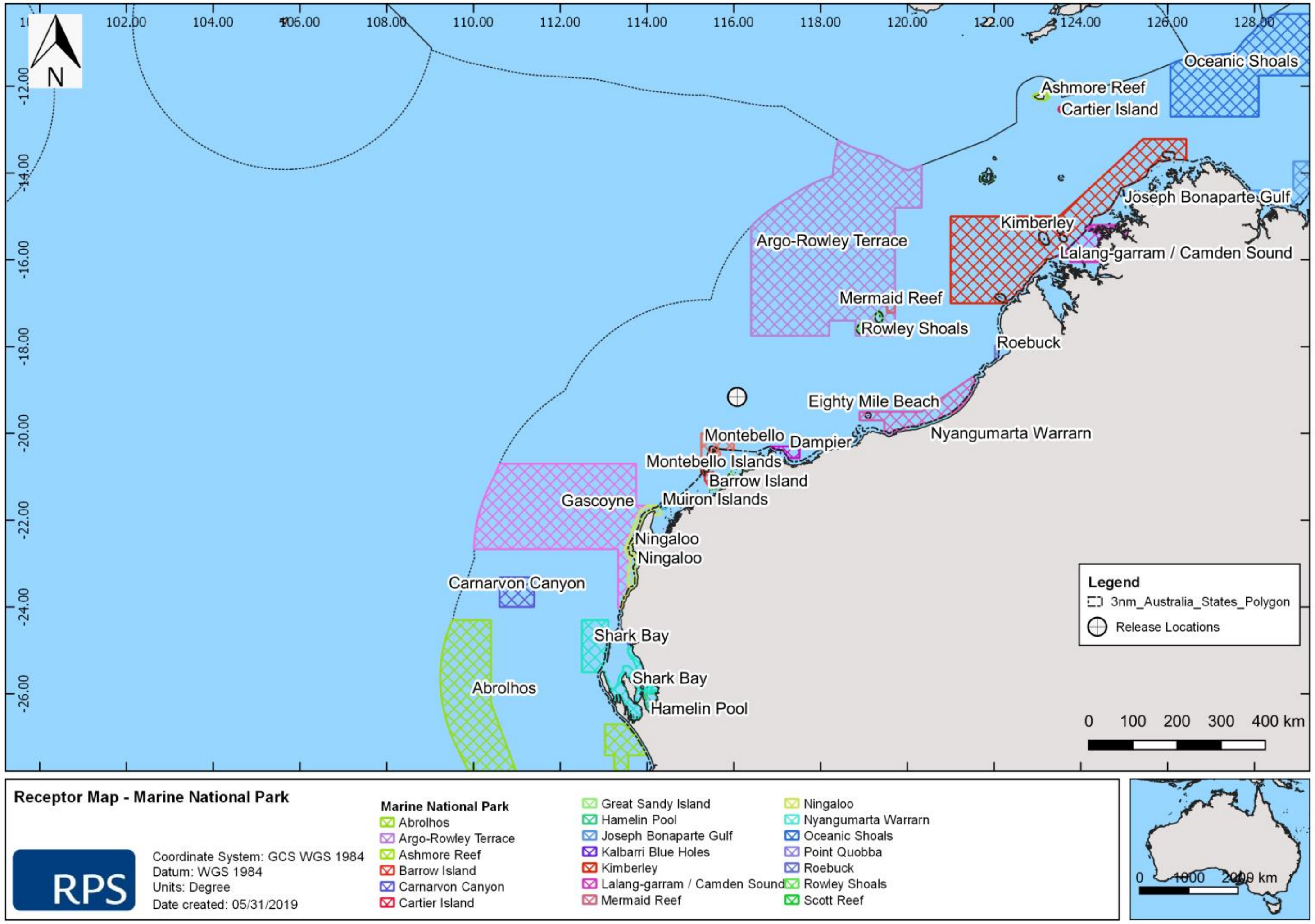

Figure 22 Receptor map for Marine Parks.

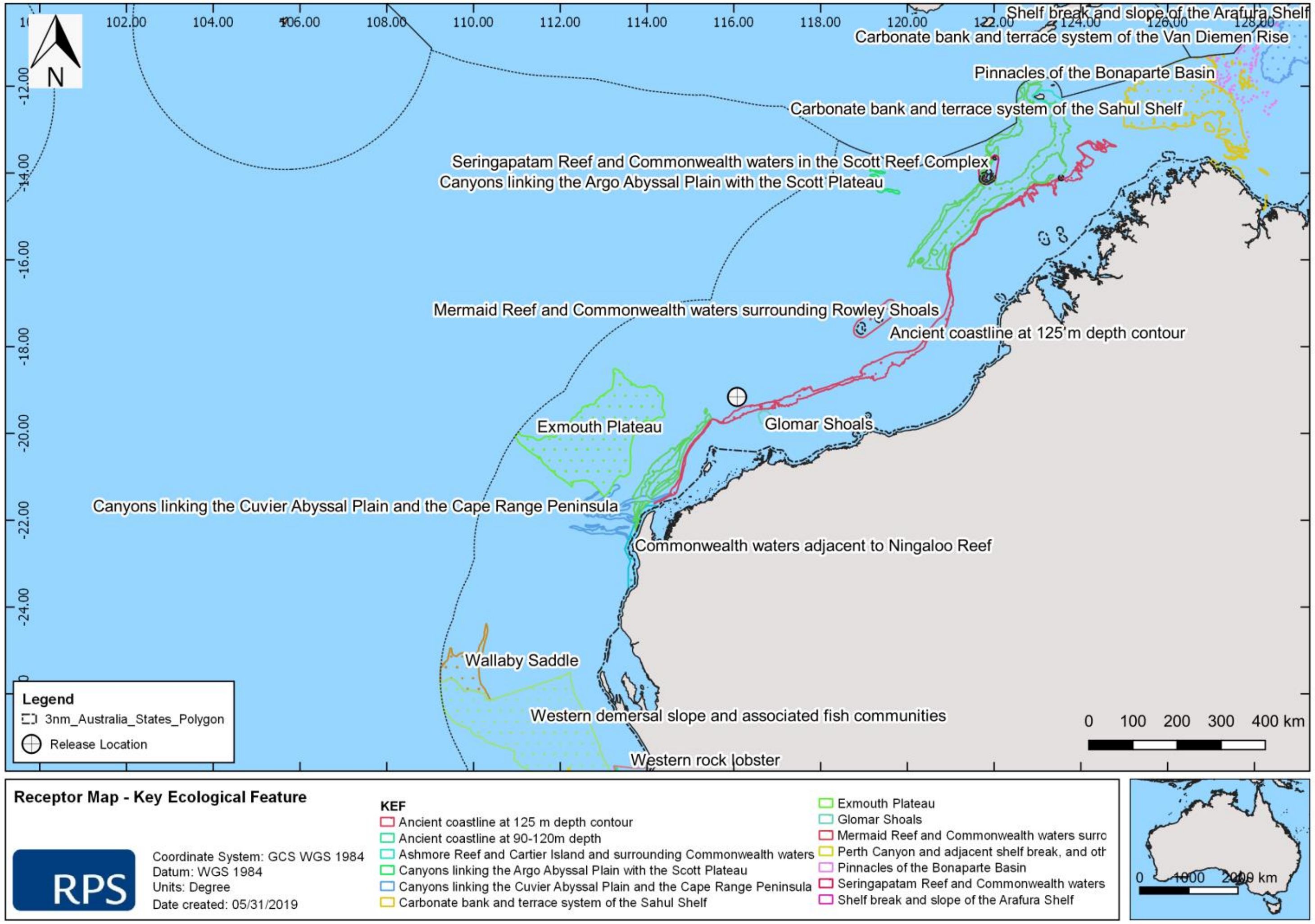

Figure 23 Receptor map of Key Ecological Features (KEF).

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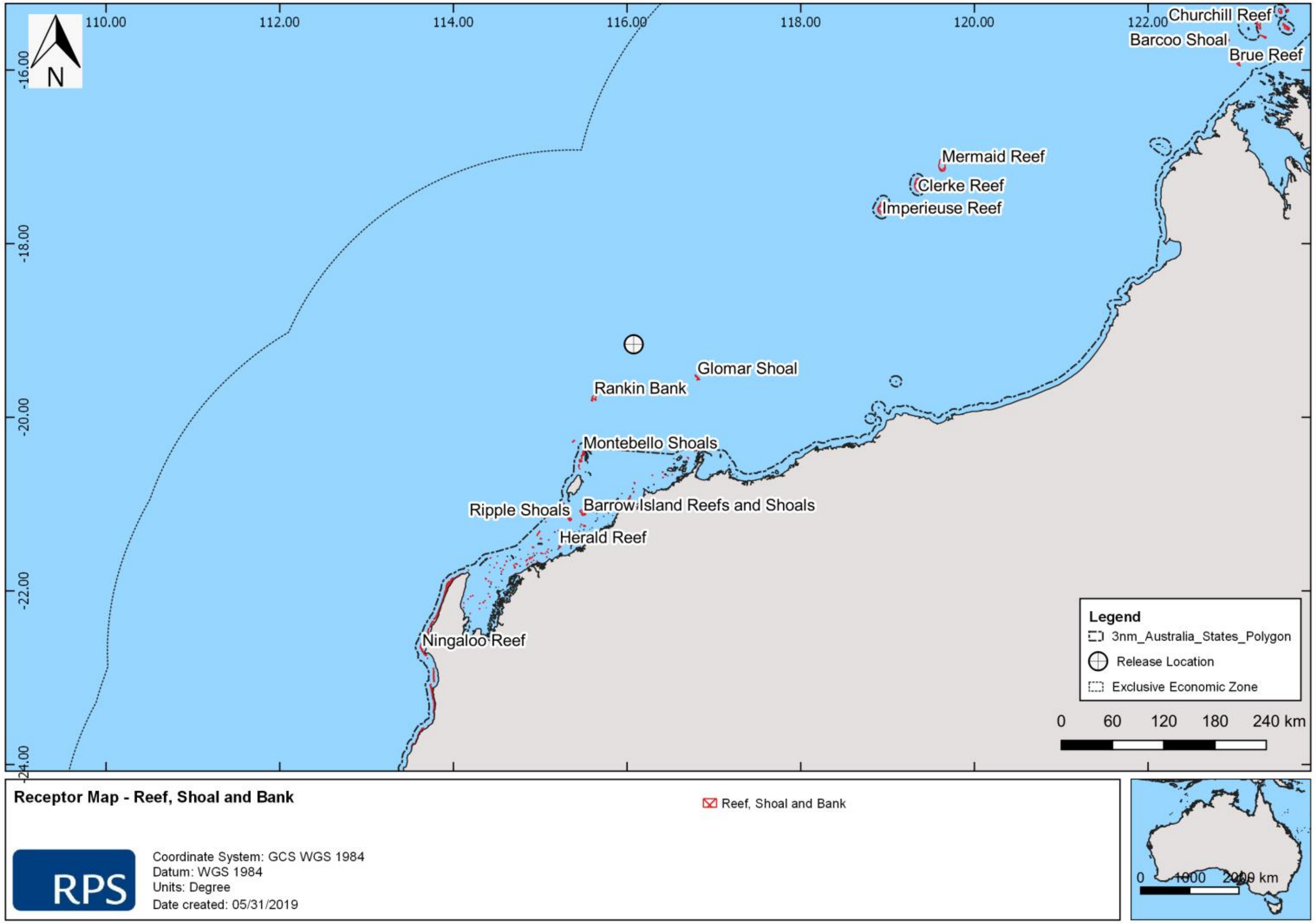

Figure 24 Receptor map of Reefs, Shoals and Banks (RSB) (1/2).

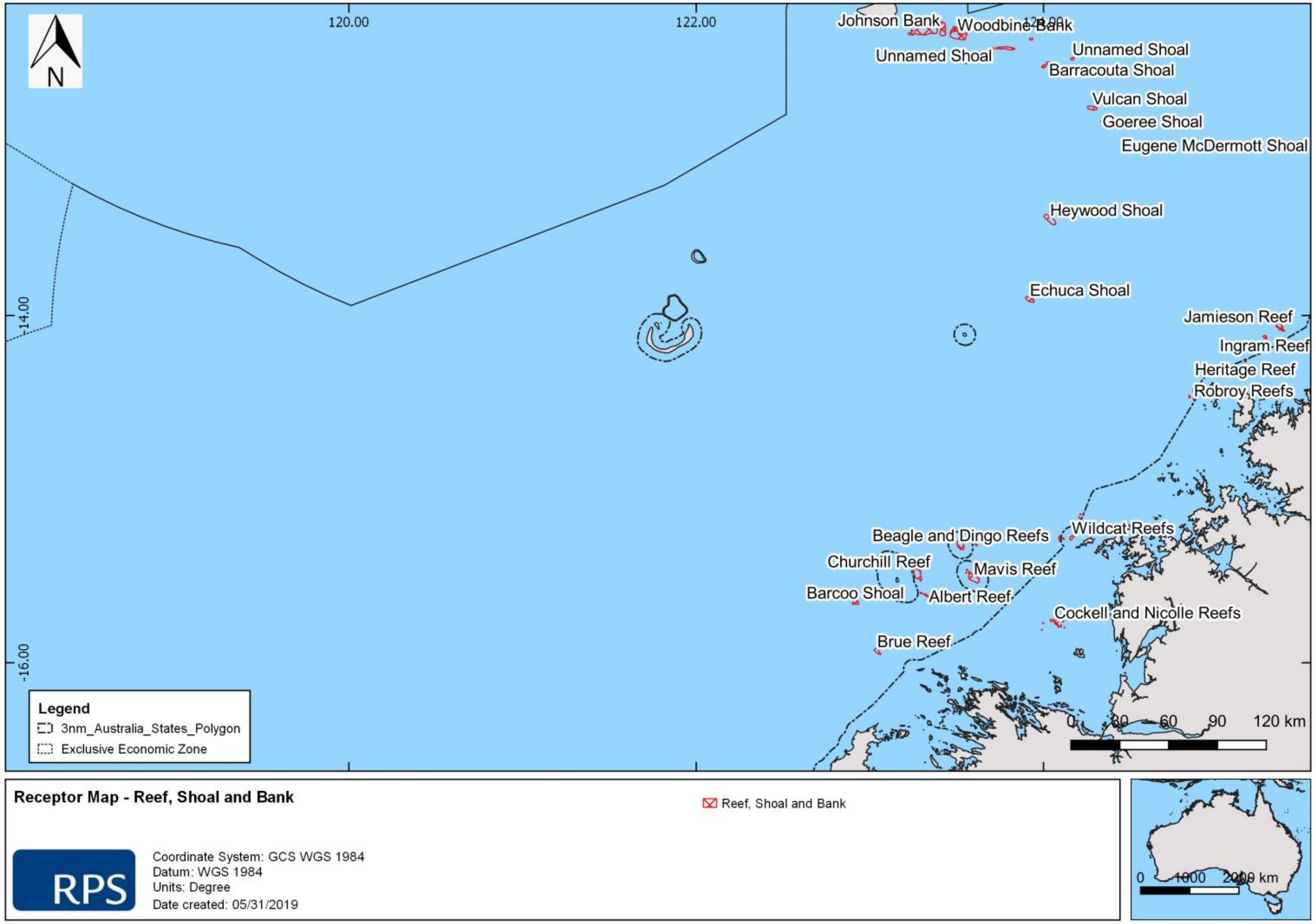

Figure 25 Receptor map of Reefs, Shoals and Banks (RSB) (2/2).

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9 SCENARIO 1 RESULTS: 250 M^3 SURFACE RELEASE OF MARINE DIESEL OIL OVER 6 HOURS

The scenario examined a 250 m^3 surface release of MDO over 6 hours (tracked for 30 days) to represent a vessel collision at the Ironbark well location. A total of 100 spill trajectories were simulated for each of the seasons, summer, transitional and winter.

Section 9.1 presents stochastic results in tabulated and figure-based formats.

Note, no shoreline contact was predicted for any of the seasons modelled above the minimum threshold.

9.1 Stochastic Analysis

9.1.1 Sea Surface Exposure

Table 12 presents a summary of the maximum distance and direction travelled by the MDO on the sea surface at the low (1 – 10 g/m^2), moderate (10 – 100 g/m^2) and high (>50 g/m^2) exposure thresholds for the three seasons considered, summer, transitional and winter. The maximum distance the low exposure surface hydrocarbons occurred from the release location ranged from 97 km and 166 km during winter and transitional conditions, respectively. Additionally, the maximum distance of sea surface exposure was predicted to occur from the release location at the moderate and high zones of exposure ranged from 45 km (summer) to 54 km (transitional) and 5 km (winter) to 27 km (summer), respectively.

Table 13 presents the potential sea surface exposure to individual receptors predicted during summer, transitional and winter conditions. For each of the seasonal conditions modelled one (1) receptor was predicted to be contacted at the low exposure sea surface threshold. The maximum probability of sea surface exposure to any given receptor was 2% predicted during summer conditions above the Ancient coastline KEF at 125 m depth with a corresponding minimum time before exposure of 1.2 days. No sea surface exposure at the moderate or high exposure thresholds was predicted for any receptor during any of the seasons modelled (Table 13)

Figure 26 to Figure 28 show zones of sea surface exposure for the summer, transitional and winter seasons, respectively. Zones of sea surface exposure were variable in direction during the summer conditions with no dominant directionality, whilst exposure zones during the transitional and winter conditions typically occurred in a northeast and southwest direction from the release location corresponding with the predominant current patterns adjacent to the release location (see Section 3.2).

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Table 12 Maximum distance and direction travelled from the release location to oil exposure thresholds on the sea surface. Results are based on a 250 m3 surface release of MDO over 6 hours and tracked for 30 days.

Season	Distance and direction	Zones of potential sea surface exposure		
		Low	Moderate	High
Summer	Max. distance from release site (km)	109	45	27
	Max distance from release site (km) (99th percentile)	94	43	27
	Direction	N	WSW	ENE
Transitional	Max. distance from release site (km)	166	54	25
	Max distance from release site (km) (99th percentile)	153	49	25
	Direction	NE	NE	NE
Winter	Max. distance from release site (km)	97	52	5
	Max distance from release site (km) (99th percentile)	71	50	5
	Direction	SW	NE	W

Table 13 Summary of the potential sea surface exposure to individual receptors. Results are based on a 250 m^3 surface release of MDO over 6 hours and tracked for 30 days.

			Probability of oil exposure on the sea surface (%)			Minimum time before oil exposure on the sea surface (days)		
Season	Receptor		Low	Moderate	High	Low	Moderate	High
Summer	KEF	Ancient coastline at 125 m depth contour	2	-	-	1.2	-	-
Transitional	AMP	Argo-Rowley Terrace	1	-	-	4.3	-	-
Winter	KEF	Continental Slope Demersal Fish Communities	1	-	-	1.3	-	-

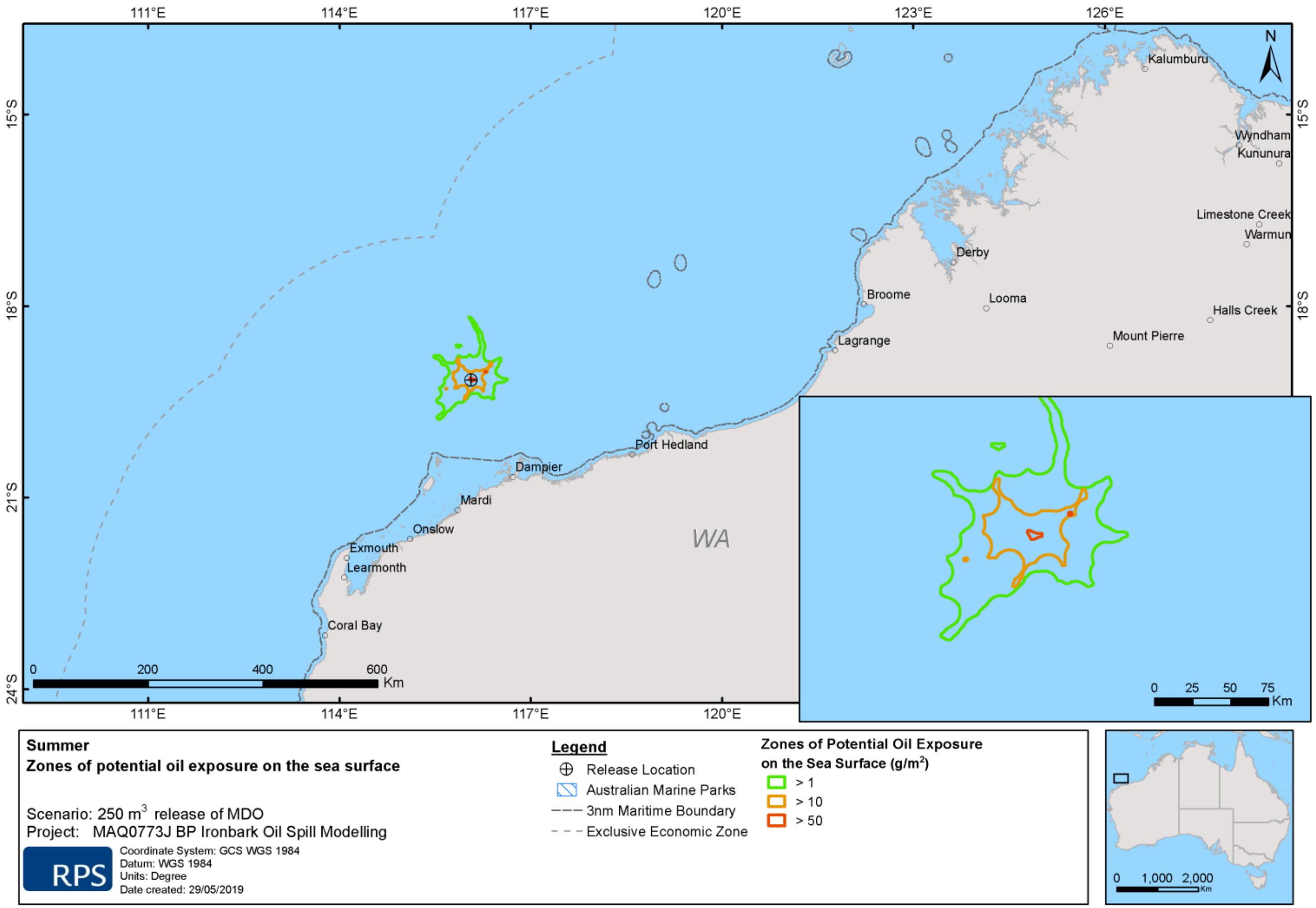

Figure 26 **Zones of potential oil exposure on the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.**

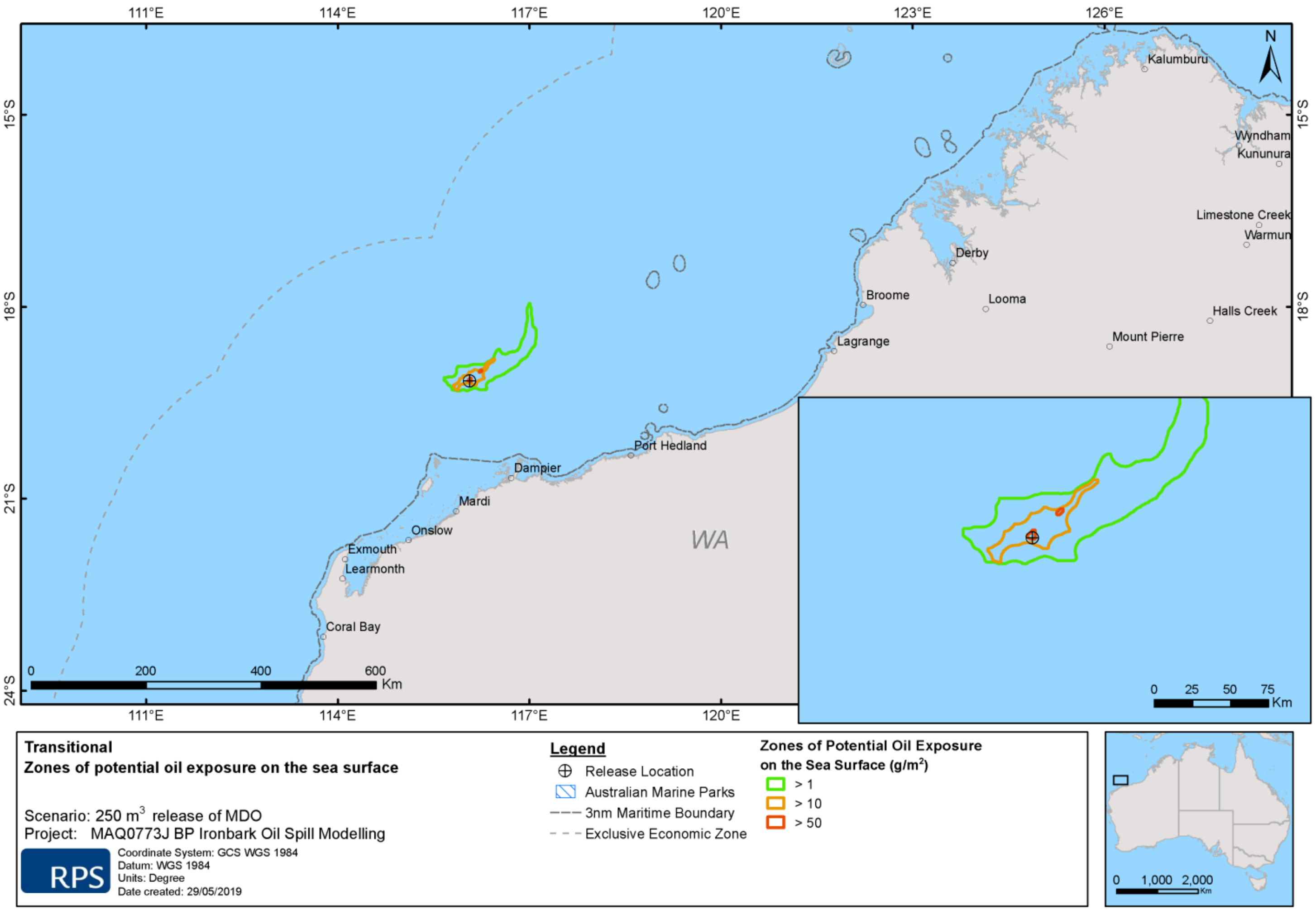

Figure 27 Zones of potential oil exposure on the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

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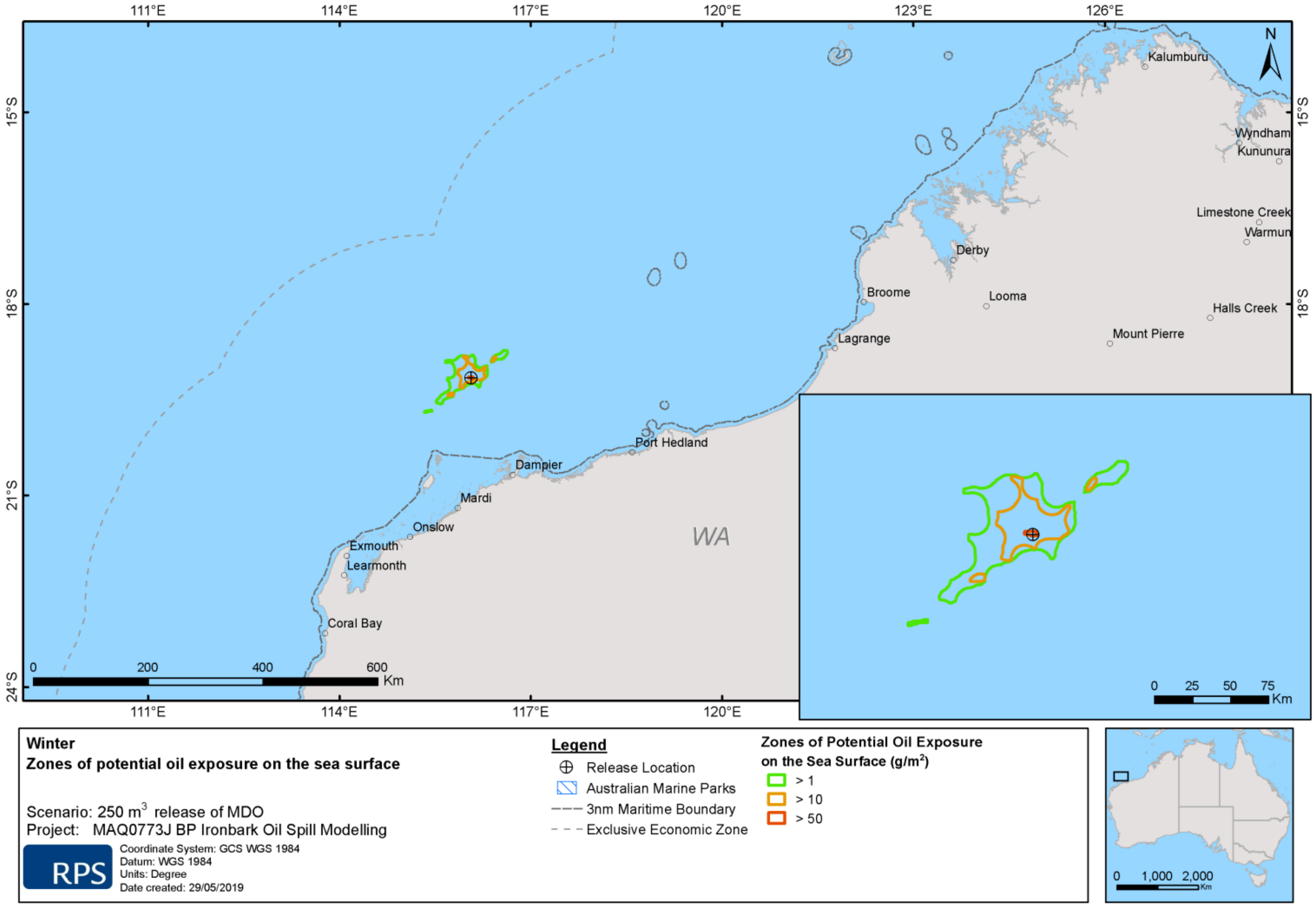

Figure 28 Zones of potential oil exposure on the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

9.2 Water Column Exposure

9.2.1 Dissolved Hydrocarbons

Table 14 and Table 15 summarise the probability and maximum dissolved hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to individual receptors in the 0–10 m depth layer, during the transitional and winter conditions. No receptors were predicted to be exposed to dissolved hydrocarbons during the summer conditions.

Based on the 1 hour exposure window, the Continental Slope Demersal Fish Communities KEF receptor recorded the greatest dissolved hydrocarbon concentration of 15.4 ppb during winter. Additionally, during the transitional conditions the Continental Slope Demersal Fish Communities KEF recorded a dissolved hydrocarbon concentration of 11 ppb. No dissolved hydrocarbon exposure based on a 48-hour window was predicted for any of the assessed receptors during any of the seasons modelled.

Zones of potential dissolved hydrocarbon exposure based on the 1 hour exposure window are presented for each season in Figure 29 to Figure 34 for the 0–10 m and 10–20 m depth layers, respectively.

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Table 14 Probability of exposure to receptors from dissolved hydrocarbons(for 1 hour and 48-hour exposure windows) in the 0–10 m depth layer below the sea surface. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

Transitional Receptor		Maximum dissolved hydrocarbon exposure (ppb) for 48 hour window	Probability of time-averaged dissolved hydrocarbon exposure for 48 hour window			Maximum dissolved hydrocarbon exposure (ppb) for 1 hour window	Probability of dissolved hydrocarbon exposure for 1 hour window		
			Low	Moderate	High		Low	Moderate	High
KEF	Continental Slope Demersal Fish Communities	-	-	-	-	11.0	1	-	-

Table 15 Probability of exposure to receptors from dissolved hydrocarbons (for 1 hour and 48-hour exposure windows) in the 0–10 m depth layer below the sea surface. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

Winter Receptor		Maximum dissolved hydrocarbon exposure (ppb) for 48 hour window	Probability of time-averaged dissolved hydrocarbon exposure for 48 hour window			Maximum dissolved hydrocarbon exposure (ppb) for 1 hour window	Probability of dissolved hydrocarbon exposure for 1 hour window		
			Low	Moderate	High		Low	Moderate	High
KEF	Ancient coastline at 125 m depth contour	-	-	-	-	10.0	1	-	-
	Continental Slope Demersal Fish Communities	-	-	-	-	15.4	1	-	-

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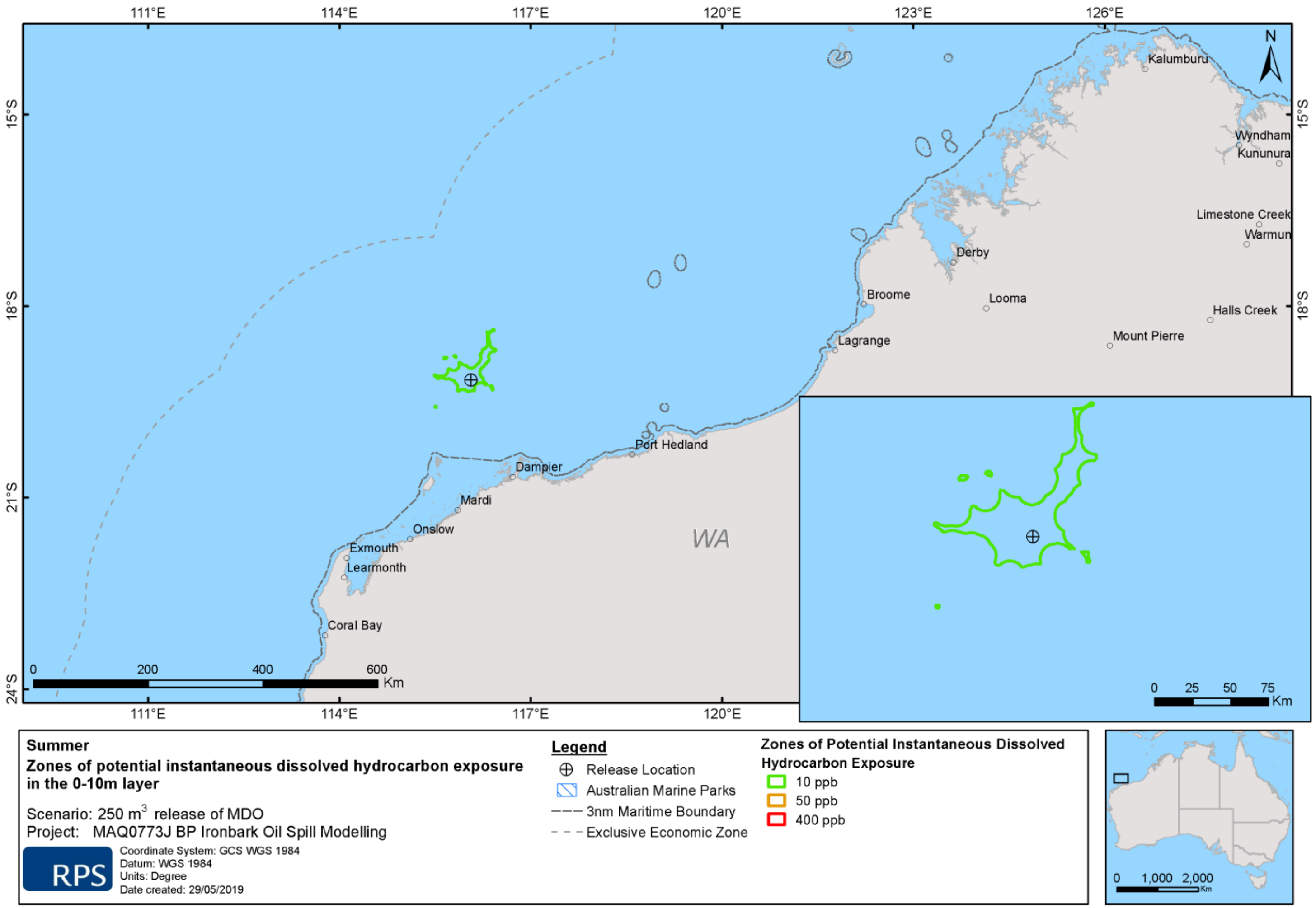

Figure 29 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 0–10 m below the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

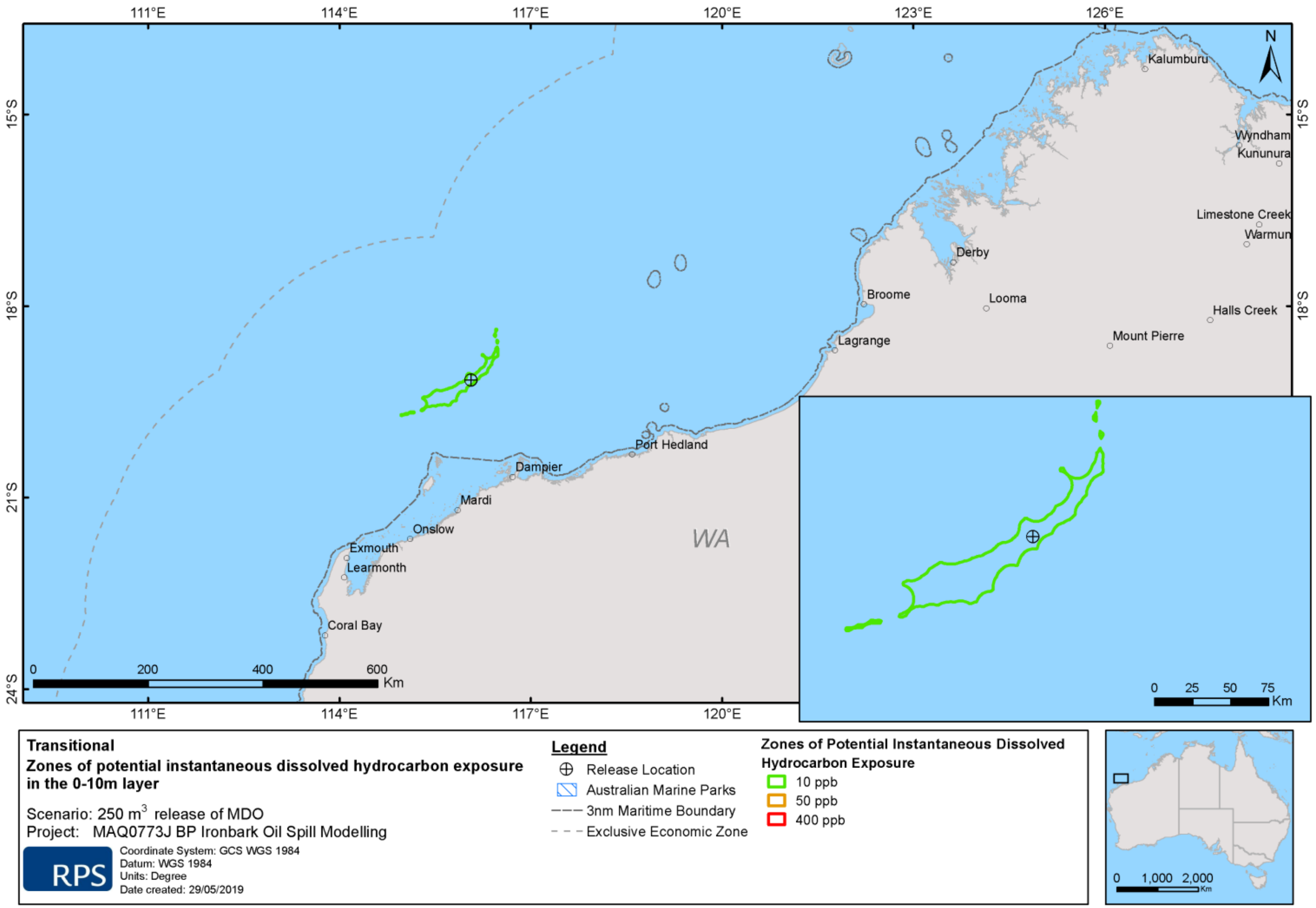

Figure 30 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 0–10 m below the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

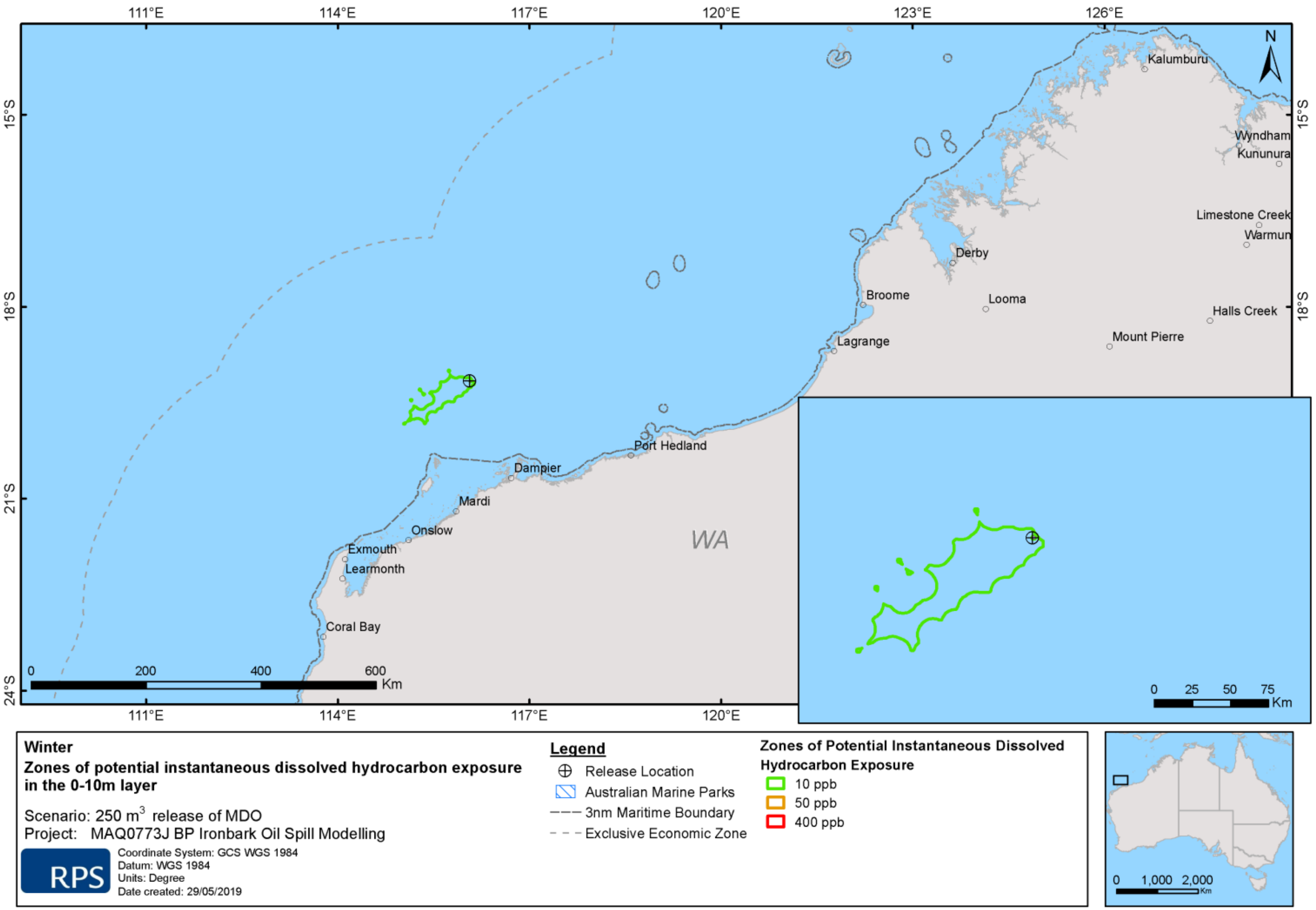

Figure 31 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 0–10 m below the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

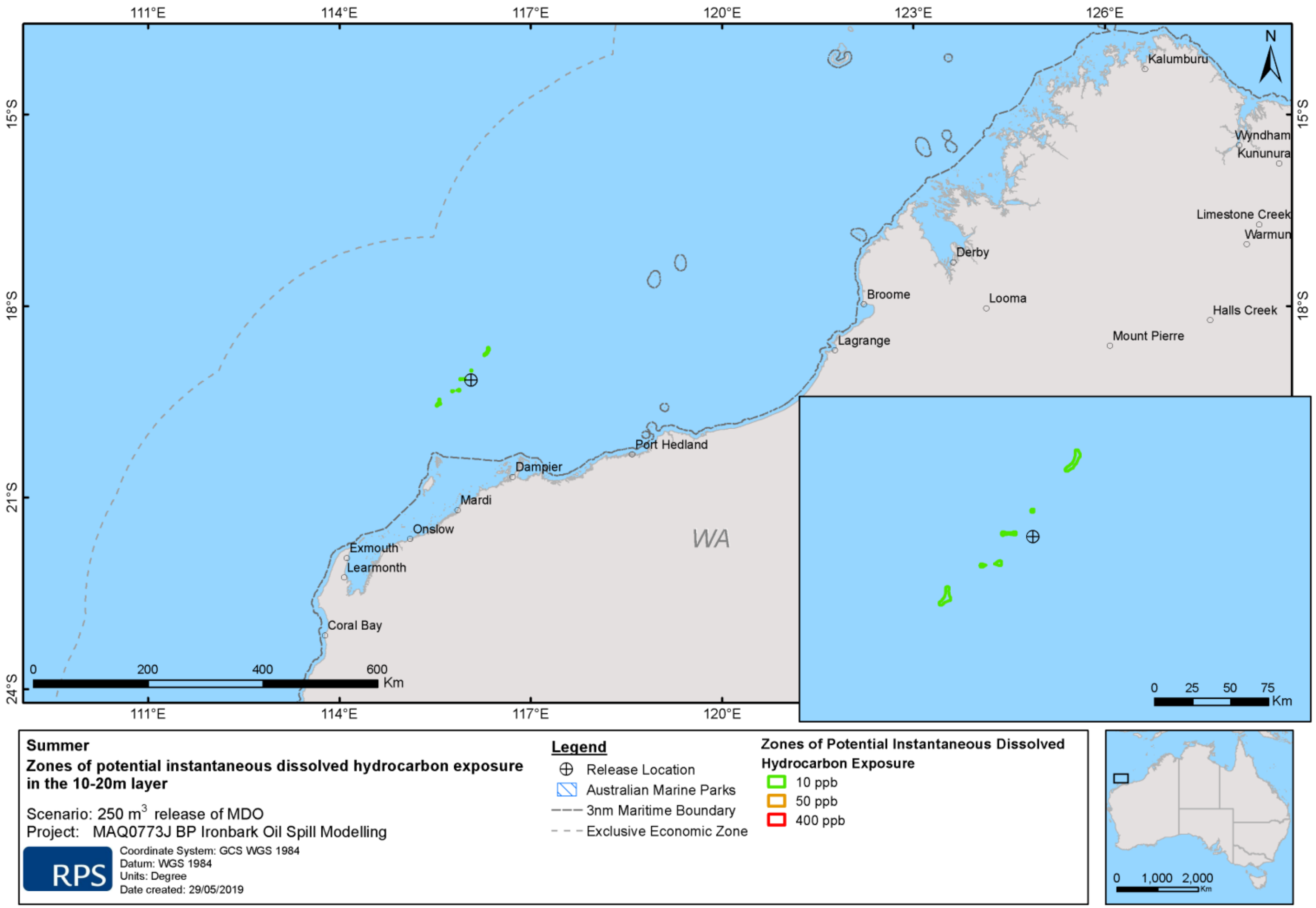

Figure 32 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 10–20m below the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

RPS

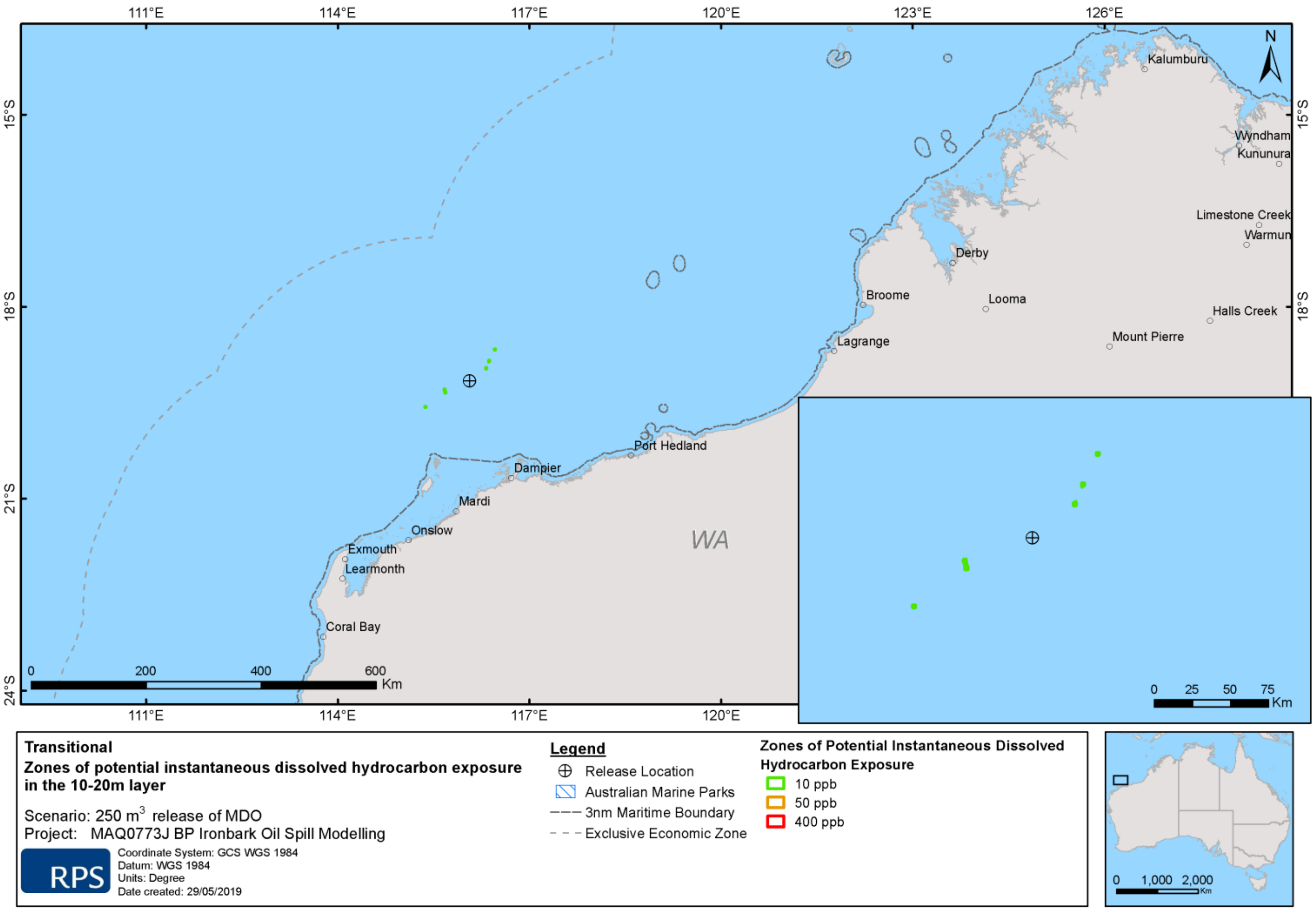

Figure 33 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 10–20 m below the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

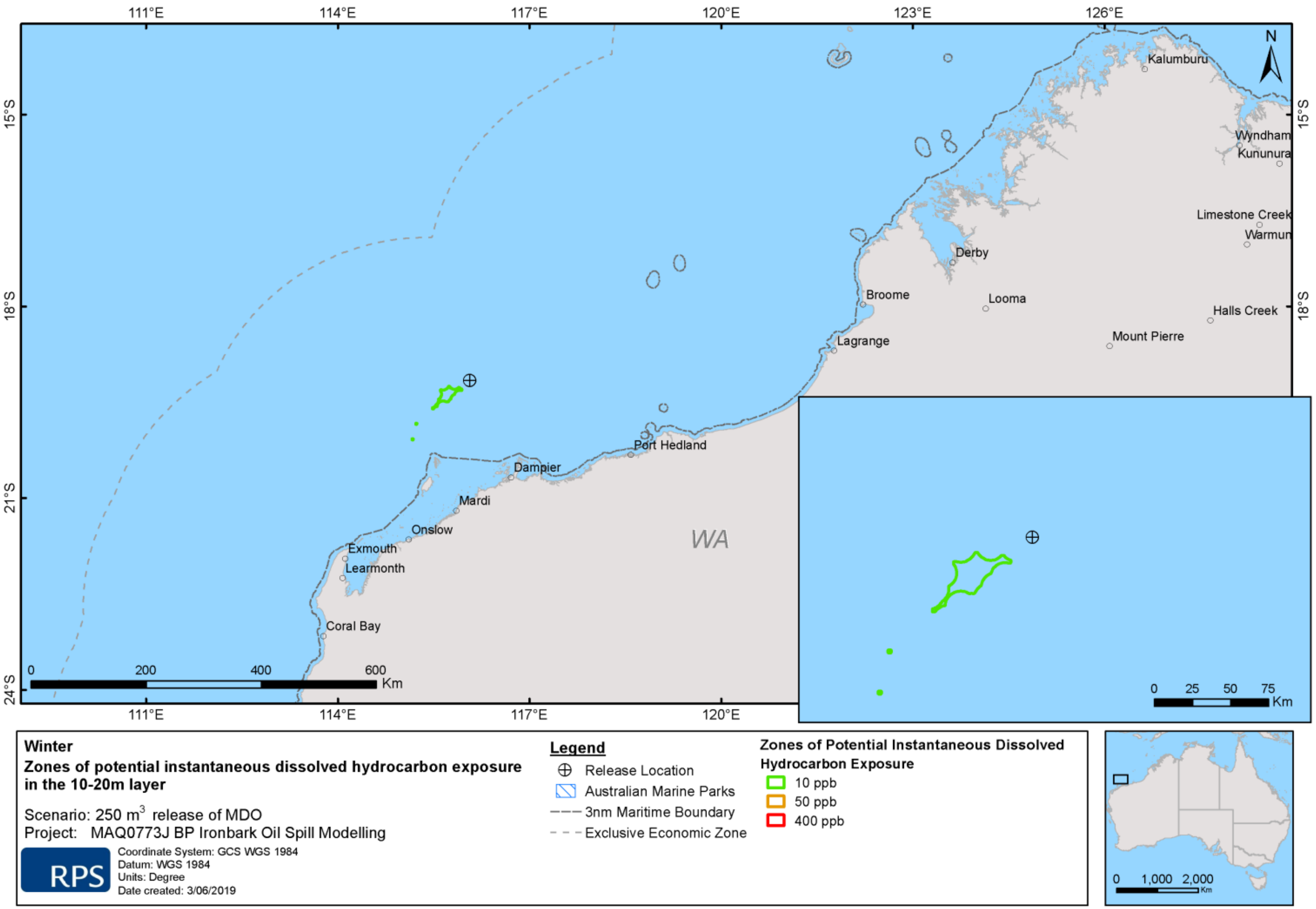

Figure 34 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 10–20 m below the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

9.2.2 Entrained Hydrocarbons

Table 16 to Table 18 summarise the maximum entrained hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to receptors in the 0–10 m depth layer at or above the exposure thresholds discussed in Section 7.2 over the seasonal assessments.

For the 48 hour time-averaged exposure window, maximum entrained hydrocarbons were greatest at the Ancient coastline KEF at 125 m depth contour and Continental Slope Demersal Fish Communities KEF, ranging between 41.5 ppb (winter) and 59.8 ppb (summer). Maximum concentrations at the Continental Slope Demersal Fish Communities KEF ranged between 53.9 ppb (transitional) and 103.7 ppb (winter). During summer conditions, the probability of low exposure ranged from 1% (Gascoyne and Montebello AMPs) to 6% (Continental Slope Demersal Fish Communities KEF). During transitional conditions, the probability of low exposure ranged from 2% (Gascoyne AMP, Ningaloo MP and Ningaloo Reef RSB) to 12% (Continental Slope Demersal Fish Communities KEF). Additionally, during winter conditions, the probability of low exposure ranged from 1% (Mermaid Reef and Montebello AMPs, Mermaid Reef RSB, and Mermaid Reef and Commonwealth waters surrounding Rowley Shoals and Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula KEFS) to 14% (Continental Slope Demersal Fish Communities KEF).

The analysis for the entrained hydrocarbons over a 1 hour window showed that the maximum exposure was 218.6 ppb during summer, 327.5 ppb during transitional and 458.0 ppb during winter conditions, occurring at the Continental Slope Demersal Fish Communities Kef in all seasons. During summer conditions, the probability of moderate exposure to entrained hydrocarbons ranged from 1% (Argo-Rowley Terrace AMP) to 2% (Ancient coastline at 125 m depth contour and Continental Slope Demersal Fish Communities KEF). Under transitional conditions, the probability of moderate exposure (over 1 hour) to entrained hydrocarbons ranged from 1% (G Argo-Rowley Terrace and Montebello AMPS) to 9% for the Continental Slope Demersal Fish Communities KEF. During winter conditions, the probability of moderate exposure to entrained hydrocarbons ranged from 1% to 11%, occurring at the Ancient coastline KEF at 125 m depth contour and the Continental Slope Demersal Fish Communities KEF, respectively.

Zones of potential entrained hydrocarbon exposure based on 48 hour exposure window for each season for the 0–10 m and 10–20 m depth layers are shown in Figure 35 to Figure 37.

Zones of potential entrained hydrocarbon exposure based on the 1 hour exposure window are presented for each season in Figure 38 to Figure 40 for the 0–10 m and 10–20 m depth layers, respectively.

RPS

Table 16 Probability of exposure to receptors from entrained hydrocarbons (for 1 hour and 48-hour exposure windows) in the 0–10 m depth layer below the sea surface. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

Summer Receptor		Maximum entrained hydrocarbon exposure (ppb) over 48 hour window	Probability of time-averaged entrained hydrocarbon exposure over 48 hour window		Maximum entrained hydrocarbon exposure (ppb) over 1 hour window	Probability of instantaneous entrained hydrocarbon exposure over 1 hour window	
			Low	High		Low	High
AMP	Argo-Rowley Terrace	38.0	4	-	148.5	9	1
	Gascoyne	14.7	1	-	23.5	2	-
	Montebello	15.1	1	-	36.3	1	-
	Ningaloo	-	-	-	16.3	1	-
MP	Barrow Island	-	-	-	18.3	1	-
	Montebello Islands	-	-	-	23.3	1	-
	Ningaloo	-	-	-	14.8	1	-
RSB	Rankin Bank	-	-	-	12.0	1	-
	Montebello Shoals	-	-	-	15.6	1	-
	Ningaloo Reef	-	-	-	12.4	1	-
KEF	Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	-	-	-	24.1	2	-
	Ancient coastline at 125 m depth contour	59.8	5	-	137.8	8	2
	Exmouth Plateau	23.8	2	-	59.9	6	-
	Commonwealth waters adjacent to Ningaloo Reef	-	-	-	16.3	1	-

RPS

	Continental Slope Demersal Fish Communities	56.9	6	-	218.6	10	2

Table 17 Probability of exposure to receptors from entrained hydrocarbons (for 1 hour and 48-hour exposure windows) in the 0–10 m depth layer below the sea surface. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

Transitional Receptor		Maximum entrained hydrocarbon exposure (ppb) over 48 hour window	Probability of time-averaged entrained hydrocarbon exposure over 48 hour window		Maximum entrained hydrocarbon exposure (ppb) over 1 hour window	Probability of instantaneous entrained hydrocarbon exposure over 1 hour window	
			Low	High		Low	High
AMP	Argo-Rowley Terrace	42.5	5	-	106.3	9	1
	Gascoyne	20.0	2	-	46.9	6	-
	Montebello	41.4	4	-	103.5	6	1
	Ningaloo	-	-	-	36.2	3	-
MP	Ningaloo	22.1	2	-	37.3	2	-
	Rowley Shoals	-	-	-	16.4	2	-
RSB	Imperieuse Reef	-	-	-	14.3	2	-
	Rankin Bank	-	-	-	25.4	3	-
	Ningaloo Reef	20.5	2	-	26.9	2	-
KEF	Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	-	-	-	17.9	2	-

RPS

	Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	12.8	3	614.5	42.7	7	-
	Ancient coastline at 125 m depth contour	47.0	6	2,258.3	201.4	7	3
	Exmouth Plateau	22.1	3	1,060.9	66.6	9	-
	Commonwealth waters adjacent to Ningaloo Reef	-	-	-	36.2	3	-
	Continental Slope Demersal Fish Communities	53.9	12	-	327.5	21	9

Table 18 Probability of exposure to receptors from entrained hydrocarbons (for 1 hour and 48-hour exposure windows) in the 0–10 m depth layer below the sea surface. Results are based on a 250 m³ surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

Winter Receptor		Maximum entrained hydrocarbon exposure (ppb) over 48 hour window	Probability of time-averaged entrained hydrocarbon exposure over 48 hour window		Maximum entrained hydrocarbon exposure (ppb) over 1 hour window	Probability of instantaneous entrained hydrocarbon exposure over 1 hour window	
			Low	High		Low	High
AMP	Argo-Rowley Terrace	15.8	2	-	41.6	3	-
AMP	Gascoyne	20.5	2	-	44.9	6	-
AMP	Mermaid Reef	15.1	1	-	24.1	1	-
AMP	Montebello	17.0	1	-	95.5	5	-
AMP	Ningaloo	-	-	-	11.5	1	-
RSB	Mermaid Reef	10.9	1	-	17.6	1	-

	Rankin Bank	24.3	2	-	50.9	4	-
KEF	Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	15.8	1	-	27.5	1	-
	Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	20.0	1	-	33.7	5	-
	Ancient coastline at 125 m depth contour	41.5	3	-	184.5	9	1
	Exmouth Plateau	27.8	3	-	56.1	8	-
	Commonwealth waters adjacent to Ningaloo Reef	-	-	-	11.5	1	-
	Continental Slope Demersal Fish Communities	103.7	14	-	458.0	23	11

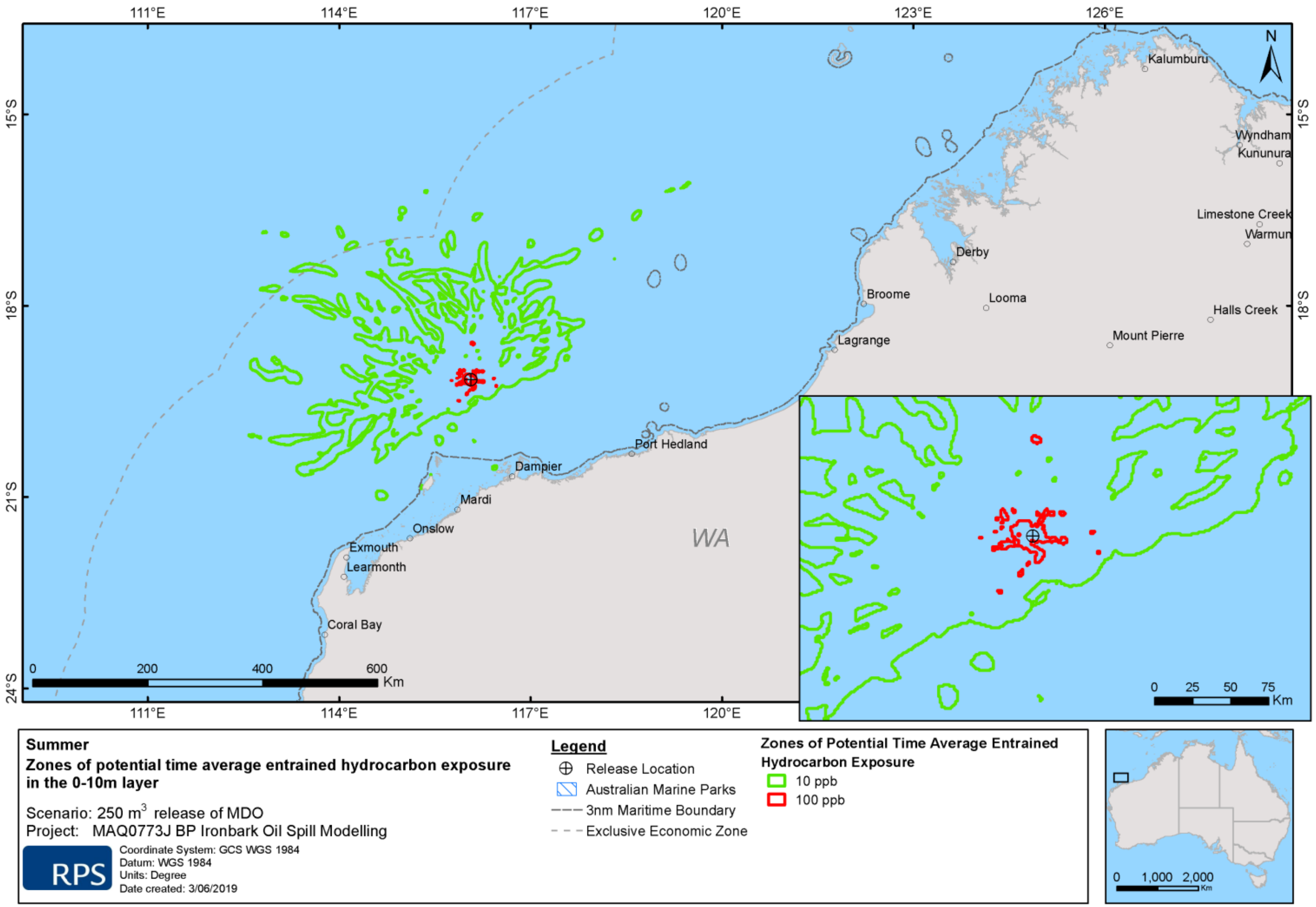

Figure 35 Zones of potential entrained hydrocarbon exposure over a 48 hour window at 0–10 m below the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

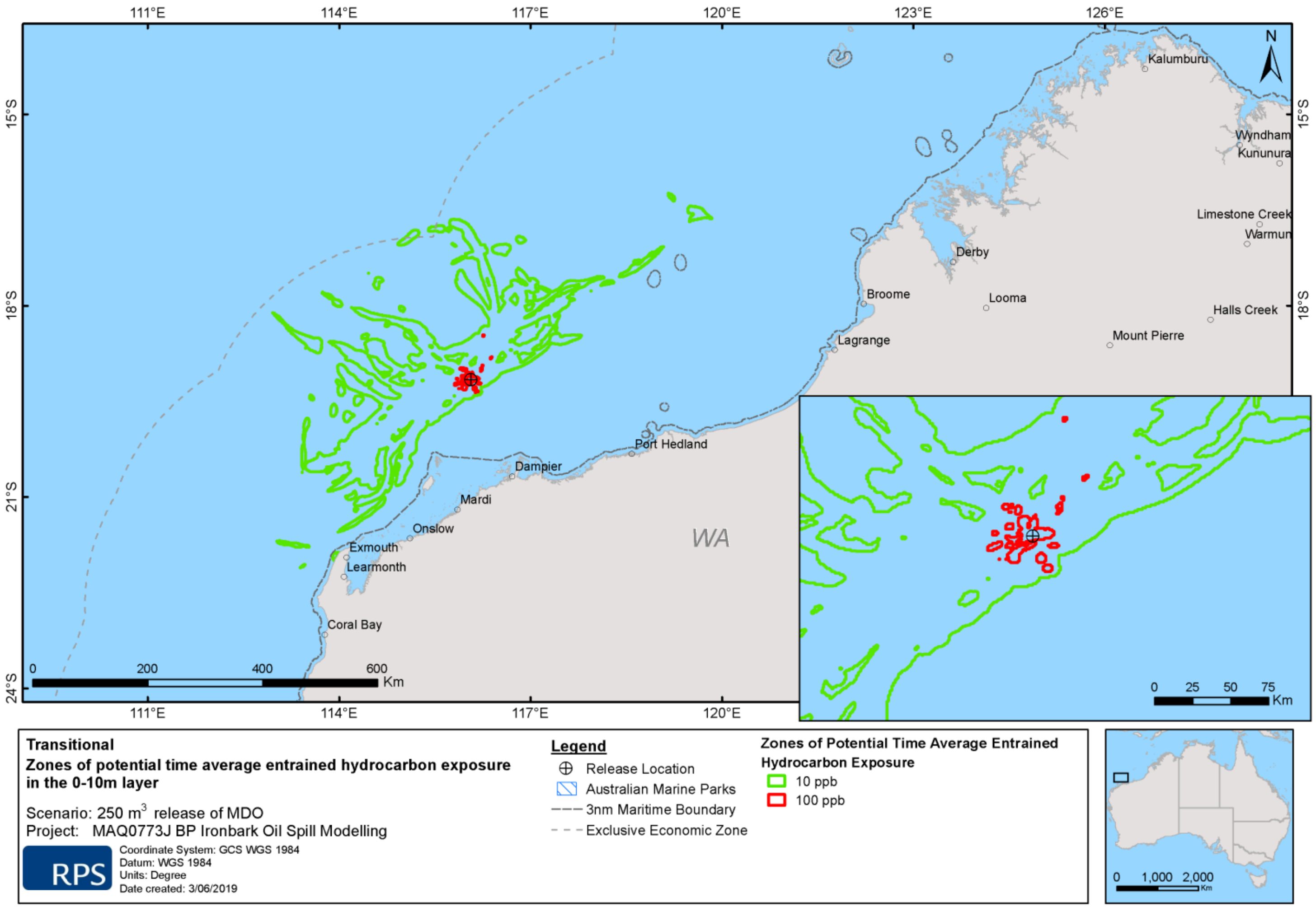

Figure 36 Zones of potential entrained hydrocarbon exposure over a 48 hour window at 0–10 m below the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

RPS

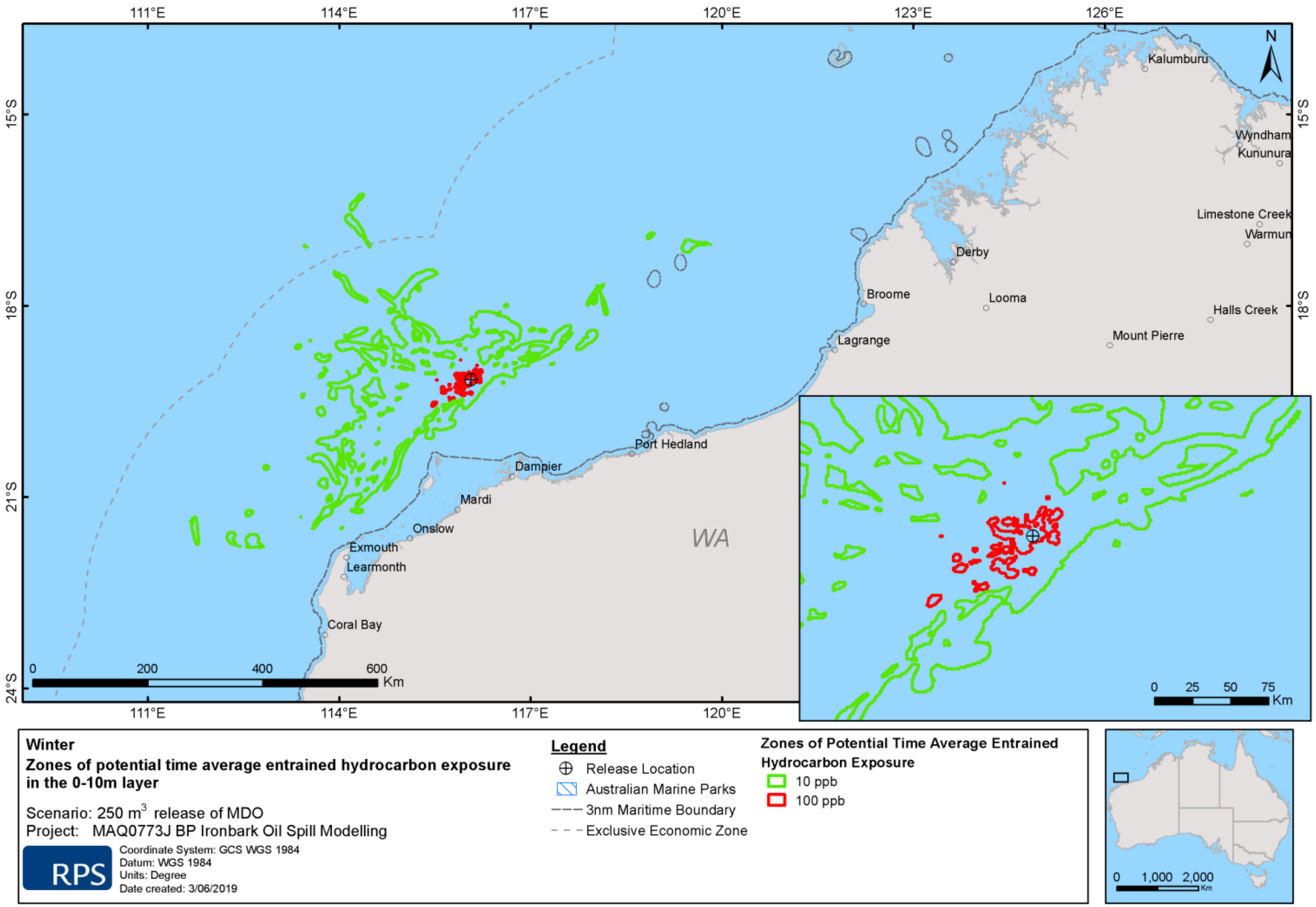

Figure 37 Zones of potential entrained hydrocarbon exposure over a 48 hour window at 0–10 m below the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

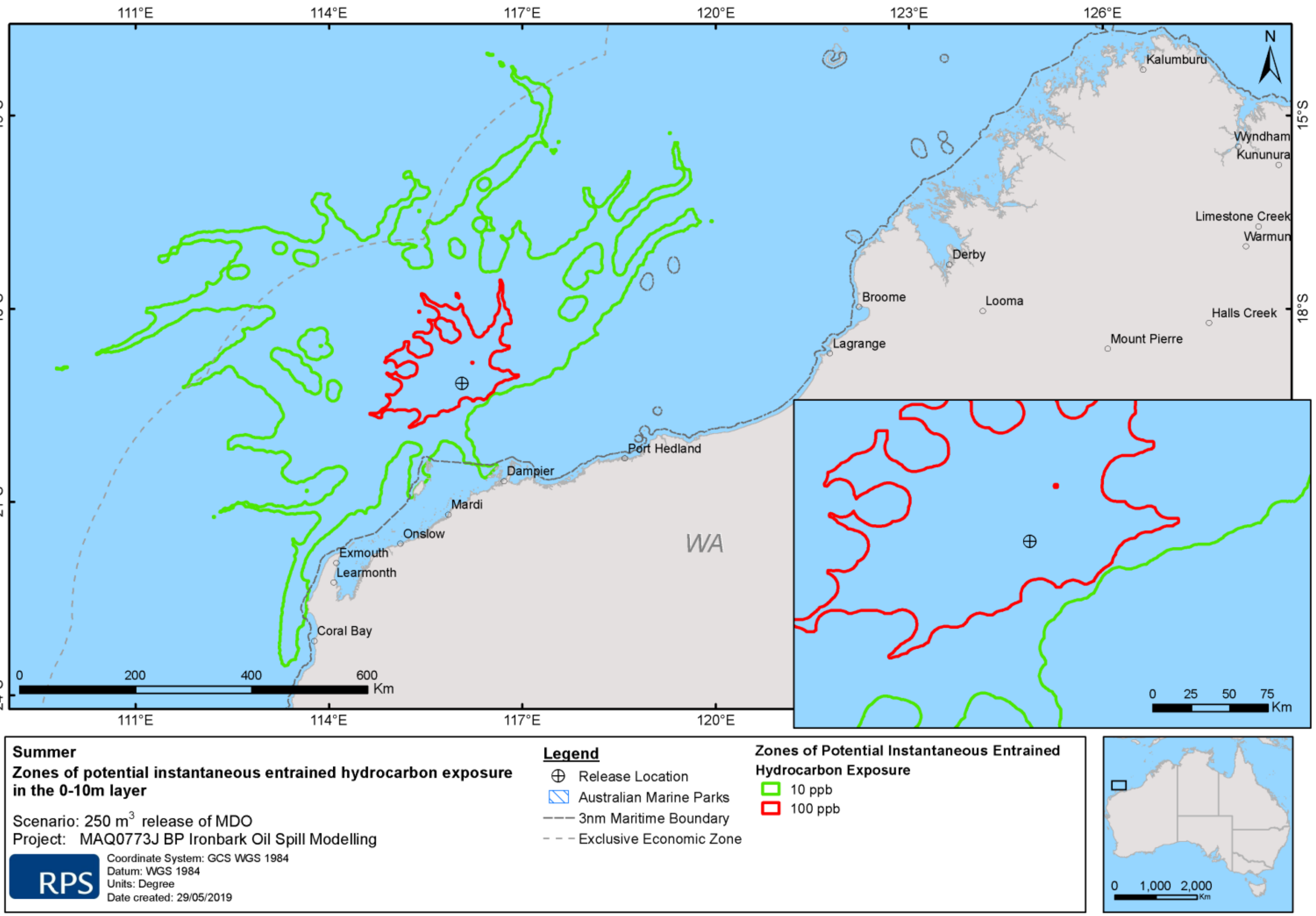

Figure 38 Zones of potential entrained hydrocarbon exposure over a 1 hour window at 0–10 m below the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

RPS

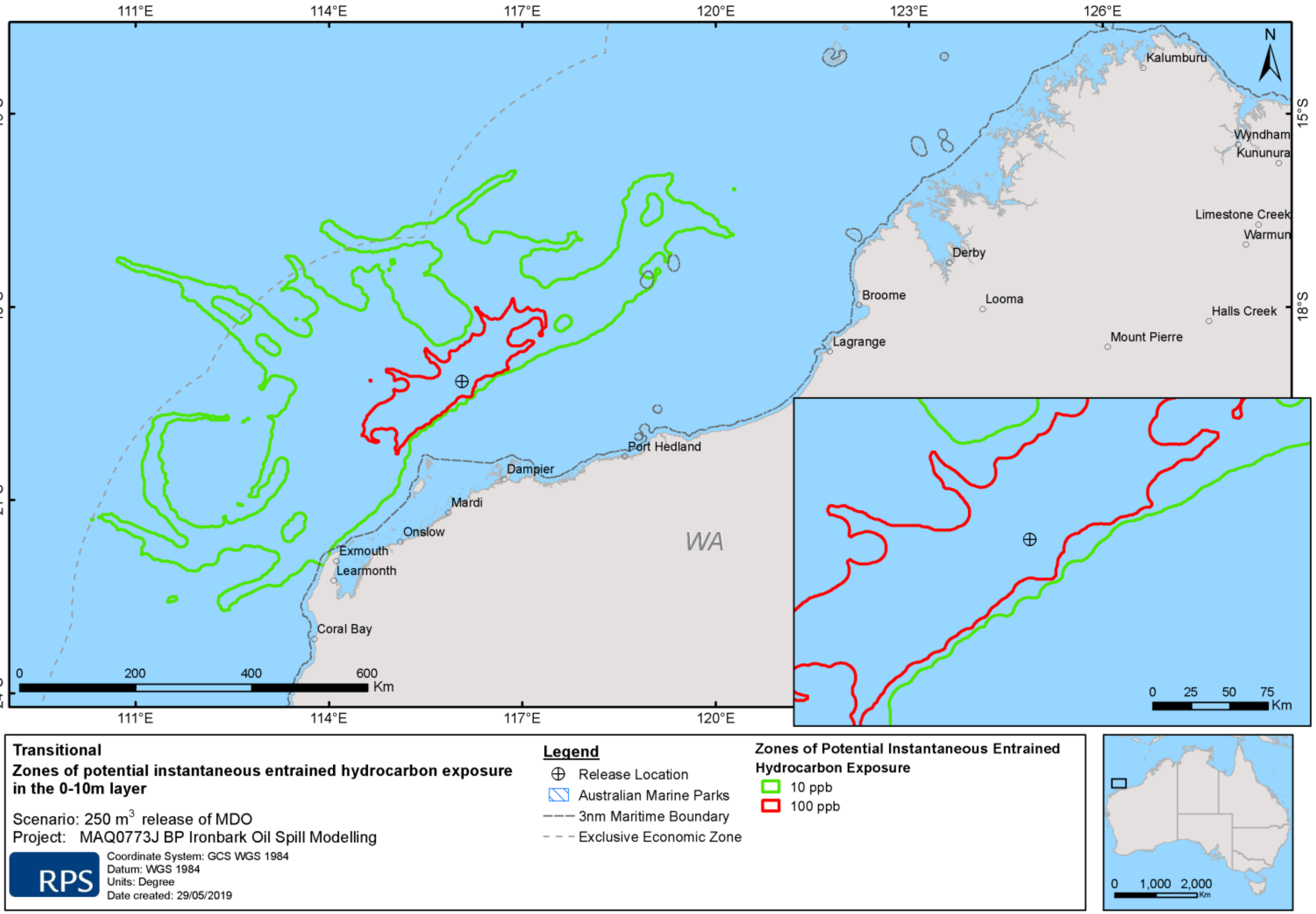

Figure 39 Zones of potential entrained hydrocarbon exposure over a 1 hour window at 0–10 m below the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

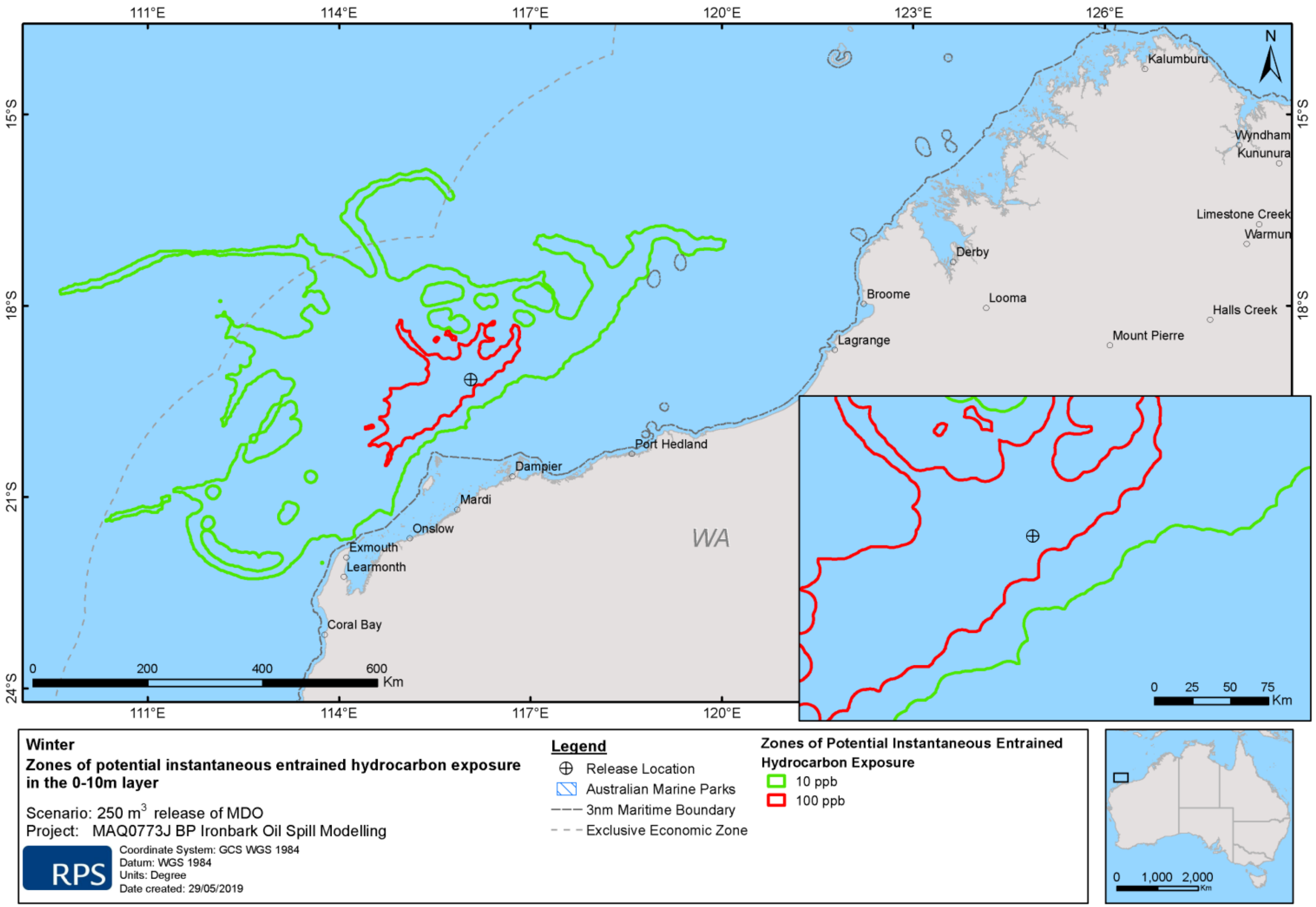

Figure 40 Zones of potential entrained hydrocarbon exposure over a 1 hour window at 0–10 m below the sea surface, in the event of a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

RPS

10 SCENARIO 2 RESULTS: 9.016 MMstb SUBSEA RELEASE OF CONDENSATE OVER 103 DAYS

The scenario examined a 9.016 MMstb (1,433,544 m^3) subsea release of Goodwyn condensate over 103 days (tracked for 133 days) to represent a represent an unrestricted loss of well control at the Ironbark well location. A total of 100 spill trajectories were simulated for each of the seasons, summer, transitional and winter.

Section 10.1 presents stochastic results in tabulated and figure-based formats.

Note, no shoreline contact was predicted for any of the seasons modelled above the minimum threshold.

10.1 Stochastic Analysis

10.1.1 Sea Surface Exposure

Table 19 presents a summary of the maximum distance and direction travelled by the condensate on the sea surface at the low (1 – 10 g/m^2), moderate (10 – 100 g/m^2) and high (>50 g/m^2) exposure thresholds for each of the three seasons considered. The maximum distance for low exposure from the release location ranged from 374 km and 575 km during summer and transitional conditions, respectively. Additionally, the maximum distance from the release location at the moderate and high zones of exposure ranged from 174 km (transitional) to 180 km (winter) and 70 km (summer) to 115 km (winter), respectively.

Table 20 presents the potential sea surface exposure to individual receptors. The summer stochastic modelling results demonstrated the greatest number of receptors (13) potentially being exposed to surface hydrocarbons, at or above, the low exposure threshold out of all three seasons. Probabilities of low exposure on the sea surface, at or above, the low threshold under summer conditions ranged from 1% (KEF, RSB, and MP receptors) to 71% (KEF – Continental Slope Demersal Fish Communities). During each of the seasons modelled the Continental Slope Demersal Fish Communities KEF was predicted to have the greatest probability of sea surface exposure (above the low threshold, 68–77%) with corresponding minimum times to exposure ranging from 2 days (transitional) to 5 days (summer). Additionally, the Argo-Rowley Terrace AMP and Montebello AMP were both predicted to be exposed to surface hydrocarbons, at or above, the low exposure threshold during the modelled summer, transitional and winter conditions with probabilities of exposure ranging between 15–43% and 10–19%, respectively.

Figure 41 to Figure 43 show zones of sea surface exposure for the summer, transitional and winter seasons, respectively. Zones of sea surface exposure generally occurred in a northeast and southwest direction from the release location corresponding with the predominant current patterns adjacent to the release location (see Section 3.2).

RPS

Table 19 Maximum distance and direction from the release location to condensate exposure thresholds on the sea surface. Results are based on a 9.016 MMstb subsea release of condensate over 103 days and tracked for 133 days.

Season	Distance and direction	Zones of potential sea surface exposure		
		Low	Moderate	High
Summer	Max. distance from release site (km)	374	175	70
	Max distance from release site (km) (99th percentile)	275	116	57
	Direction	SW	NNE	NNE
Transitional	Max. distance from release site (km)	575	174	96
	Max distance from release site (km) (99th percentile)	290	154	62
	Direction	WSW	WSW	ENE
Winter	Max. distance from release site (km)	423	180	115
	Max distance from release site (km) (99th percentile)	275	172	82
	Direction	WSW	NNE	ENE

Table 20 Summary of the potential sea surface exposure to individual receptors. Results are based on a 9.016 MMstb subsea release of condensate over 103 days and tracked for 133 days.

			Probability of exposure on the sea surface (%)			Minimum time before exposure on the sea surface (days)		
Season	Receptor		Low	Moderate	High	Low	Moderate	High
Summer	AMP	Argo-Rowley Terrace	35	3	-	6	38	-
		Gascoyne	3	-	-	92	-	-
		Montebello	19	-	-	14	-	-
	RSB	Rankin Bank	19	-	-	13	-	-
		Glomar Shoal	1	-	-	15	-	-
	MP	Montebello Islands	1	-	-	48	-	-
	KEF	Glomar Shoals	10	-	-	11	-	-
		Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	1	-	-	93	-	-
		Ancient coastline at 125 m depth contour	59	4	-	2	16	-
		Exmouth Plateau	23	-	-	10	-	-

RPS

			Probability of exposure on the sea surface (%)			Minimum time before exposure on the sea surface (days)		
		Continental Slope Demersal Fish Communities	71	1	-	5	87	-
	IMCRA	Northwest Shelf	96	73	35	1	2	4
		Pilbarra (offshore)	21	-	-	13	-	-
Transitional	AMP	Argo-Rowley Terrace	15	0	0	5	0	0
		Gascoyne	16	0	0	10	0	0
		Montebello	12	0	0	61	0	0
	RSB	Rankin Bank	2	0	0	103	0	0
	MP	Montebello Islands	1	0	0	106	0	0
	KEF	Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	3	0	0	88	0	0
		Ancient coastline at 125 m depth contour	31	0	0	6	0	0
		Exmouth Plateau	36	0	0	6	0	0
		Continental Slope Demersal Fish Communities	77	6	0	2	33	0
	IMCRA	Northwest Shelf	87	31	10	2	2	2
		Pilbarra (offshore)	12	0	0	61	0	0
Winter	AMP	Argo-Rowley Terrace	43	19	0	11	17	0
		Gascoyne	9	0	0	11	0	0
		Montebello	10	0	0	7	0	0
	KEF	Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	4	0	0	20	0	0
		Ancient coastline at 125 m depth contour	25	0	0	3	0	0
		Exmouth Plateau	18	0	0	11	0	0
		Continental Slope Demersal Fish Communities	68	2	0	3	30	0
	IMCRA	Northwest Shelf	73	18	0	2	2	0
		Pilbarra (offshore)	11	0	0	5	0	0

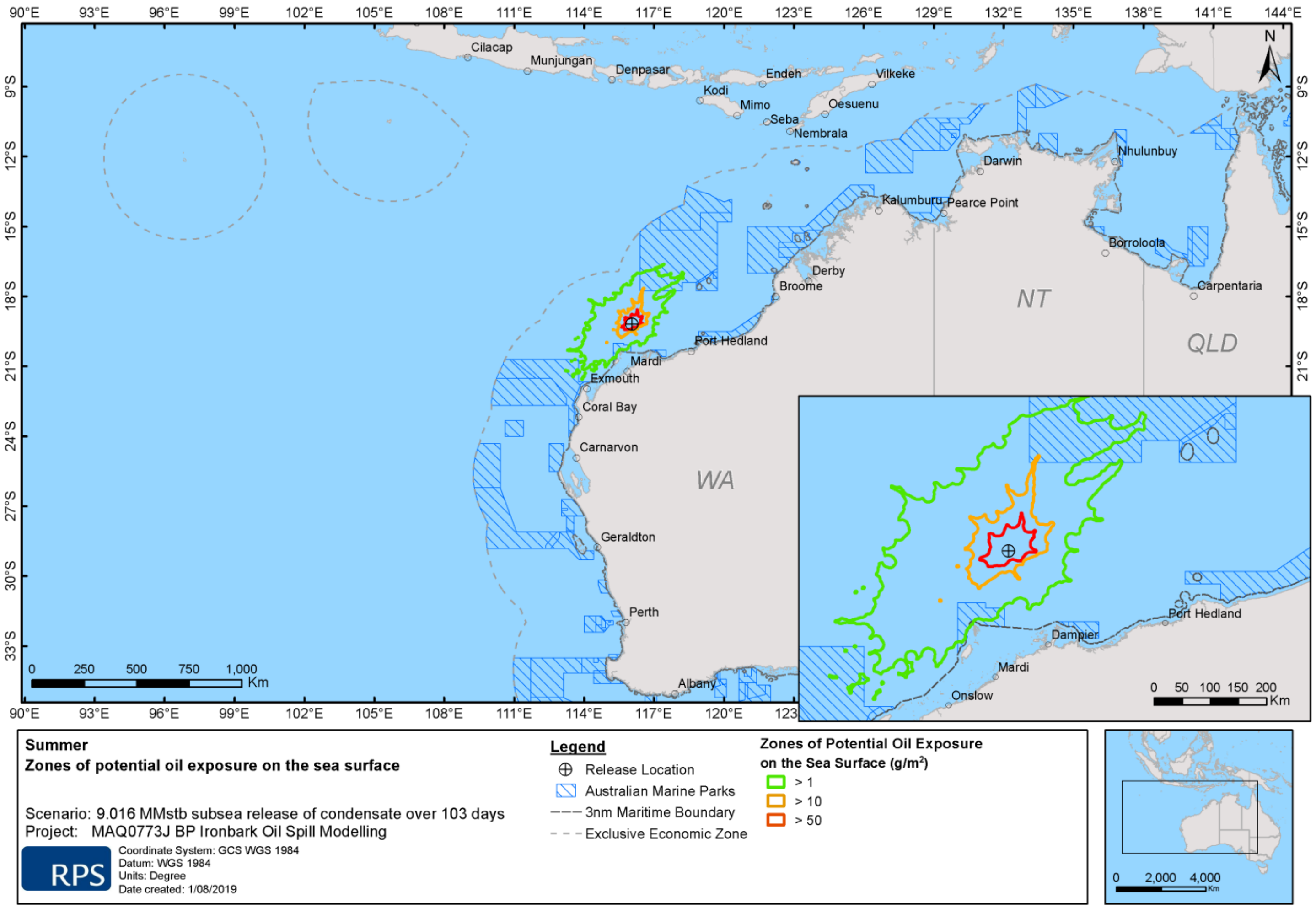

Figure 41 Zones of potential exposure on the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

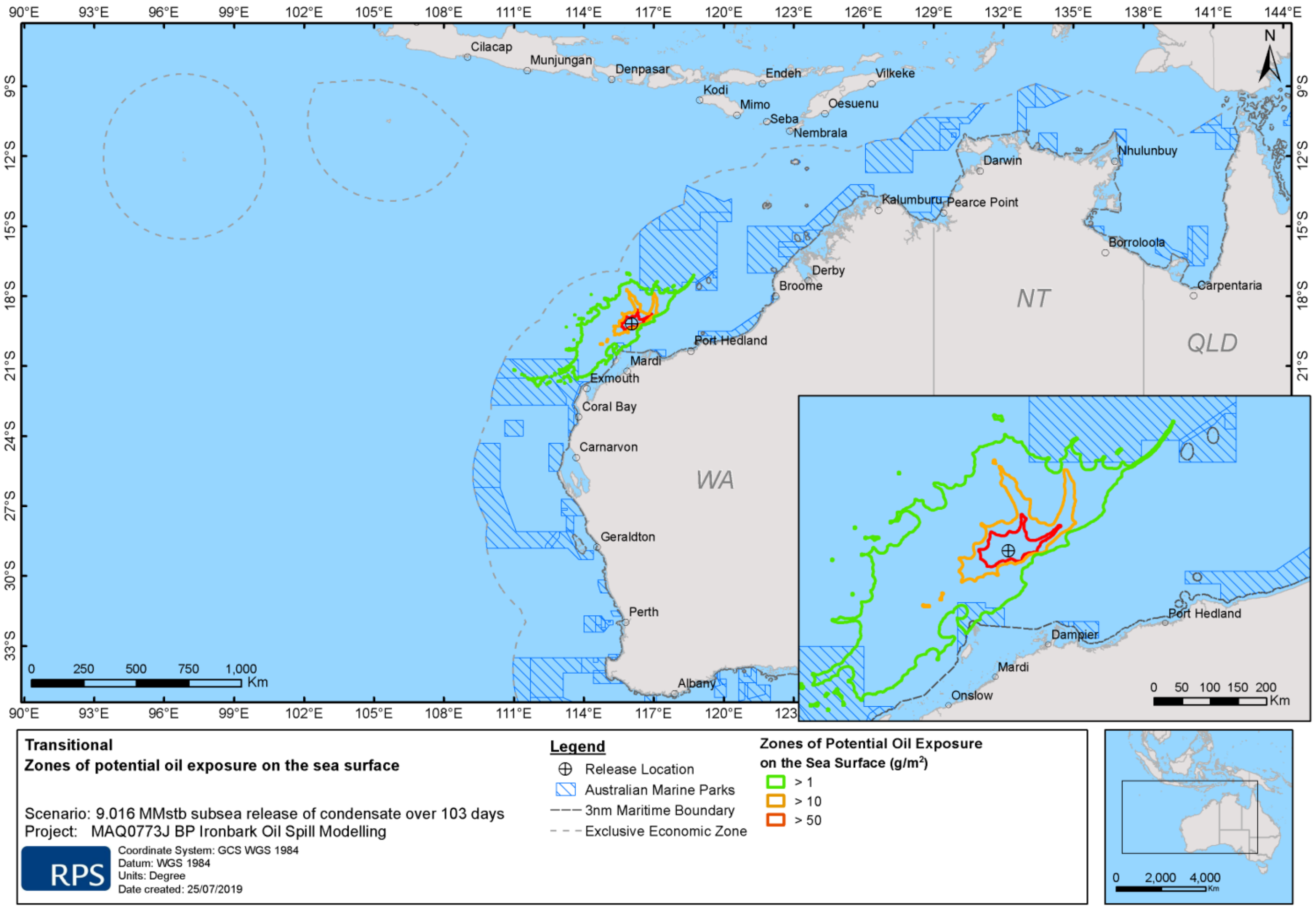

Figure 42 Zones of potential exposure on the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

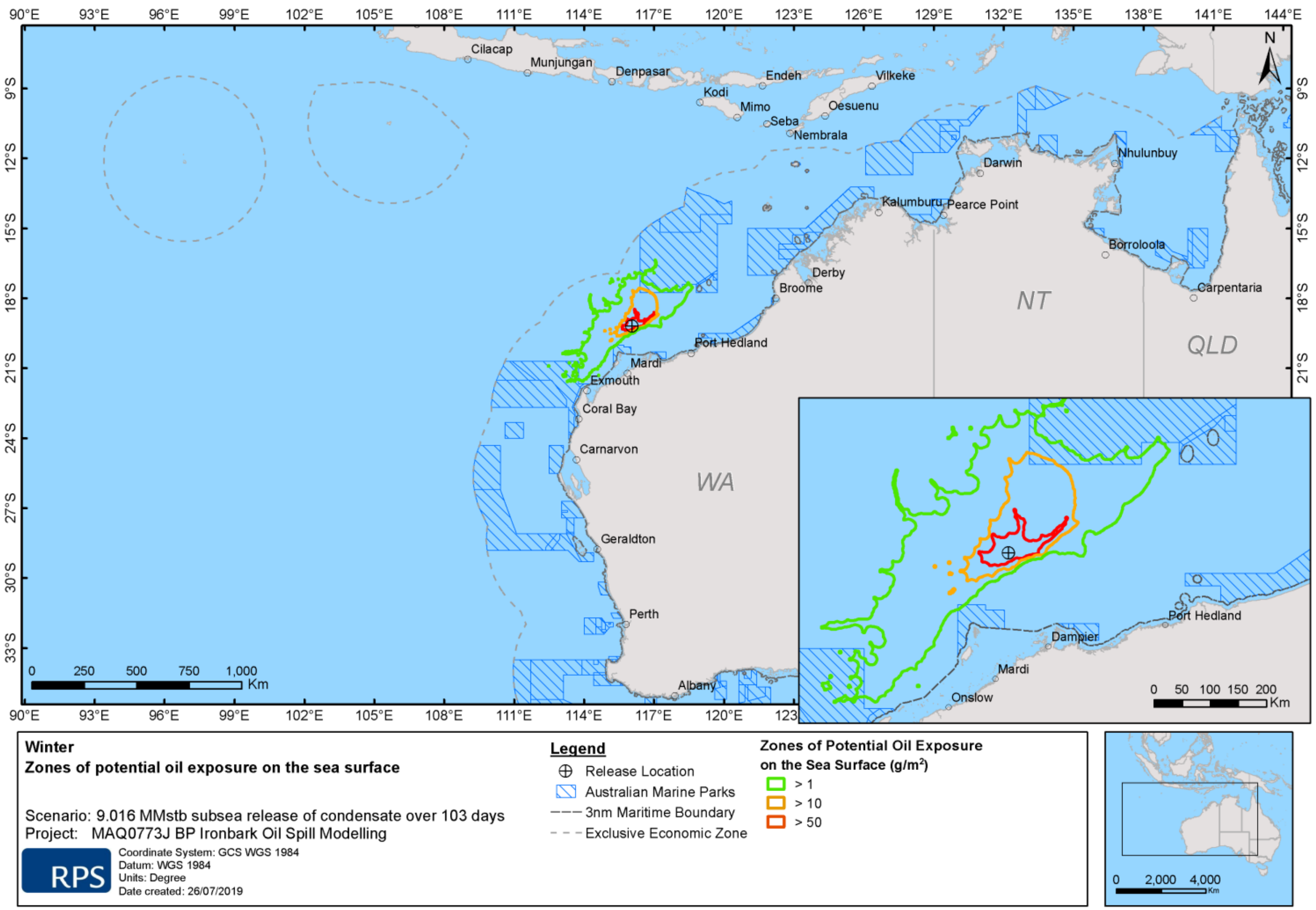

Figure 43 Zones of potential exposure on the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

10.2 Water Column Exposure

10.2.1 Dissolved Hydrocarbons

Table 21 to Table 23 summarise the maximum dissolved hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to receptors in the 0–10 m depth layer at or above the assigned exposure thresholds.

For the 48-hour time-averaged exposure window, the greatest predicted concentration at a receptor was 306 ppb (IMCRA – Northwest Shelf) for a simulation commencing under winter conditions. The maximum (48 hour) time-averaged concentrations at the IMCRA Northwest Shelf KEF under summer and transitional conditions was 220 ppb and 173 ppb, respectively.

Based on the 1-hour exposure window, the Continental Slope Demersal Fish Communities KEF receptor recorded the greatest dissolved hydrocarbon concentration of 2,890 ppb during transitional conditions. The probability of dissolved hydrocarbon exposure at the Continental Slope Demersal Fish Communities KEF was recorded as 97% (summer) and 100% (transitional) at low exposure threshold, 43% (summer) and 70% (transitional) at the moderate exposure threshold and 1% (summer) and 11% (transitional) at the high exposure threshold.

Zones of potential dissolved hydrocarbon exposure based on 48 hour time exposure window for each season for the 0–10 m, 10–20 m and 20-30 m depth layers are shown in Figure 44 to Figure 52.

Zones of potential dissolved hydrocarbon exposure based on the 1 hour exposure window are presented for each season in Figure 53 to Figure 61 for the 0–10, 10–20 m and 20-30 m depth layers, respectively.

RPS

Table 21 Probability of exposure to receptors from dissolved hydrocarbons (for 1 hour and 48-hour exposure windows) in the 0–10 m depth layer below the sea surface. Results are based on a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

Summer Receptor		Maximum dissolved hydrocarbon exposure (ppb) for 48-hour window	Probability of time-averaged dissolved hydrocarbon exposure for 48-hour window			Maximum dissolved hydrocarbon exposure (ppb) for 1-hour window	Probability of dissolved hydrocarbon exposure for 1-hour window		
			Low	Moderate	High		Low	Moderate	High
IMCRA	Northwest Shelf	220	38	5	0	2,072	87	71	7
	Pilbarra (offshore)	34	1	0	0	360	25	3	-
	Ningaloo	1	0	0	0	13	1	-	-
AMP	Argo-Rowley Terrace	11	1	0	0	300	25	4	-
	Gascoyne	2	0	0	0	56	3	1	-
	Montebello	24	1	0	0	360	18	2	-
	Ningaloo	1	0	0	0	13	1	-	-
RSB	Tryal Rocks	1	0	0	0	10	1	-	-
	Rankin Bank	26	1	0	0	177	27	2	-
	Glomar Shoal	1	0	0	0	11	1	-	-
KEF	Glomar Shoals	9	0	0	0	92	3	1	-
	Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	2	0	0	0	30	2	-	-
	Ancient coastline at 125 m depth contour	71	22	1	0	820	60	24	1
	Exmouth Plateau	7	0	0	0	101	8	1	-

	Commonwealth waters adjacent to Ningaloo Reef	1	0	0	0	13	1	-	-
	Continental Slope Demersal Fish Communities	53	18	1	0	1,005	97	43	1

RPS

Table 22 Probability of exposure to receptors from dissolved hydrocarbons (for 1 hour and 48-hour exposure windows) in the 0–10 m depth layer below the sea surface. Results are based on a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

Transitional	Receptor	Maximum dissolved hydrocarbon exposure (ppb) for 48-hour window	Probability of time-averaged dissolved hydrocarbon exposure for 48-hour window			Maximum dissolved hydrocarbon exposure (ppb) for 1-hour window	Probability of dissolved hydrocarbon exposure for 1-hour window		
			Low	Moderate	High		Low	Moderate	High
NEAR-SHORE	Sunday Island	5	-	-	-	63	1	1	-
	Murion Islands	6	-	-	-	105	3	1	-
	Flat Island	4	-	-	-	45	1	-	-
	Peak Island	4	-	-	-	66	2	1	-
	Exmouth	2	-	-	-	14	1	-	-
IMCRA	Northwest Shelf	173	42	10	-	1,911	78	49	3
	Pilbarra (offshore)	39	4	-	-	736	36	6	1
	Pilbarra (nearshore)	2	-	-	-	14	1	-	-
	Ningaloo	5	-	-	-	55	3	1	-
IBRA	Cape Range	6	-	-	-	105	3	1	-
AMP	Argo-Rowley Terrace	25	1	-	-	329	13	6	-
	Gascoyne	2	-	-	-	94	4	1	-
	Montebello	16	1	-	-	130	18	2	-
MMA	Muiron Islands	12	1	-	-	139	3	1	-
AMP	Ningaloo	2	-	-	-	55	3	1	-
MP	Ningaloo	5	-	-	-	39	2	-	-

RPS

State Waters	Western Australia State Waters	12	1	-	-	157	3	1	-
RSB	Rankin Bank	6	-	-	-	60	13	1	-
	Ningaloo Reef	1	-	-	-	14	1	-	-
KEF	Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	3	-	-	-	92	3	1	-
	Ancient coastline at 125 m depth contour	152	13	1	-	1,406	66	20	1
	Exmouth Plateau	68	3	1	-	869	29	11	1
	Commonwealth waters adjacent to Ningaloo Reef	2	-	-	-	55	3	1	-
	Continental Slope Demersal Fish Communities	109	23	2	-	2,890	100	70	11

RPS

Table 23 Probability of exposure to receptors from dissolved hydrocarbons (for 1 hour and 48-hour exposure windows) in the 0–10 m depth layer below the sea surface. Results are based on a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

Winter	Receptor	Maximum dissolved hydrocarbon exposure (ppb) for 48-hour window	Probability of time-averaged dissolved hydrocarbon exposure for 48-hour window			Maximum dissolved hydrocarbon exposure (ppb) for 1-hour window	Probability of dissolved hydrocarbon exposure for 1-hour window		
			Low	Moderate	High		Low	Moderate	High
NEAR-SHORE	Observation Island	2	-	-	-	18	1	-	-
	Sunday Island	5	-	-	-	59	2	1	-
	Murion Islands	4	-	-	-	59	4	1	-
	Flat Island	12	1	-	-	46	2	-	-
	Peak Island	2	-	-	-	39	4	-	-
	Serrurier Island	2	-	-	-	43	2	-	-
	Bessieres Island	3	-	-	-	35	1	-	-
IMCRA	Northwest Shelf	306	42	10	-	2,129	97	78	7
	Pilbarra (offshore)	40	3	-	-	1,033	32	10	2
	Pilbarra (nearshore)	4	-	-	-	48	2	-	-
	Ningaloo	3	-	-	-	52	5	1	-
IBRA	Cape Range	12	1	-	-	59	4	1	-
AMP	Argo-Rowley Terrace	9	-	-	-	161	16	3	-
	Gascoyne	5	-	-	-	92	2	1	-
	Montebello	25	2	-	-	240	21	5	-
MMA	Muiron Islands	5	-	-	-	105	4	1	-

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AMP	Ningaloo	3	-	-	-	51	3	1	-
MP	Ningaloo	2	-	-	-	56	2	1	-
State Waters	Western Australia State Waters	15	1	-	-	204	6	2	-
RSB	Rankin Bank	12	1	-	-	95	27	2	-
	Hood Reef	1	-	-	-	20	1	-	-
KEF	Glomar Shoals	1	-	-	-	11	1	-	-
	Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	1	-	-	-	22	1	-	-
	Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	4	-	-	-	75	5	1	-
	Ancient coastline at 125 m depth contour	126	12	3	-	1,001	62	20	2
	Exmouth Plateau	9	-	-	-	72	6	1	-

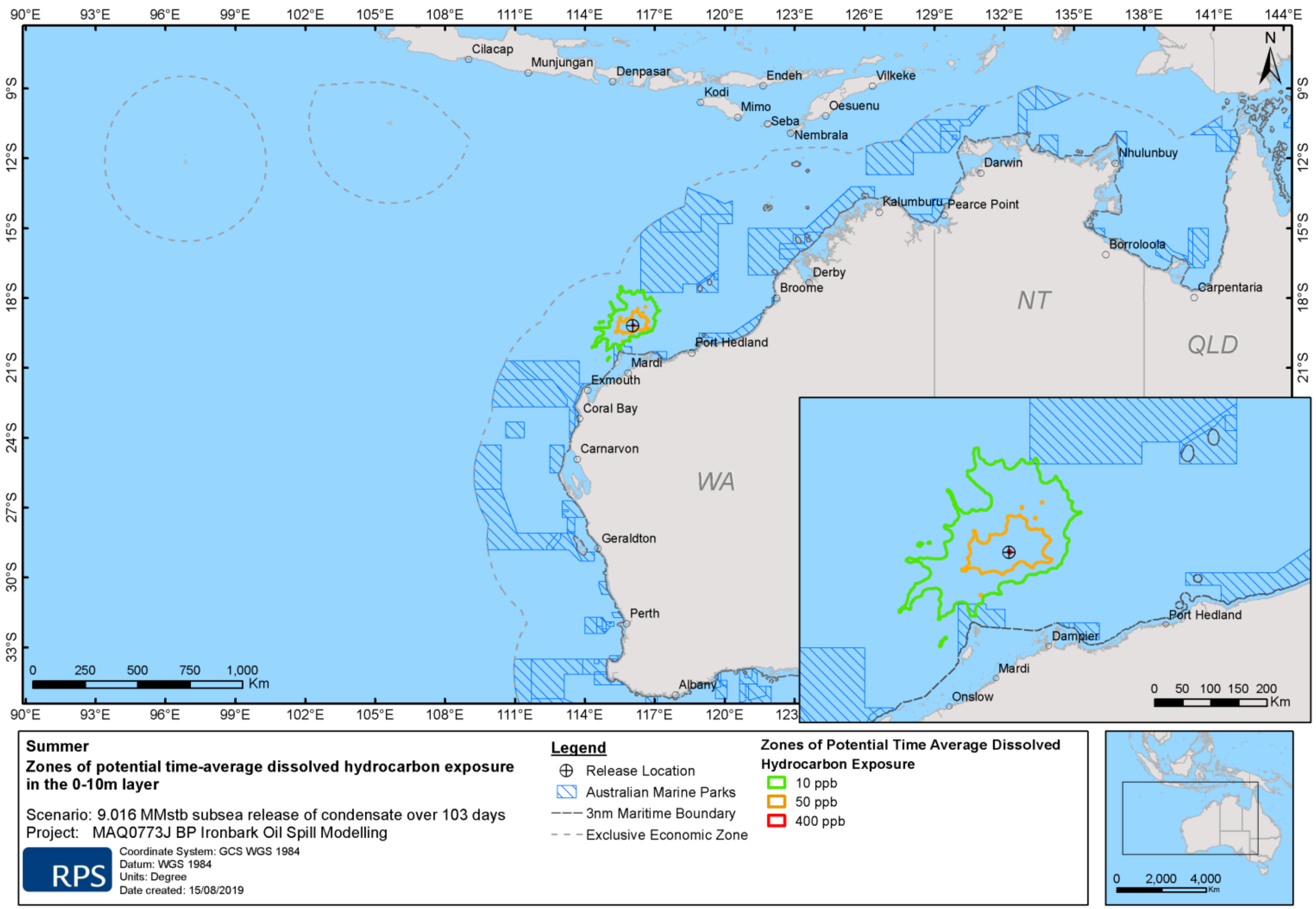

Figure 44 Zones of potential dissolved hydrocarbon exposure based on a 48 hour window at 0–10 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

RPS

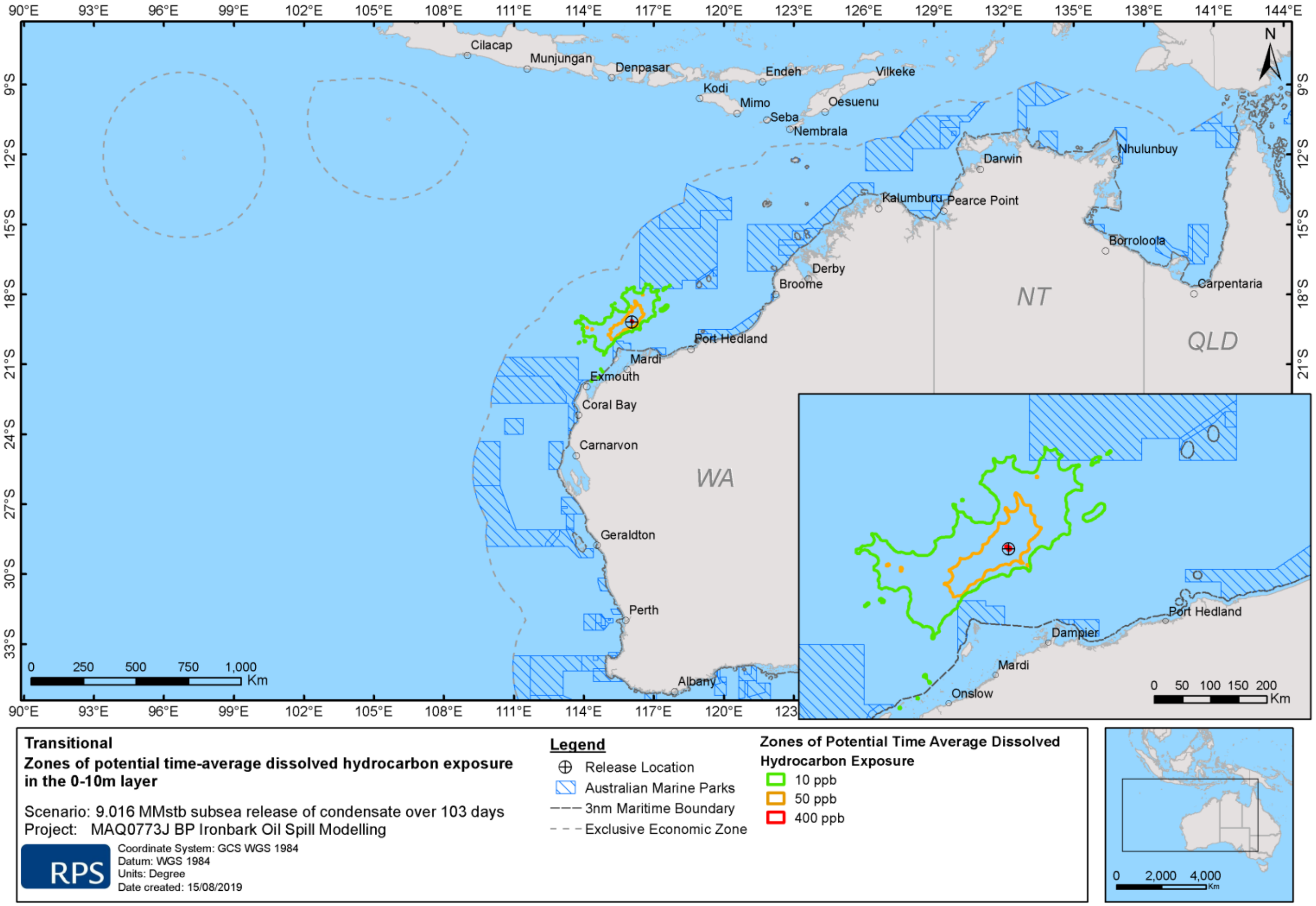

Figure 45 Zones of potential dissolved hydrocarbon exposure based on a 48 hour window at 0–10 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

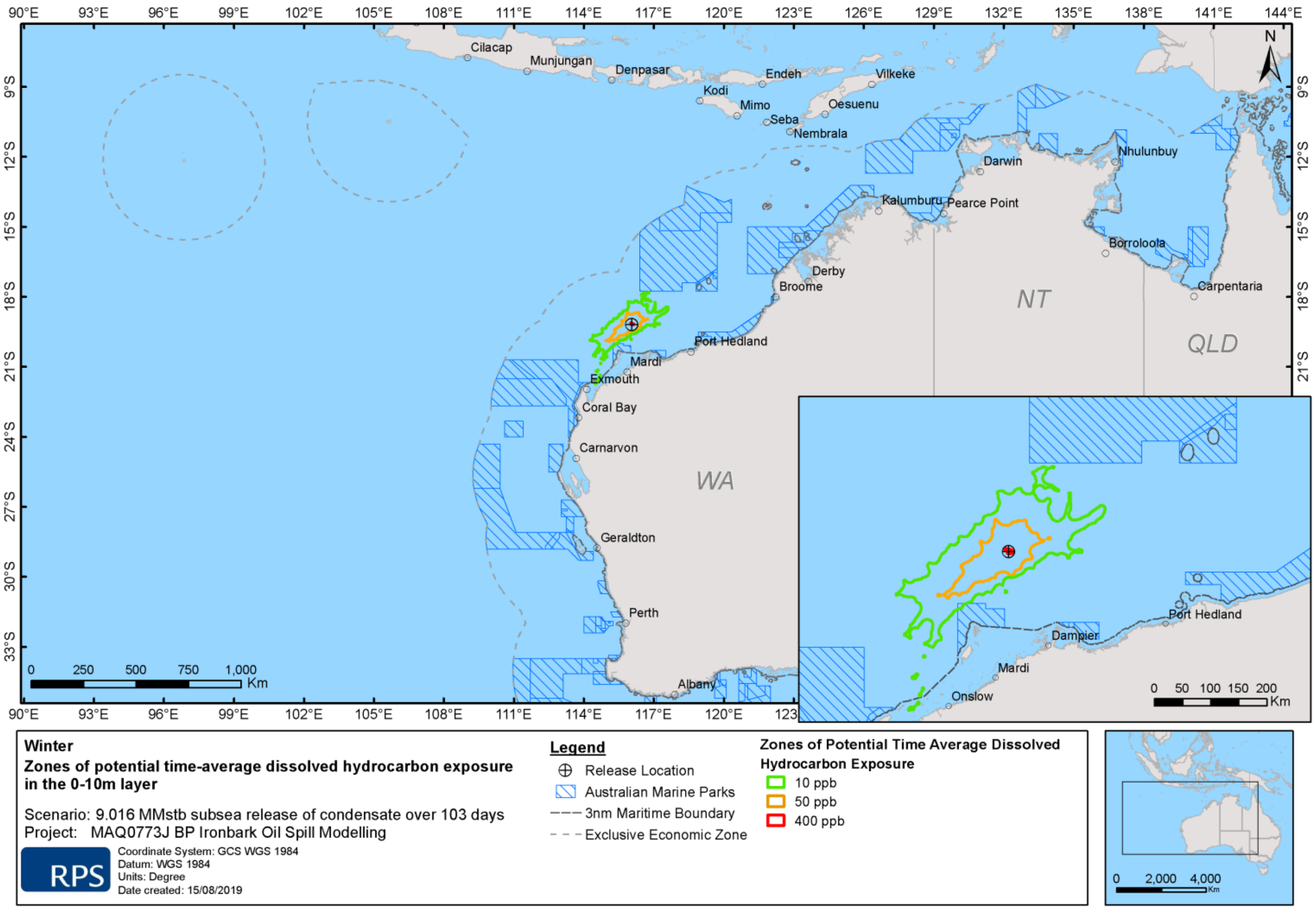

Figure 46 **Zones of potential dissolved hydrocarbon exposure based on a 48 hour window at 0–10 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.**

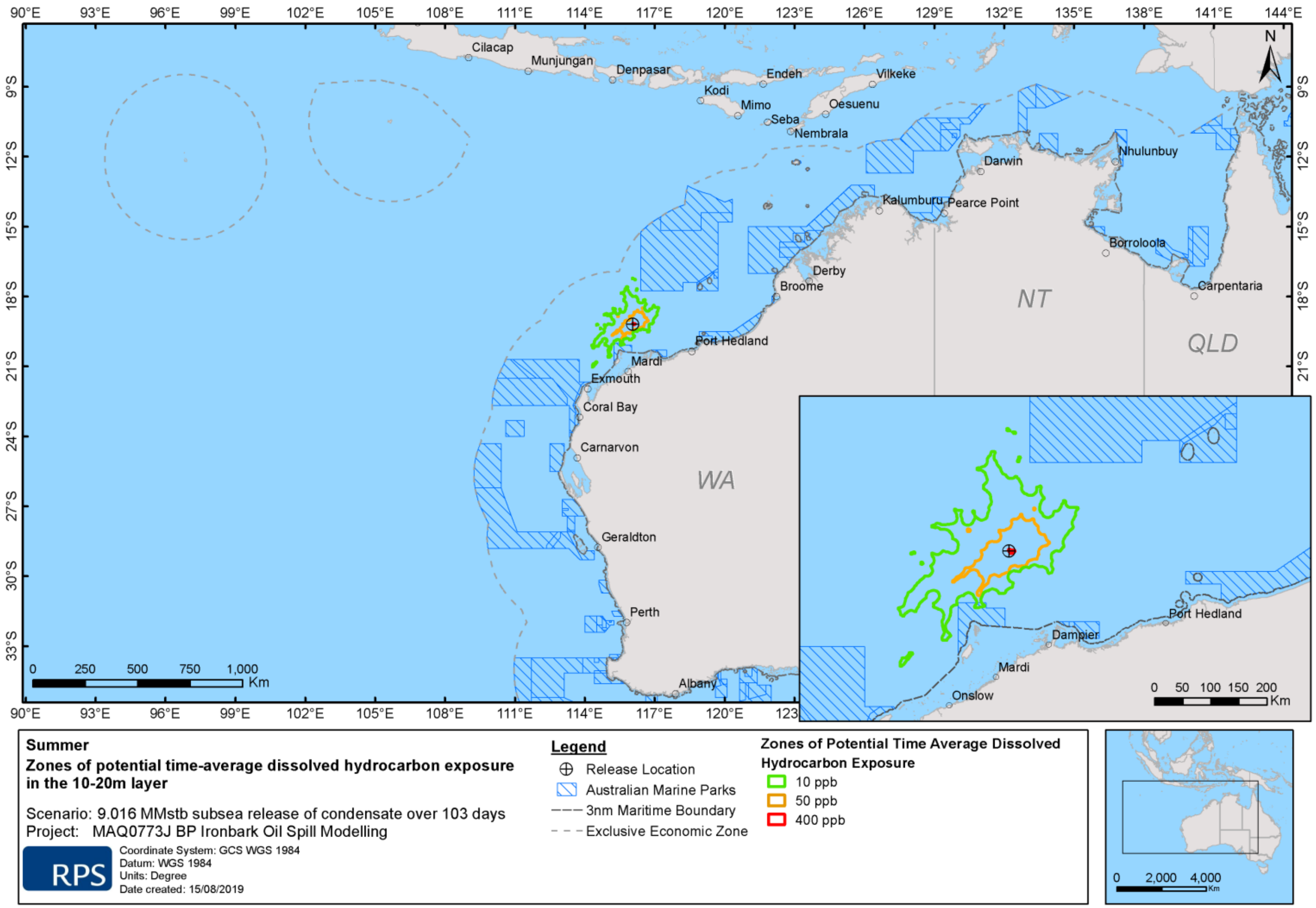

Figure 47 Zones of potential dissolved hydrocarbon exposure based on a 48 hour window at 10–20 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

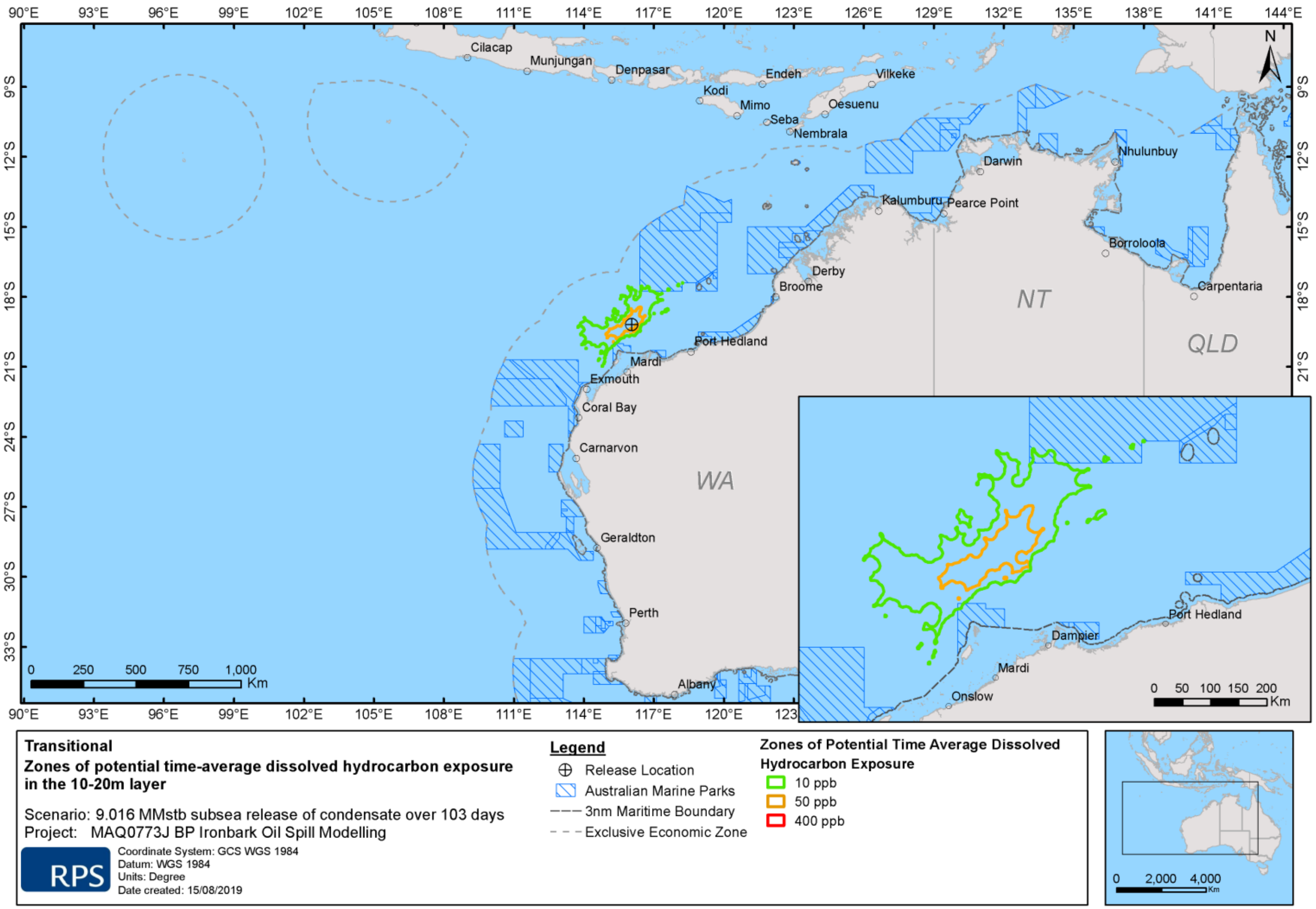

Figure 48 Zones of potential dissolved hydrocarbon exposure based on a 48 hour window at 10–20 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

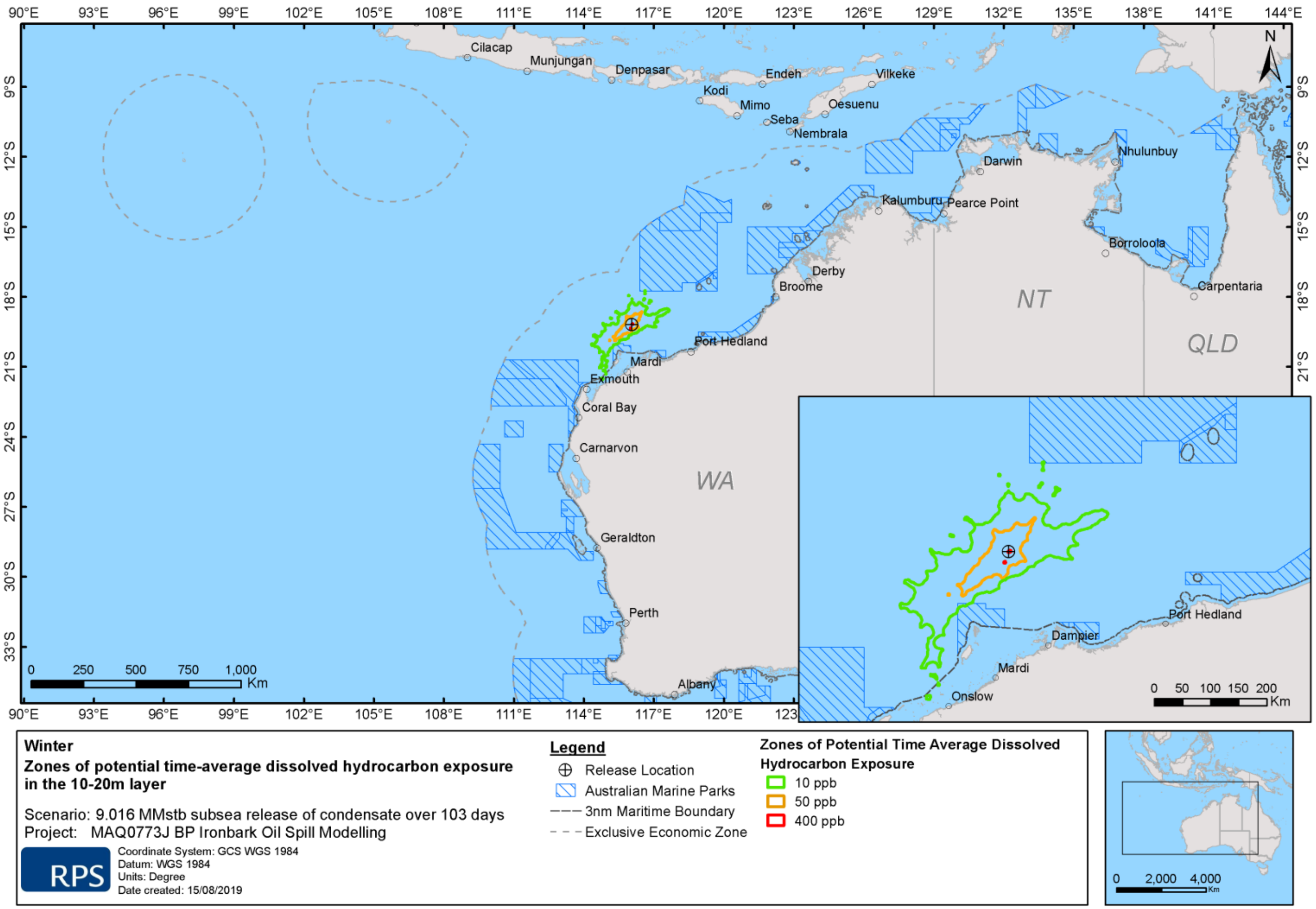

Figure 49 Zones of potential dissolved hydrocarbon exposure based on a 48 hour window at 10–20 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

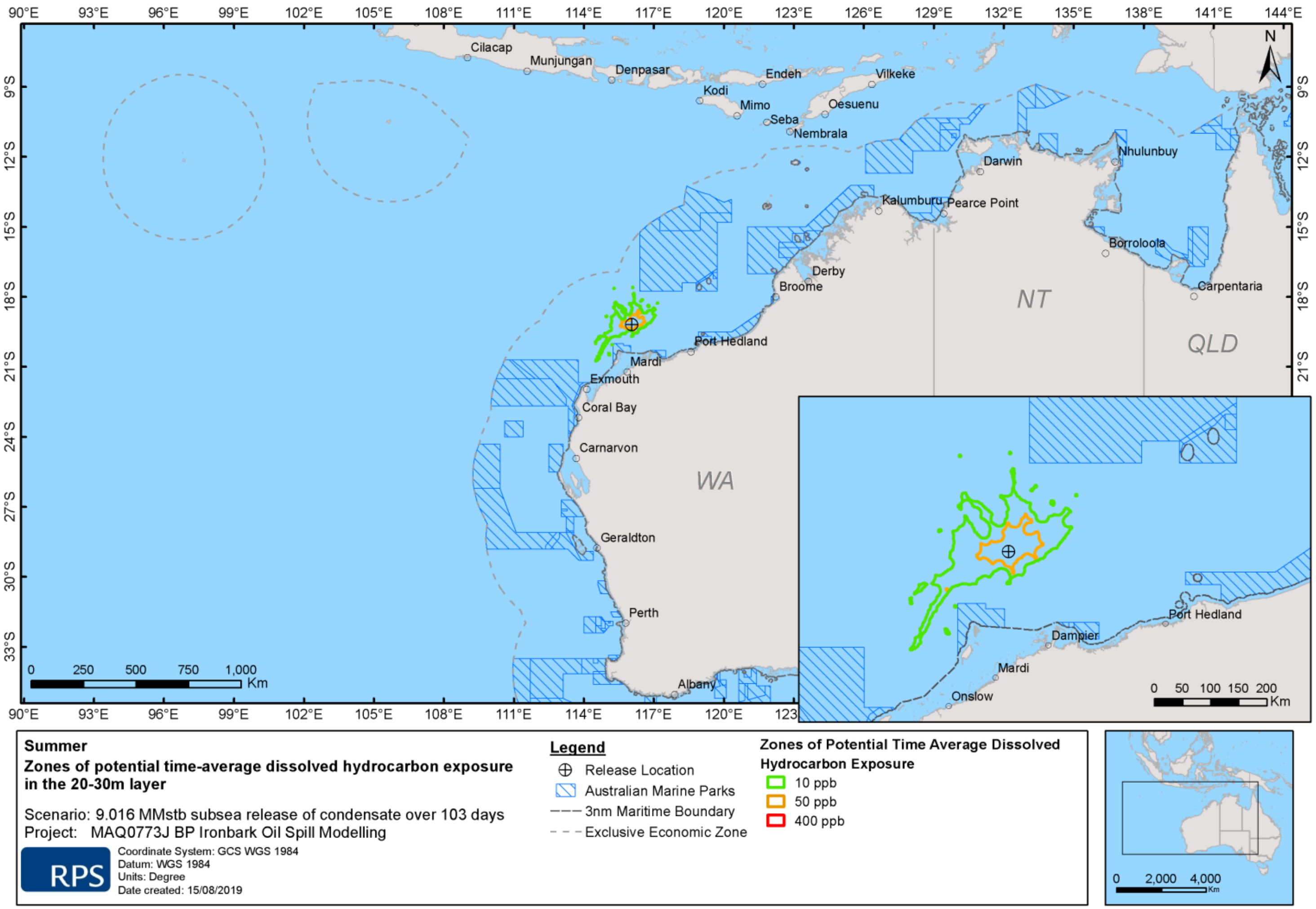

Figure 50 Zones of potential dissolved hydrocarbon exposure based on a 48 hour window at 20–30 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

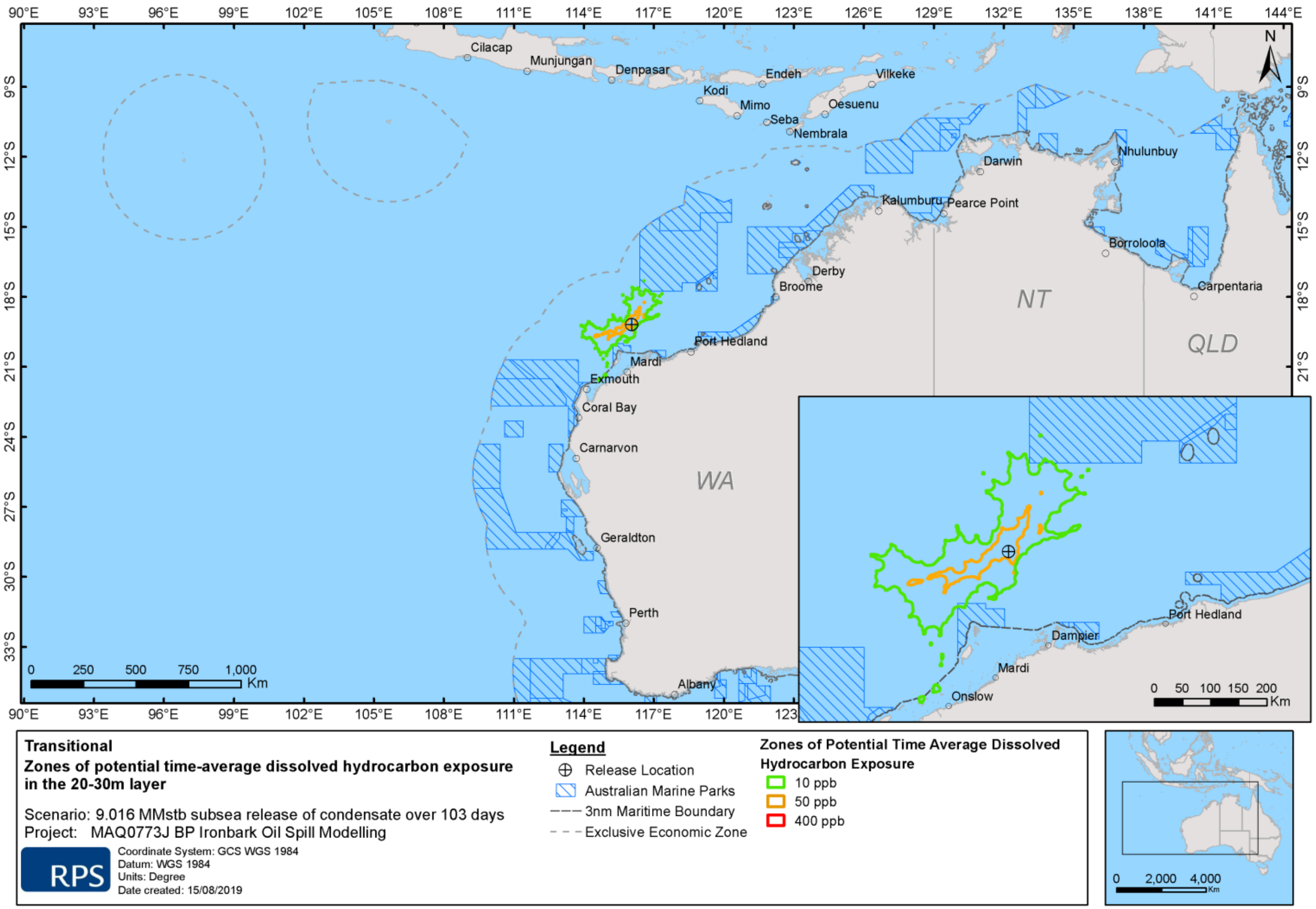

Figure 51 Zones of potential dissolved hydrocarbon exposure based on a 48 hour window at 20–30 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

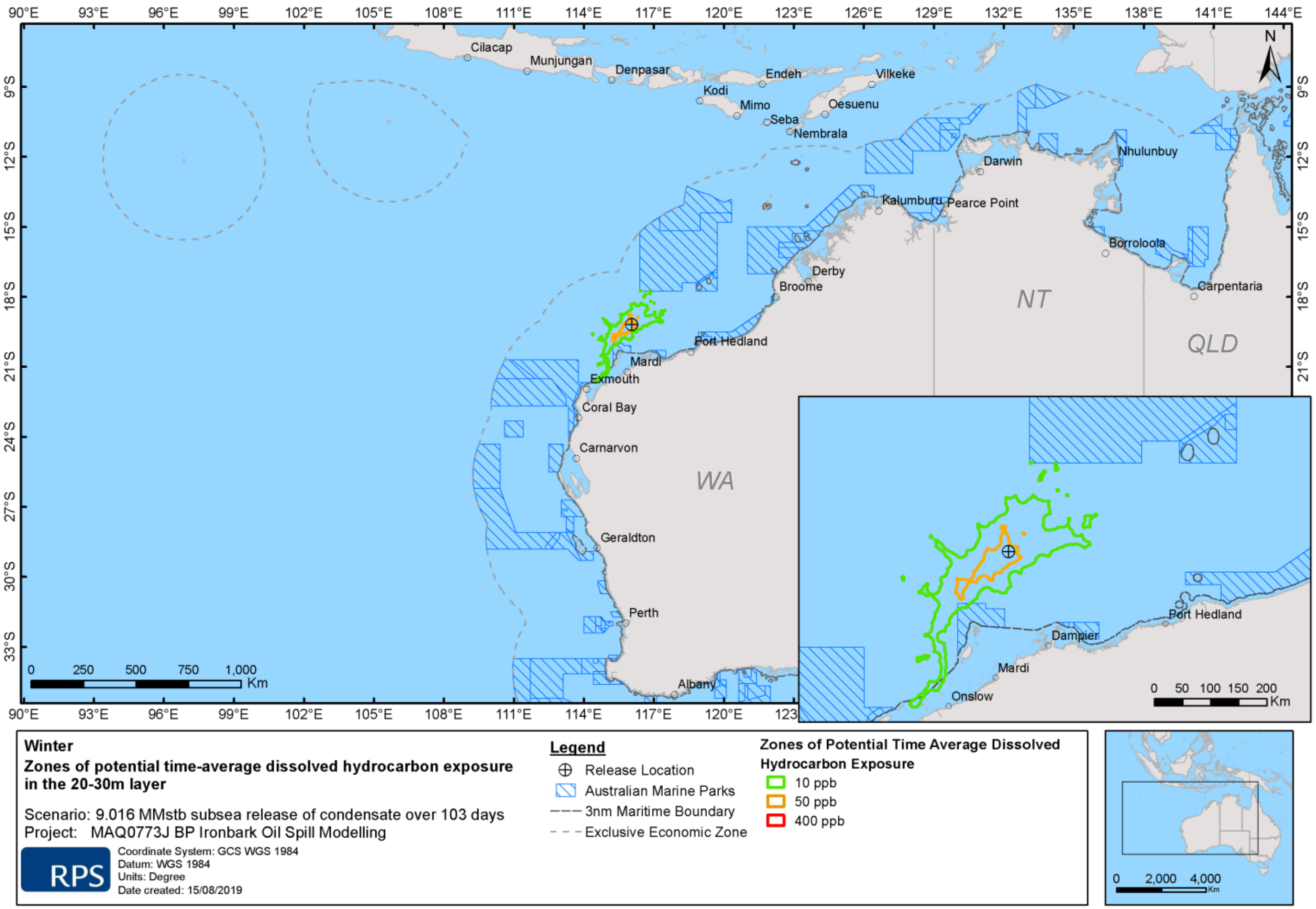

Figure 52 Zones of potential dissolved hydrocarbon exposure based on a 48 hour window at 20–30 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

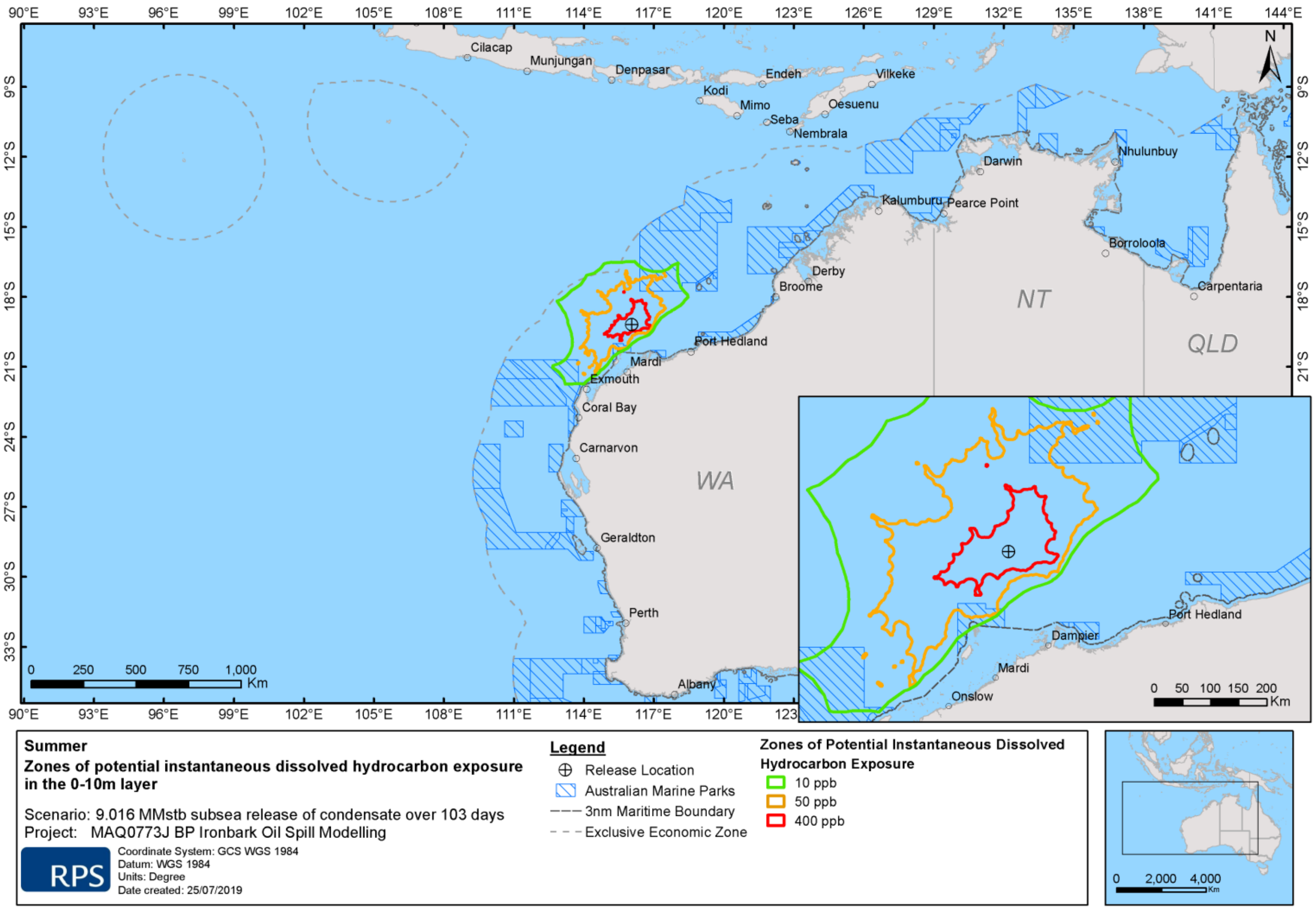

Figure 53 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 0–10 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

RPS

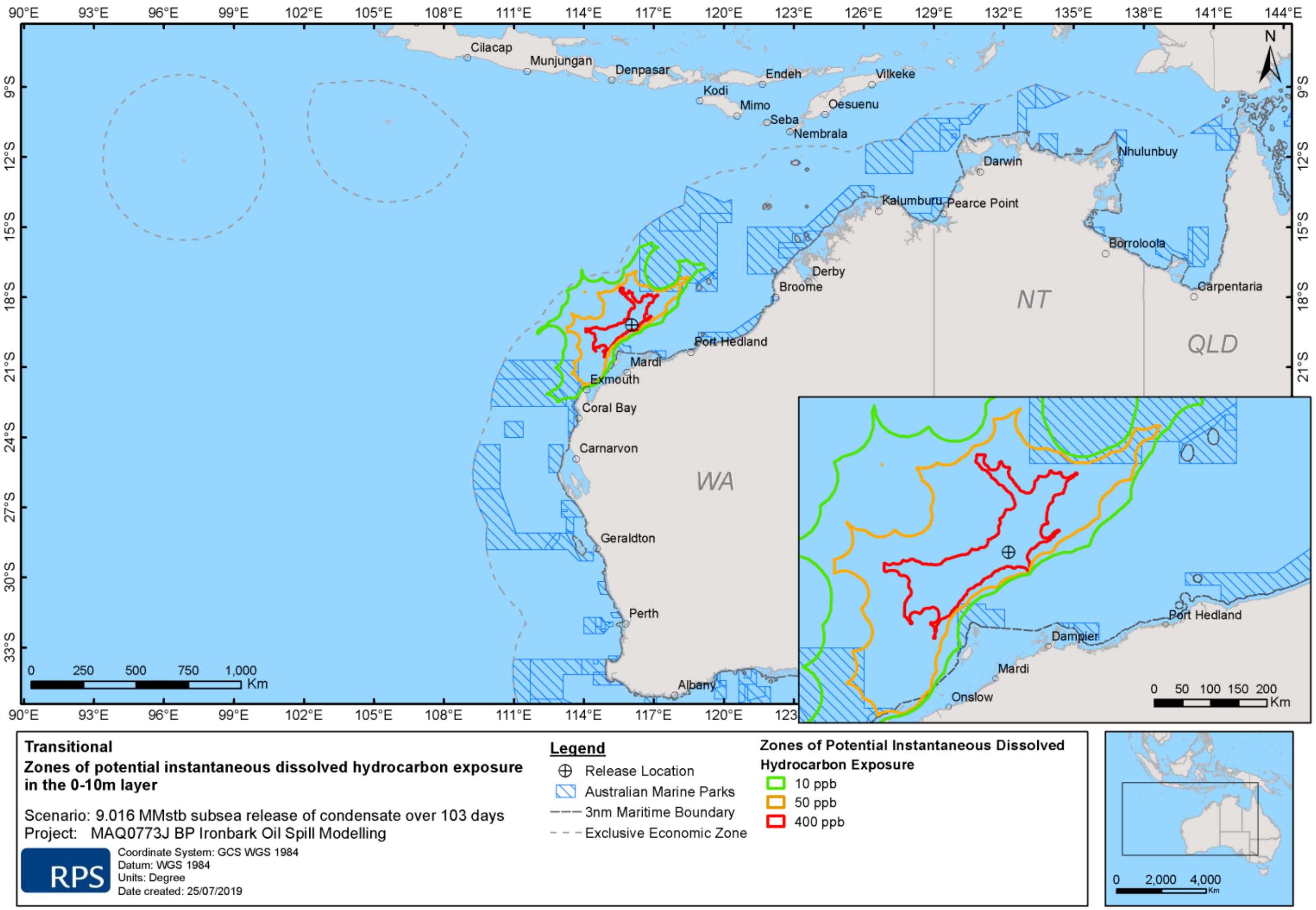

Figure 54 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 0–10 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

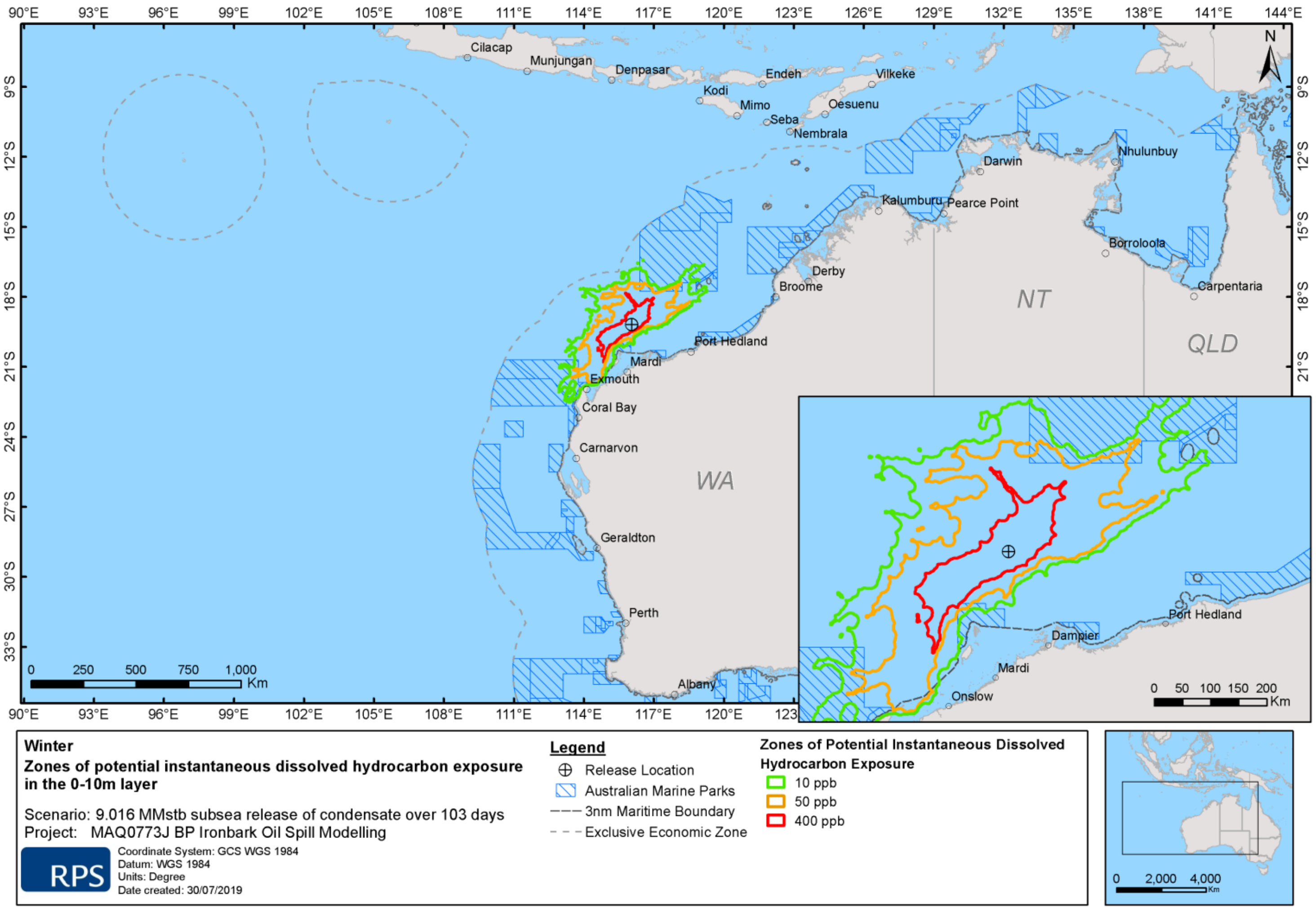

Figure 55 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 0–10 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

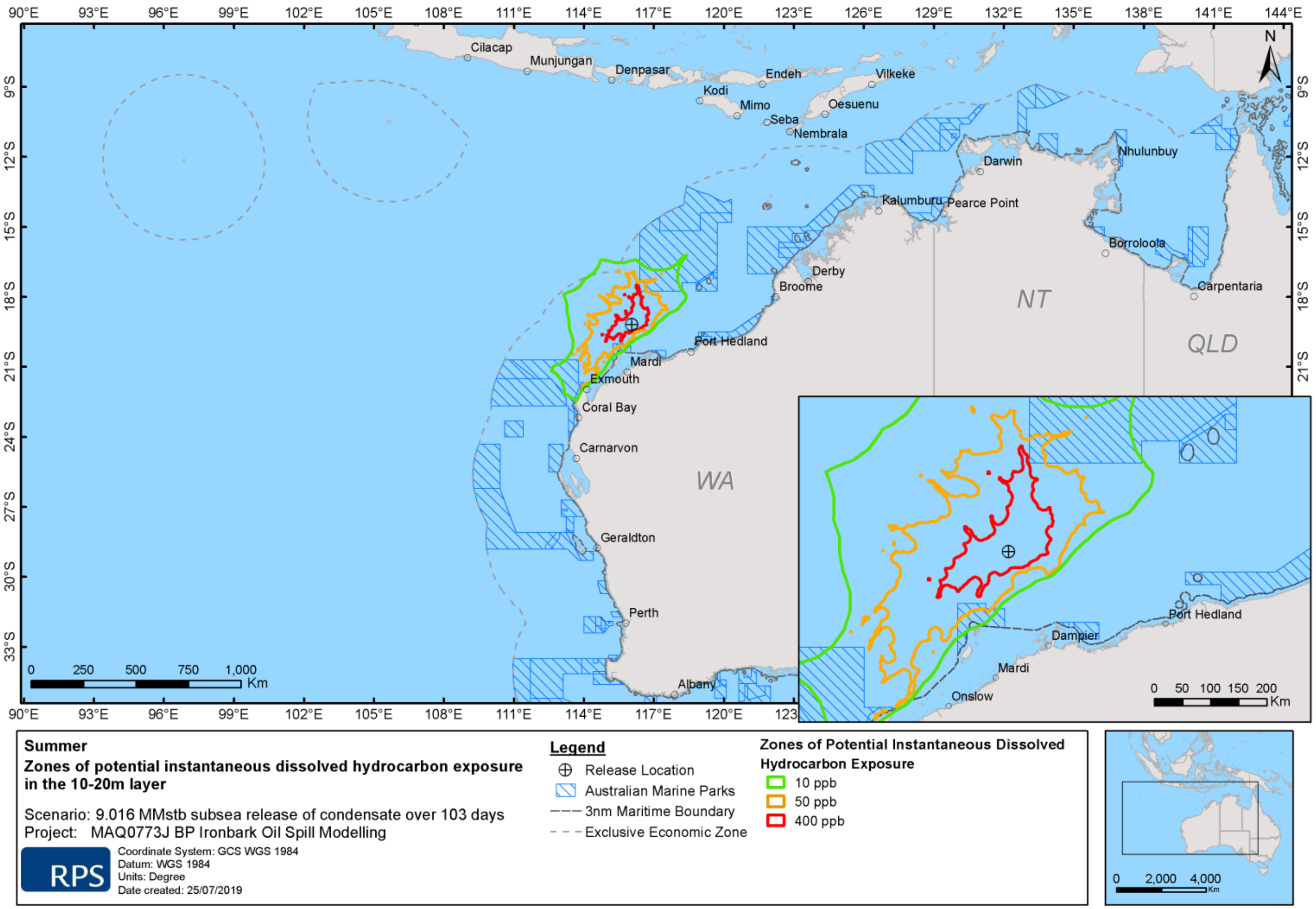

Figure 56 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 10–20 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

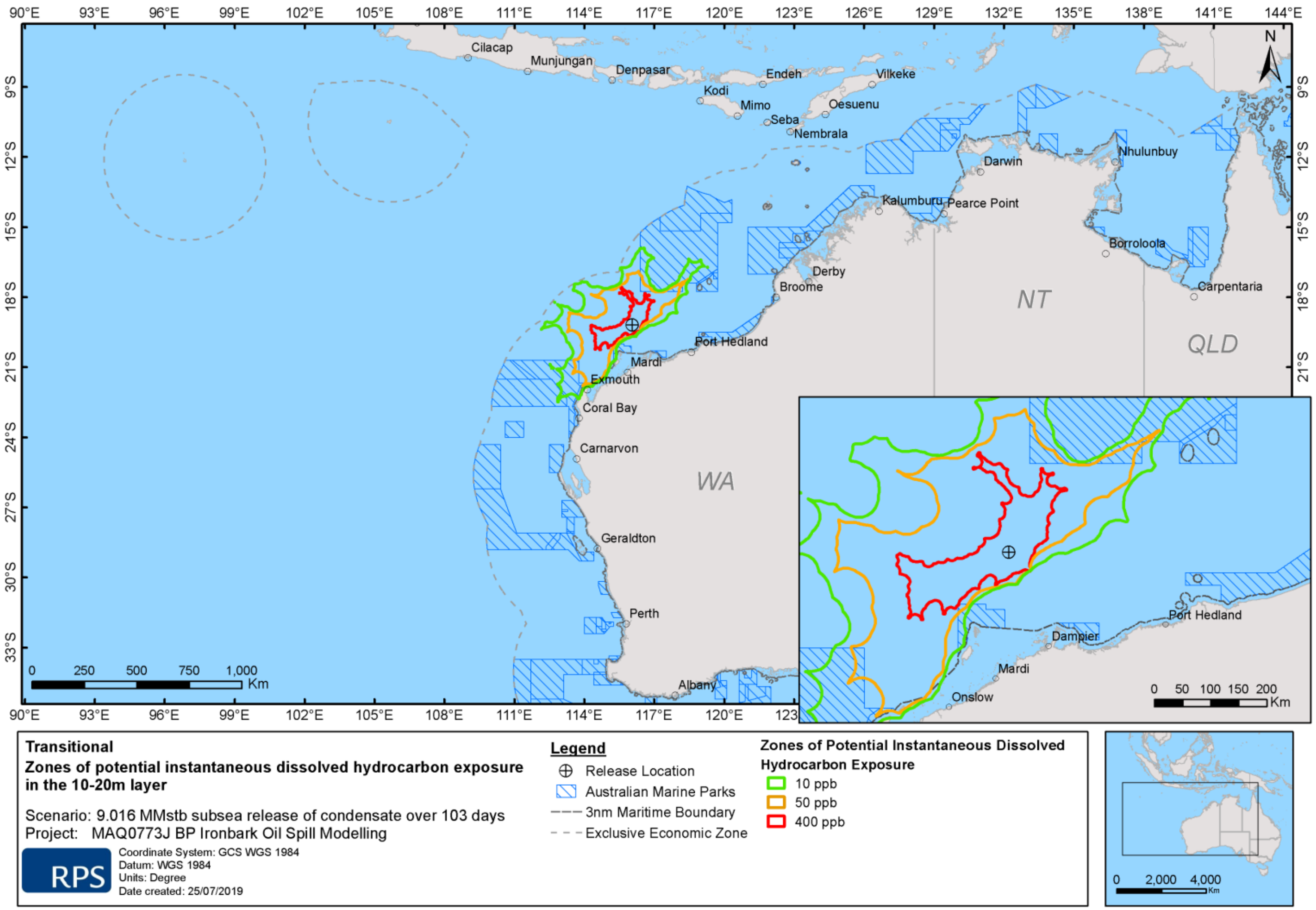

Figure 57 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 10–20 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

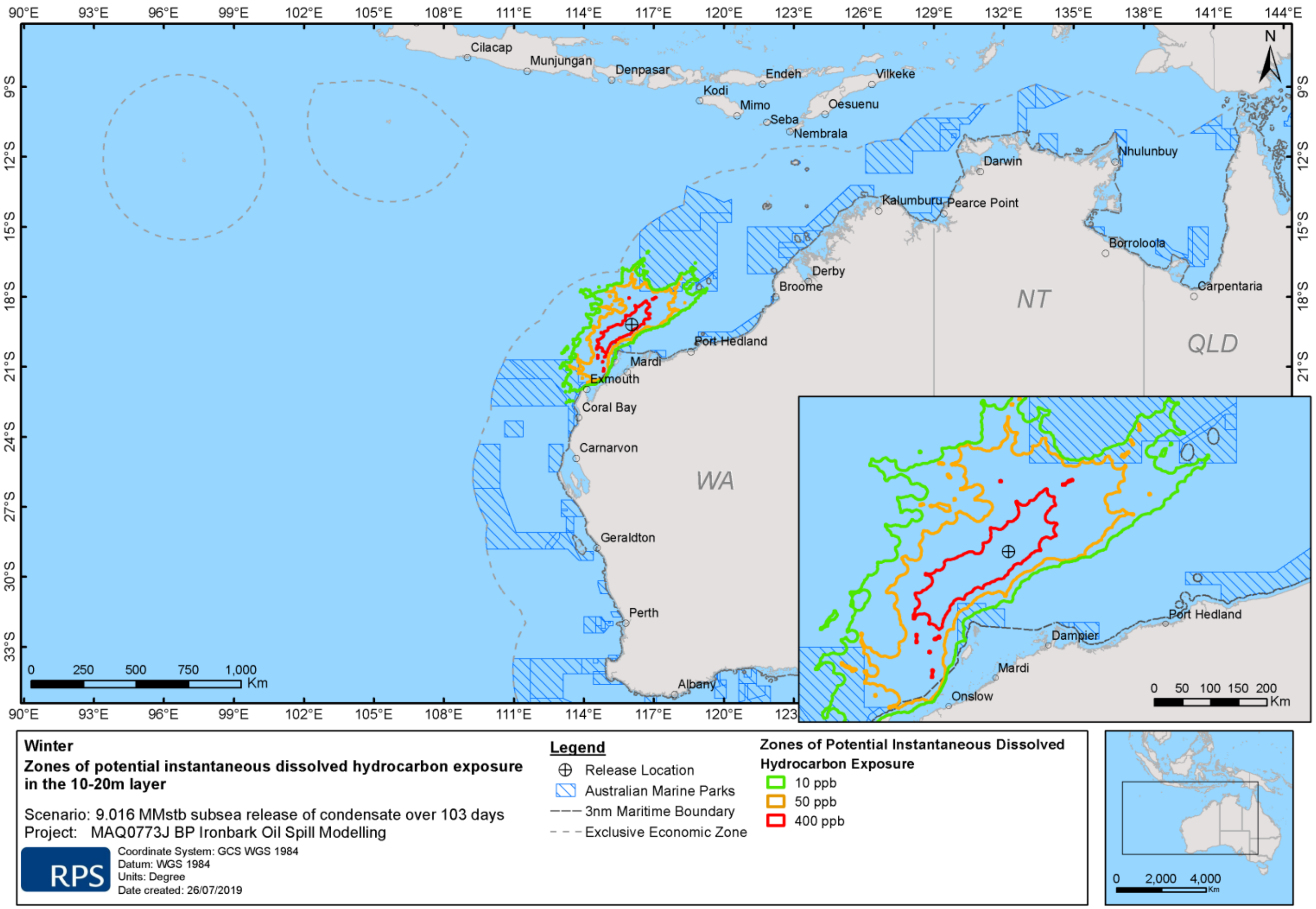

Figure 58 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 10–20 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

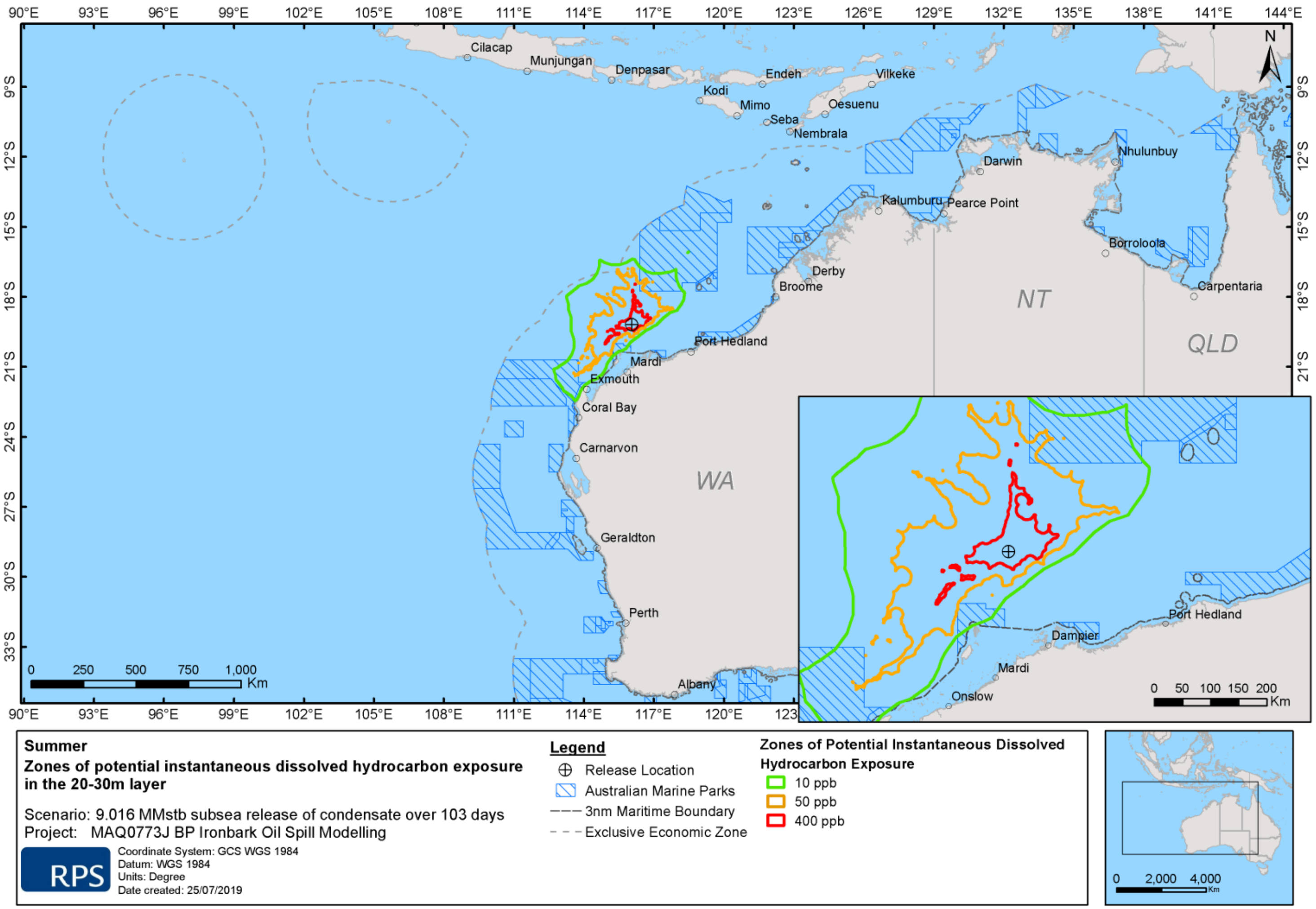

Figure 59 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 20–30 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

RPS

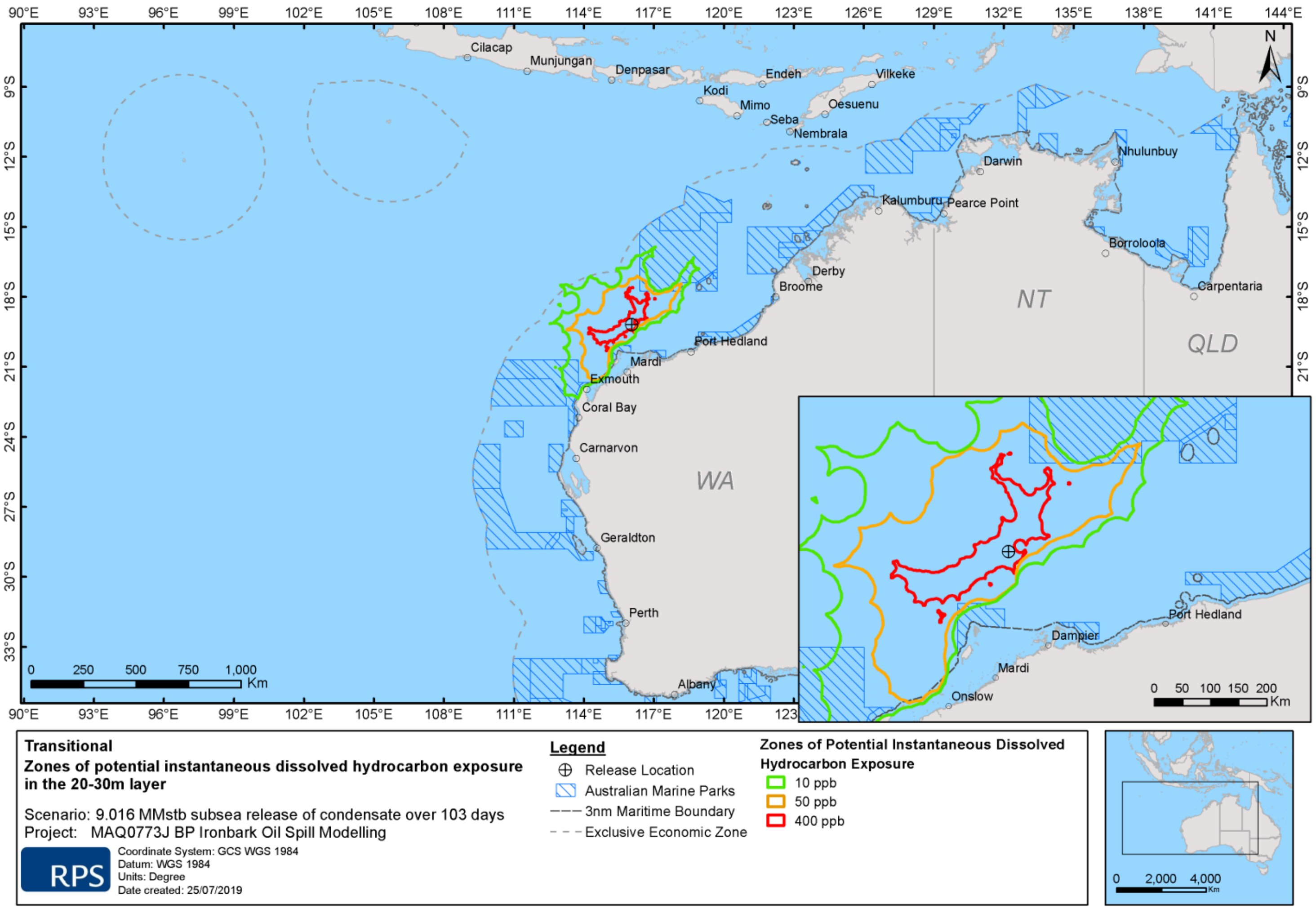

Figure 60 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 20–30 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

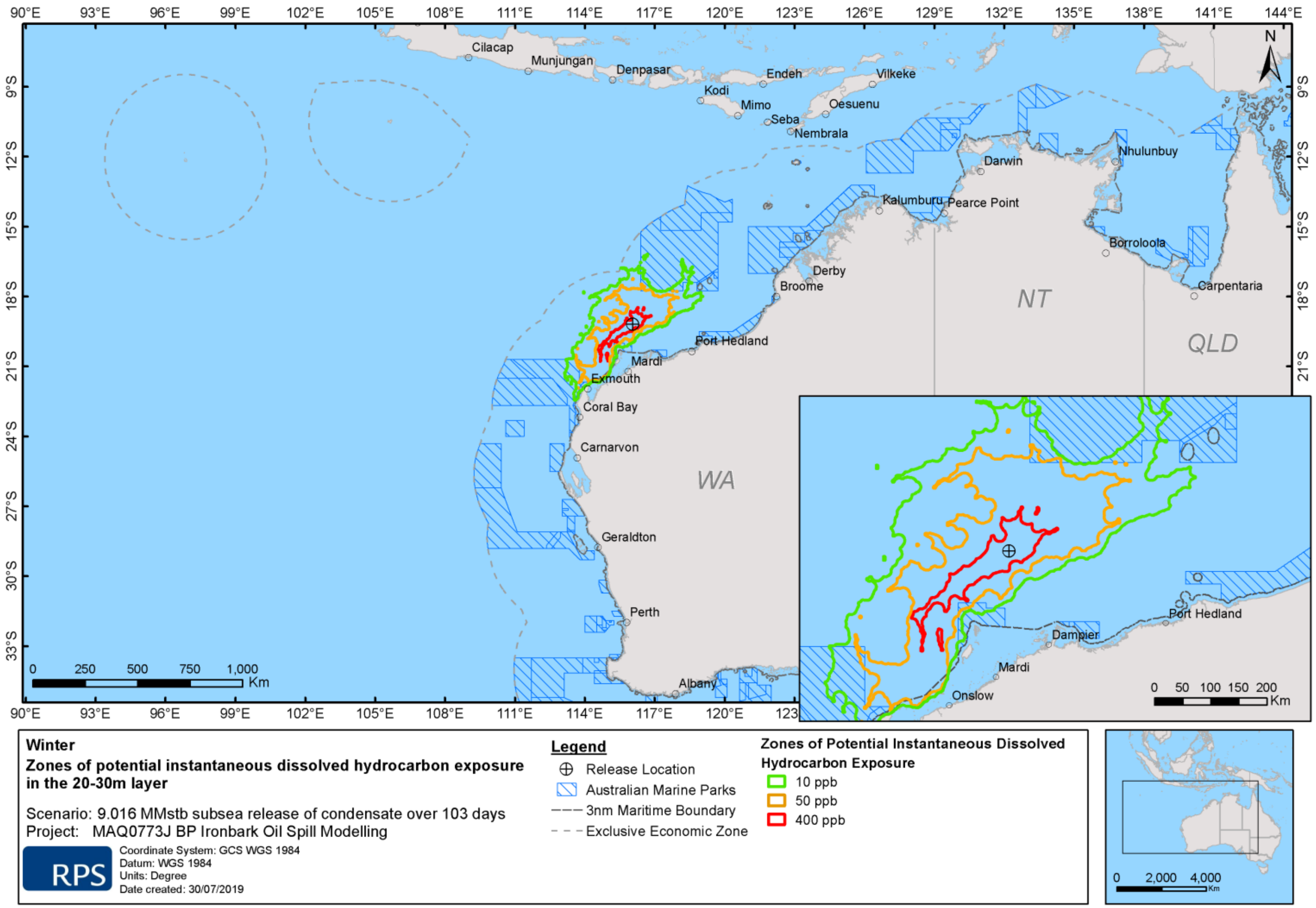

Figure 61 Zones of potential dissolved hydrocarbon exposure based on a 1 hour window at 20–30 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

10.2.2 Entrained Hydrocarbons

Table 24 to Table 26 summarise the maximum entrained hydrocarbon exposure (for 1 hour and 48-hour exposure windows) to receptors in the 0–10 m depth layer at or above the exposure thresholds discussed in Section 7.2 over the seasonal assessments.

For the 48 hour time-averaged exposure window, maximum entrained hydrocarbons were greatest at the IMCRA - Northwest Shelf. The maximum 48 hour time-averaged concentrations at the IMCRA Northwest Shelf ranged between 6,067 ppb (summer) and 3,445 ppb (winter).

The analysis for the entrained hydrocarbons over a 1 hour window showed that the maximum exposure was 12,087 ppb (IMCRA – Northwest Shelf) during transitional conditions, 12,045 ppb for summer conditions and 8,619 ppb for winter conditions.

Zones of potential entrained hydrocarbon exposure based on the 48 hour exposure window are presented for each season in Figure 62 to Figure 67 for the 0–10 m and 10–20 m depth layers, respectively.

Zones of potential entrained hydrocarbon exposure based on the 1 hour exposure window are presented for each season in Figure 68 to Figure 76 for the 0–10 m, 10–20 m and 20-30 m depth layers, respectively.

RPS

Table 24 Probability of exposure to receptors from entrained hydrocarbons (for 1 hour and 48-hour exposure windows) in the 0–10 m depth layer below the sea surface. Results are based on a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

Summer Receptor		Maximum entrained hydrocarbon exposure (ppb) over 48 hour window	Probability of time-averaged entrained hydrocarbon exposure over 48 hour window		Maximum entrained hydrocarbon exposure (ppb) over 1 hour window	Probability of instantaneous entrained hydrocarbon exposure over 1 hour window	
			Low	High		Low	High
NEAR-SHORE	Garden Island	2	-	-	12	1	-
	Pelsaert Group	2	-	-	13	1	-
	Easter Group	2	-	-	13	1	-
	Wallabi Group	4	-	-	19	3	-
	Dorre Island	3	-	-	15	2	-
	Bermier Island	2	-	-	12	1	-
	Airlie Island	167	4	4	336	8	4
	Mary Anne Group	69	4	-	130	6	2
	Passage Islands	22	4	-	65	6	-
	Boodie Island	366	4	4	540	21	4
	Middle Island	337	4	4	508	19	4
	Barrow Island	232	4	4	402	21	4
	Ragnard Islands	5	-	-	13	2	-
	Lowendal Island	60	4	-	84	5	-
	West Lewis Island	1	-	-	12	1	-
	Enderby Island	1	-	-	10	1	-

Hermite Island	167	4	3	362	17	4
Rosemary Island	2	-	-	12	1	-
Gidley Island	1	-	-	11	1	-
Legendre Island	1	-	-	10	1	-
Imperieuse Reef	96	47	-	163	59	15
Cunningham Island	88	52	-	155	61	3
Clerke Reef	77	58	-	138	68	16
Mermaid Reef	106	64	3	368	67	22
Lacepede Islands	2	-	-	11	1	-
Pulau Ndana	2	-	-	11	1	-
Pulau Dana	6	-	-	16	4	-
Pulau Sawu	3	-	-	11	1	-
Rivoli Islands	12	4	-	42	23	-
Fly Island	21	21	-	54	35	-
Observation Island	33	22	-	67	41	-
Locker Island	107	4	1	195	17	3
Sunday Island	67	35	-	135	46	3
Murion Islands	74	39	-	164	55	6
Round Island	213	22	4	426	39	4
Table Island	297	22	4	605	37	4
Flat Island	611	24	4	945	44	4

Peak Island	296	39	4	475	49	5
Serrurier Island	584	22	4	853	44	4
Ashburton ISland	140	4	4	280	13	4
Tortoise Island	340	4	4	447	29	4
Direction Island	20	4	-	47	4	-
Twin Island	12	2	-	30	5	-
Bessieres Island	488	25	4	760	45	6
Mangrove Islands	5	-	-	18	5	-
Thevenard Island	304	8	4	492	37	4
Pulau Raijua	3	-	-	14	1	-
Browse Island	5	-	-	14	3	-
Hibernia Reef	7	-	-	26	7	-
Sandy Islet	31	22	-	68	27	-
Cartier Island	12	6	-	42	15	-
Ashmore Reef	16	4	-	42	18	-
Seringapatam Reef	38	21	-	73	28	-
Scott Reef North	38	22	-	101	27	1
Scott Reef South	34	22	-	85	28	-
Fremantle	3	-	-	10	1	-
Stirling	3	-	-	15	1	-
Joondalup	5	-	-	16	1	-

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	Wanneroo	6	-	-	20	1	-
	Gingin	5	-	-	15	2	-
	Dandaragan	3	-	-	16	1	-
	Carnarvon	11	1	-	42	19	-
	Exmouth	46	40	-	137	58	1
	Ashburton	62	4	-	114	14	1
	Karratha	7	-	-	22	4	-
	Broome	8	-	-	22	5	-
	Derby - West Kimberely	6	-	-	21	5	-
	Dirk Hartog Island	2	-	-	12	1	-
IMCRA	Oceanic Shoals	32	9	-	79	15	-
	Kimberley	16	5	-	46	6	-
	Northwest Shelf	6,067	98	93	12,045	98	97
	Canning	17	5	-	46	6	-
	King Sound	5	-	-	12	3	-
	Pilbarra (offshore)	1,748	98	70	3,042	99	72
	Pilbarra (nearshore)	334	22	4	504	43	4
	Ningaloo	477	67	14	823	79	41
	Zuytdorp	35	27	-	114	60	1
	Shark Bay	3	-	-	12	2	-
	Central West Coast	6	-	-	23	2	-

	Abrolhos Islands	5	-	-	22	3	-
	Leeuwin-Naturaliste	3	-	-	17	1	-
IBRA	Geraldton Hills	4	-	-	19	3	-
	Perth	6	-	-	20	2	-
	Edel	3	-	-	15	2	-
	Wooramel	11	1	-	42	11	-
	Cape Range	611	40	4	945	58	6
	Roebourne	383	4	4	580	21	4
	Pindanland	8	-	-	22	5	-
	Mitchell	6	-	-	21	5	-
	Christmas Island	2	-	-	11	1	-
	Timor Sea Coral Islands	16	6	-	42	18	-
AMP	Abrolhos	53	22	-	108	51	1
	Argo-Rowley Terrace	1,459	90	66	2,202	93	74
	Ashmore Reef	16	4	-	42	18	-
	Carnarvon Canyon	396	46	12	698	83	21
	Cartier Island	13	7	-	48	15	-
	Dampier	1	-	-	13	1	-
	Gascoyne	1,096	98	73	2,528	100	94
	Jurien	4	-	-	18	2	-
	Kimberley	140	41	10	222	53	12

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	Mermaid Reef	131	64	12	486	70	35
	Montebello	1,301	75	42	2,460	85	50
	Ningaloo	298	66	11	514	75	32
	Oceanic Shoals	24	6	-	50	9	-
	Perth Canyon	2	-	-	13	1	-
	Shark Bay	25	16	-	63	53	-
	South-west Corner	1	-	-	13	1	-
	Two Rocks	5	-	-	23	2	-
MP	Barrow Island	219	4	4	477	23	4
	Jurien Bay	4	-	-	18	2	-
	Marmion	5	-	-	17	2	-
	Montebello Islands	295	16	4	507	31	16
	Ningaloo	104	49	1	261	72	14
	Rowley Shoals	117	62	9	187	71	23
NR	Buller, Whittell And Green Islands	3	-	-	12	1	-
	Great Sandy Island	127	4	4	184	4	4
	Scott Reef	34	22	-	85	27	-
	Thevenard Island	271	4	4	445	32	4
CP	Montebello Islands	144	4	3	238	16	4
MMA	Muiron Islands	86	40	-	200	62	6
MMA	Barrow Island	384	16	4	580	27	16

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FHPA	Abrolhos Islands	5	-	-	22	3	-
RAMSAR	Ashmore Reef National Nature Reserve	16	4	-	42	18	-
State Waters	Western Australia State Waters	722	62	23	1,097	72	24
EEZ	Christmas Island EEZ	19	3	-	62	9	-
	East Timorian EEZ	13	6	-	32	7	-
	Joint regime area Australia / East Timor	13	6	-	32	7	-
	Australian EEZ	19,495	100	100	37,211	100	100
	Indonesian EEZ	526	36	20	854	47	23
RSB	Mermaid Reef	106	64	3	384	67	35
	Brue Reef	6	-	-	14	4	-
	Barcoo Shoal	5	-	-	14	5	-
	Churchill Reef	2	-	-	12	1	-
	Beagle and Dingo Reefs	2	-	-	10	1	-
	Imperieuse Reef	96	53	-	163	63	17
	Clerke Reef	92	60	-	162	68	22
	Tryal Rocks	203	27	4	439	29	16
	Rankin Bank	1,380	75	57	2,316	85	58
	Glomar Shoal	692	21	21	1,029	22	21
	Dillon Shoal	8	-	-	22	6	-
	Echo Shoals	4	-	-	11	1	-

Big Bank Shoals	3	-	-	11	1	-
Karmt Shoal	10	1	-	25	6	-
Jabiru Shoals	8	-	-	25	10	-
Pee Shoal	5	-	-	13	5	-
Mangola Shoal	6	-	-	22	8	-
Johnson Bank	11	1	-	28	17	-
Woodbine Bank	10	2	-	40	15	-
Barracouta Shoal	20	9	-	59	10	-
Vulcan Shoal	16	9	-	43	14	-
Goeree Shoal	15	8	-	48	10	-
Eugene McDermott Shoal	5	-	-	11	1	-
Echuca Shoal	5	-	-	17	6	-
Barrow Island Reefs and Shoals	137	4	4	216	8	4
Montebello Shoals	160	4	4	259	17	4
Meda Reef	7	-	-	23	4	-
Lightfoot Reef	39	4	-	78	4	-
Herald Reef	14	2	-	32	4	-
Ningaloo Reef	54	41	-	137	59	4
West Reef	37	4	-	55	4	-
North West Reef	37	34	-	88	45	-
Geelvink Channel Shoals	2	-	-	10	1	-

RPS

Pelsaert Bank	1	-	-	10	1	-
Direction Bank	4	-	-	14	2	-
North Tail Reef	2	-	-	11	1	-
Exmouth Reef	15	5	-	30	24	-
Fairway Reef	46	22	-	113	38	1
Web Reef	20	21	-	48	38	-
Hood Reef	138	22	1	302	38	4
Baylis Patches	46	4	-	86	34	-
Hayman Rock	64	4	-	118	34	2
Tongue Shoals	221	4	4	362	15	4
Manicom Bank	109	4	1	158	10	4
Inner Northwest Patch	180	4	4	261	12	4
Southwest Patch	77	4	-	123	9	1
Brewis Reef	291	4	4	474	35	4
Saladin Shoal	71	4	-	145	8	3
Rosily Shoals	283	24	4	548	39	4
Trap Reef	272	10	4	411	32	4
Taunton Reef	163	4	4	255	5	4
Moresby Shoals	26	4	-	52	4	-
Poivre Reef	354	4	4	481	21	4
Ripple Shoals	146	4	4	233	7	4

RPS

	Flinders Shoal	90	4	-	145	6	4
	O'Grady Shoal	5	-	-	15	2	-
	Cod Bank	10	-	-	15	4	-
	Unamed Timor Sea Shoal	11	2	-	22	9	-
	Unnamed Shoal	21	9	-	57	14	-
KEF	Canyons linking the Argo Abyssal Plain with the Scott Plateau	441	43	18	868	63	26
	Glomar Shoals	1,647	27	21	2,049	58	21
	Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	140	64	18	486	71	35
	Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	620	97	44	2,329	100	71
	Pinnacles of the Bonaparte Basin	11	1	-	25	6	-
	Ancient coastline at 125 m depth contour	2,414	91	71	6,122	94	75
	Wallaby Saddle	19	12	-	59	47	-
	Exmouth Plateau	1,068	100	100	1,819	100	100
	Carbonate bank and terrace system of the Sahul Shelf	28	9	-	63	11	-
	Commonwealth waters adjacent to Ningaloo Reef	298	66	11	514	75	32
	Carbonate bank and terrace system of the Van Diemen Rise	2	-	-	13	2	-

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	Perth Canyon and adjacent shelf break, and other west coast canyons	17	13	-	49	21	-
	Commonwealth marine environment within and adjacent to the west coast inshore lagoons	6	-	-	23	2	-
	Commonwealth marine environment surrounding the Houtman Abrolhos Islands	4	-	-	21	5	-
	Ancient coastline at 90-120m depth	3	-	-	15	2	-
	Western demersal slope and associated fish communities	43	28	-	103	54	1
	Western rock lobster	6	-	-	23	3	-
	Continental Slope Demersal Fish Communities	3,295	100	100	5,885	100	100
	Ashmore Reef and Cartier Island and surrounding Commonwealth waters	16	7	-	49	19	-
	Seringapatam Reef and Commonwealth waters in the Scott Reef Complex	41	22	-	105	29	1

RPS

Table 25 Probability of exposure to receptors from entrained hydrocarbons (for 1 hour and 48-hour exposure windows) in the 0–10 m depth layer below the sea surface. Results are based on a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

Transitional Receptor		Maximum entrained hydrocarbon exposure (ppb) over 48 hour window	Probability of time-averaged entrained hydrocarbon exposure over 48 hour window		Maximum entrained hydrocarbon exposure (ppb) over 1 hour window	Probability of instantaneous entrained hydrocarbon exposure over 1 hour window	
			Low	High		Low	High
NEAR-SHORE	Sumbawa	2	-	-	13	2	-
	Pulau Flores	2	-	-	10	1	-
	Garden Island	4	-	-	14	2	-
	Carnac Island	3	-	-	11	1	-
	Rottnest Island	3	-	-	14	3	-
	Pelsaert Group	2	-	-	12	2	-
	Easter Group	3	-	-	14	3	-
	Wallabi Group	4	-	-	21	5	-
	North Island	2	-	-	12	1	-
	Dorre Island	3	-	-	14	2	-
	Bermier Island	2	-	-	11	1	-
	Airlie Island	3	-	-	18	3	-
	Boodie Island	4	-	-	18	6	-
	Middle Island	6	-	-	21	13	-
	Barrow Island	13	2	-	44	16	-
	Hermite Island	10	-	-	48	16	-

Rosemary Island	2	-	-	11	1	-
Kendrew Island	2	-	-	13	1	-
Imperieuse Reef	57	28	-	123	47	2
Cunningham Island	66	29	-	149	51	2
Clerke Reef	59	20	-	104	30	2
Mermaid Reef	52	17	-	101	24	1
Pulau Ndana	3	-	-	10	1	-
Pulau Doo	3	-	-	12	3	-
Pulau Dana	15	3	-	35	6	-
Pulau Rote	3	-	-	12	4	-
Pulau Dao	4	-	-	14	2	-
Pulau Nuse	3	-	-	12	2	-
Pulau Sawu	14	2	-	32	7	-
Pulau Mangudu	2	-	-	12	2	-
Pulau Lahalura	3	-	-	12	3	-
Sumba Barat	3	-	-	14	3	-
Pulau Rinca	5	-	-	14	3	-
Pulau Komodo	4	-	-	12	2	-
Pulau Kawula	4	-	-	12	2	-
Rivoli Islands	5	-	-	19	14	-
Fly Island	14	2	-	34	28	-

RPS

Observation Island	22	6	-	47	44	-
Locker Island	4	-	-	12	2	-
Sunday Island	40	22	-	98	55	-
Murion Islands	53	33	-	162	65	6
Round Island	24	6	-	52	46	-
Table Island	26	6	-	50	34	-
Flat Island	39	16	-	88	59	-
Peak Island	52	33	-	104	63	3
Serrurier Island	37	11	-	77	55	-
Tortoise Island	4	-	-	19	8	-
Bessieres Island	39	12	-	98	52	-
Thevenard Island	9	-	-	26	14	-
Pulau Raijua	16	2	-	34	7	-
Sumba Timur	3	-	-	17	5	-
Timor-Leste	3	-	-	10	1	-
Hibernia Reef	34	9	-	84	22	-
Sandy Islet	64	16	-	149	22	8
Cartier Island	20	4	-	42	20	-
Ashmore Reef	61	17	-	125	18	2
Seringapatam Reef	31	17	-	62	26	-
Scott Reef North	47	17	-	127	24	4

	Scott Reef South	83	17	-	196	22	9
	Busselton	2	-	-	13	1	-
	Waroona	2	-	-	10	1	-
	Mandurah	2	-	-	13	1	-
	Rockingham	3	-	-	13	1	-
	Kwinana	4	-	-	12	2	-
	Cockburn	4	-	-	14	4	-
	Fremantle	4	-	-	15	4	-
	Stirling	4	-	-	14	5	-
	Joondalup	5	-	-	19	10	-
	Wanneroo	5	-	-	20	11	-
	Gingin	6	-	-	21	9	-
	Dandaragan	3	-	-	15	3	-
	Irwin	1	-	-	10	1	-
	Greater Geraldton	2	-	-	13	1	-
	Carnarvon	11	1	-	33	27	-
	Exmouth	42	22	-	112	64	1
	Ashburton	3	-	-	15	5	-
	Dirk Hartog Island	2	-	-	11	1	-
IMCRA	Oceanic Shoals	20	5	-	53	24	-
	Kimberley	3	-	-	12	1	-

RPS

	Northwest Shelf	3,834	100	78	12,087	100	92
	Pilbarra (offshore)	1,385	97	80	2,994	100	88
	Pilbarra (nearshore)	33	8	-	72	50	-
	Ningaloo	442	51	10	755	72	37
	Zuytdorp	39	33	-	127	62	1
	Shark Bay	3	-	-	15	2	-
	Central West Coast	6	-	-	23	11	-
	Abrolhos Islands	5	-	-	26	7	-
	Leeuwin-Naturaliste	4	-	-	18	5	-
IBRA	Southern Jarrah Forest	1	-	-	13	1	-
	Geraldton Hills	4	-	-	21	5	-
	Perth	6	-	-	21	11	-
	Edel	3	-	-	14	2	-
	Wooramel	11	1	-	32	12	-
	Cape Range	53	33	-	162	65	6
	Roebourne	6	-	-	21	13	-
	Christmas Island	2	-	-	23	2	-
	Timor Sea Coral Islands	61	17	-	125	20	2
AMP	Abrolhos	29	20	-	90	44	-
	Argo-Rowley Terrace	1,647	73	57	2,790	73	68
	Ashmore Reef	61	17	-	125	19	2

	Carnarvon Canyon	362	44	13	651	57	14
	Cartier Island	21	5	-	49	20	-
	Gascoyne	1,136	100	89	2,322	100	100
	Geographe	1	-	-	11	1	-
	Jurien	4	-	-	23	6	-
	Kimberley	64	14	-	162	21	5
	Mermaid Reef	80	20	-	154	27	6
	Montebello	1,013	66	42	1,685	82	54
	Ningaloo	275	53	5	470	70	29
	Perth Canyon	2	-	-	16	1	-
	Shark Bay	26	31	-	64	60	-
	South-west Corner	1	-	-	11	1	-
	Two Rocks	5	-	-	23	9	-
MP	Barrow Island	17	4	-	51	19	-
	Jurien Bay	4	-	-	20	4	-
	Marmion	5	-	-	18	11	-
	Montebello Islands	53	11	-	167	20	2
	Ngari Capes	2	-	-	13	1	-
	Ningaloo	84	40	-	213	69	14
	Rowley Shoals	75	44	-	186	57	8
	Shark Bay	1	-	-	11	1	-

RPS

	Shoalwater Islands	3	-	-	11	1	-
	Swan Estuary - Alfred Cove	3	-	-	11	1	-
FHPA	Abrolhos Islands	5	-	-	24	7	-
	Cottesloe Reef	3	-	-	11	2	-
MMA	Barrow Island	32	11	-	142	23	2
	Muiron Islands	59	33	-	227	68	9
CP	Montebello Islands	8	-	-	28	15	-
NR	Scott Reef	83	14	-	153	22	9
NR	Thevenard Island	7	-	-	18	12	-
RAMSAR	Ashmore Reef National Nature Reserve	61	17	-	125	19	2
State Waters	Western Australia State Waters	132	44	5	266	68	14
EEZ	Christmas Island EEZ	19	12	-	54	20	-
	Oecussi Ambeno EEZ	3	-	-	12	1	-
	East Timorian EEZ	4	-	-	15	2	-
	Joint regime area Australia / East Timor	4	-	-	15	1	-
	Australian EEZ	25,156	100	100	42,693	100	100
	Indonesian EEZ	209	29	8	505	38	16
RSB	Mermaid Reef	53	17	-	121	25	2
	Imperieuse Reef	74	40	-	169	53	3
	Clerke Reef	59	20	-	108	30	2

Tryal Rocks	68	10	-	183	24	2
Rankin Bank	991	48	36	1,305	70	36
Glomar Shoal	107	13	1	267	20	2
Karmt Shoal	3	-	-	11	1	-
Jabiru Shoals	8	-	-	19	7	-
Pee Shoal	8	-	-	16	5	-
Mangola Shoal	5	-	-	17	3	-
Vee Shoal	8	-	-	19	12	-
Fantome Shoal	9	-	-	23	9	-
Johnson Bank	28	17	-	54	18	-
Woodbine Bank	18	3	-	37	17	-
Barracouta Shoal	7	-	-	22	18	-
Vulcan Shoal	2	-	-	13	3	-
Goeree Shoal	2	-	-	12	1	-
Eugene McDermott Shoal	3	-	-	13	2	-
Heywood Shoal	4	-	-	18	4	-
Montebello Shoals	10	-	-	49	15	-
Sand Knoll Ledge	2	-	-	10	1	-
Beagle Knoll	2	-	-	15	5	-
Ningaloo Reef	44	30	-	127	64	1
North West Reef	33	15	-	76	54	-

RPS

	Geelvink Channel Shoals	2	-	-	11	1	-
	Assail Bank	3	-	-	20	2	-
	Direction Bank	3	-	-	17	2	-
	North Tail Reef	2	-	-	10	1	-
	Exmouth Reef	10	-	-	19	25	-
	Fairway Reef	18	5	-	56	41	-
	Web Reef	11	3	-	29	28	-
	Hood Reef	26	8	-	51	45	-
	Baylis Patches	4	-	-	16	13	-
	Hayman Rock	9	-	-	22	16	-
	Brewis Reef	9	-	-	25	15	-
	Rosily Shoals	30	5	-	59	35	-
	Trap Reef	9	-	-	26	17	-
	Poivre Reef	6	-	-	21	14	-
	Cod Bank	2	-	-	19	1	-
	Unamed Timor Sea Shoal	40	10	-	72	18	-
	Unnamed Shoal	17	4	-	30	20	-
KEF	Canyons linking the Argo Abyssal Plain with the Scott Plateau	228	31	12	478	42	19
	Glomar Shoals	145	20	1	350	36	3
	Mermaid Reef and Commonwealth waters	270	53	8	412	59	15

RPS

surrounding Rowley Shoals						
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	784	83	51	2,175	94	66
Ancient coastline at 125 m depth contour	2,270	88	75	6,276	100	83
Wallaby Saddle	18	8	-	75	42	-
Exmouth Plateau	1,092	100	100	1,976	100	100
Carbonate bank and terrace system of the Sahul Shelf	7	-	-	22	9	-
Commonwealth waters adjacent to Ningaloo Reef	275	53	5	470	70	29
Perth Canyon and adjacent shelf break, and other west coast canyons	15	12	-	39	33	-
Commonwealth marine environment within and adjacent to the west coast inshore lagoons	5	-	-	21	9	-
Commonwealth marine environment surrounding the Houtman Abrolhos Islands	5	-	-	26	9	-
Commonwealth marine environment within and adjacent to Geographe Bay	1	-	-	10	1	-
Ancient coastline at 90-120m depth	4	-	-	21	5	-
Western demersal slope and associated fish communities	46	25	-	104	56	1

RPS

	Western rock lobster	5	-	-	26	9	-
	Continental Slope Demersal Fish Communities	3,395	100	100	6,030	100	100
	Ashmore Reef and Cartier Island and surrounding Commonwealth waters	61	17	-	125	22	2
	Seringapatam Reef and Commonwealth waters in the Scott Reef Complex	89	18	-	196	27	9

Table 26 Probability of exposure to receptors from entrained hydrocarbons (for 1 hour and 48-hour exposure windows) in the 0–10 m depth layer below the sea surface. Results are based on a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

Winter Receptor		Maximum entrained hydrocarbon exposure (ppb) over 48 hour window	Probability of time-averaged entrained hydrocarbon exposure over 48 hour window		Maximum entrained hydrocarbon exposure (ppb) over 1 hour window	Probability of instantaneous entrained hydrocarbon exposure over 1 hour window	
			Low	High		Low	High
NEAR-SHORE	Sumbawa	2	-	-	11	1	-
	Pulau Flores	1	-	-	11	1	-
	Garden Island	2	-	-	12	1	-
	Pelsaert Group	1	-	-	12	2	-
	Easter Group	3	-	-	16	4	-
	Wallabi Group	4	-	-	20	6	-
	North Island	2	-	-	11	1	-
	Bermier Island	1	-	-	15	1	-
	Airlie Island	2	-	-	15	1	-
	Boodie Island	4	-	-	20	4	-
	Middle Island	6	-	-	23	8	-
	Barrow Island	14	2	-	40	13	-
	Hermite Island	9	-	-	43	11	-
	Rosemary Island	1	-	-	12	1	-

Legendre Island	1	-	-	12	1	-
Imperieuse Reef	816	60	33	1,183	86	37
Cunningham Island	789	65	33	1,197	93	37
Clerke Reef	110	41	3	225	74	16
Mermaid Reef	137	40	12	221	58	28
Lacepede Islands	23	11	-	50	11	-
King Leopold Ranges	1	-	-	11	1	-
Adele Island	15	8	-	34	9	-
Pulau Ndana	3	-	-	13	1	-
Pulau Doo	3	-	-	13	1	-
Pulau Dana	15	2	-	30	3	-
Pulau Rote	3	-	-	10	1	-
Pulau Sawu	14	2	-	31	2	-
Pulau Mangudu	3	-	-	12	2	-
Pulau Lahalura	4	-	-	14	2	-
Sumba Barat	2	-	-	10	1	-
Pulau Rinca	2	-	-	13	1	-
Pulau Komodo	3	-	-	11	1	-
Rivoli Islands	5	-	-	21	7	-
Fly Island	8	-	-	34	17	-
Observation Island	11	1	-	43	29	-

Locker Island	3	-	-	14	2	-
Sunday Island	26	15	-	67	36	-
Murion Islands	61	20	-	175	46	8
Round Island	10	1	-	38	37	-
Table Island	8	-	-	27	29	-
Flat Island	21	11	-	79	45	-
Peak Island	36	20	-	141	47	3
Serrurier Island	18	5	-	58	40	-
Ashburton ISland	2	-	-	10	1	-
Tortoise Island	3	-	-	15	4	-
Bessieres Island	12	2	-	57	42	-
Thevenard Island	4	-	-	20	6	-
Pulau Raijua	16	2	-	36	2	-
Sumba Timur	4	-	-	20	6	-
Browse Island	5	-	-	16	4	-
Hibernia Reef	33	8	-	91	12	-
Sandy Islet	66	33	-	145	54	9
Cartier Island	28	11	-	56	13	-
Ashmore Reef	63	12	-	124	24	2
Seringapatam Reef	73	33	-	138	51	9
Scott Reef North	48	37	-	134	54	6

RPS

	Scott Reef South	86	37	-	169	55	12
	Wyndham - East Kimberley	4	-	-	16	4	-
	Cockburn	2	-	-	11	1	-
	Fremantle	2	-	-	12	1	-
	Joondalup	4	-	-	14	2	-
	Wanneroo	4	-	-	17	2	-
	Gingin	3	-	-	16	3	-
	Dandaragan	2	-	-	12	2	-
	Greater Geraldton	2	-	-	11	1	-
	Northhampton	2	-	-	11	1	-
	Carnarvon	7	-	-	31	8	-
	Exmouth	30	5	-	95	40	-
	Ashburton	3	-	-	21	4	-
	Broome	5	-	-	23	6	-
	Derby - West Kimberely	5	-	-	17	9	-
	Dirk Hartog Island	1	-	-	11	1	-
IMCRA	Oceanic Shoals	26	8	-	59	12	-
	Kimberley	22	9	-	53	9	-
	Northwest Shelf	3,445	100	99	8,619	100	100
	Canning	40	11	-	79	11	-
	Pilbarra (offshore)	561	87	53	2,019	100	63

RPS

	Pilbarra (nearshore)	14	2	-	50	36	-
	Ningaloo	117	24	6	326	59	14
	Zuytdorp	20	10	-	62	24	-
	Shark Bay	2	-	-	14	1	-
	Central West Coast	4	-	-	22	4	-
	Abrolhos Islands	5	-	-	28	7	-
	Leeuwin-Naturaliste	2	-	-	13	1	-
IBRA	Geraldton Hills	4	-	-	20	6	-
	Perth	4	-	-	17	3	-
	Edel	1	-	-	15	1	-
	Wooramel	1	-	-	12	1	-
	Cape Range	61	20	-	175	47	8
	Roebourne	5	-	-	23	8	-
	Pindanland	23	11	-	50	11	-
	Mitchell	14	8	-	32	9	-
	Christmas Island	10	-	-	24	9	-
	Timor Sea Coral Islands	63	12	-	124	24	2
AMP	Abrolhos	24	4	-	82	15	-
	Argo-Rowley Terrace	1,673	100	95	2,953	100	99
	Ashmore Reef	63	12	-	124	24	2
	Carnarvon Canyon	111	28	1	194	34	10

	Cartier Island	28	11	-	59	13	-
	Dampier	2	-	-	14	1	-
	Gascoyne	649	93	51	1,158	99	65
	Jurien	3	-	-	21	3	-
	Kimberley	274	55	28	437	58	40
	Mermaid Reef	160	45	13	267	62	31
	Montebello	351	71	26	1,561	97	43
	Ningaloo	100	23	-	311	61	14
	Oceanic Shoals	3	-	-	12	1	-
	Shark Bay	18	5	-	52	23	-
	Two Rocks	4	-	-	17	3	-
MP	Barrow Island	15	4	-	60	20	-
	Jurien Bay	3	-	-	16	2	-
	Lalang-garram / Camden Sound	5	-	-	20	6	-
	Marmion	4	-	-	16	3	-
	Montebello Islands	15	6	-	59	20	-
	Rowley Shoals	816	92	35	1,228	97	50
	Ningaloo	65	20	-	173	53	4
NR	Scott Reef	82	33	-	163	53	12
	Thevenard Island	3	-	-	16	6	-
CP	Montebello Islands	8	-	-	32	10	-

MMA	Barrow Island	17	6	-	60	18	-
	Muiron Islands	62	20	-	203	52	11
FHPA	Abrolhos Islands	5	-	-	24	6	-
RAMSAR	Ashmore Reef National Nature Reserve	63	12	-	124	24	2
State Waters	Western Australia State Waters	816	92	35	1,228	97	50
EEZ	Christmas Island EEZ	62	20	-	126	51	2
	Australian Exclusive EEZ	26,968	100	100	45,273	100	100
	Indonesian Exclusive EEZ	674	59	29	924	76	38
RSB	Mermaid Reef	146	40	13	261	58	28
	Brue Reef	14	7	-	30	9	-
	Barcoo Shoal	13	4	-	36	9	-
	Churchill Reef	14	8	-	30	9	-
	Beagle and Dingo Reefs	13	4	-	32	9	-
	Barton Shoal	5	-	-	11	1	-
	Heritage Reef	3	-	-	11	1	-
	Imperieuse Reef	816	81	34	1,201	97	45
	Clerke Reef	141	42	13	247	78	16
	Tryal Rocks	15	3	-	38	34	-
	Rankin Bank	658	70	67	988	90	68
	Glomar Shoal	144	49	17	345	63	18

RPS

Robroy Reefs	4	-	-	15	5	-
Jamieson Reef	2	-	-	11	1	-
Wildcat Reefs	3	-	-	15	2	-
Mavis Reef	9	-	-	27	9	-
Albert Reef	12	4	-	27	9	-
Jabiru Shoals	10	-	-	20	1	-
Pee Shoal	10	-	-	24	1	-
Mangola Shoal	7	-	-	19	1	-
Vee Shoal	9	-	-	20	7	-
Fantome Shoal	11	2	-	23	7	-
Johnson Bank	30	11	-	62	14	-
Woodbine Bank	24	8	-	54	12	-
Barracouta Shoal	7	-	-	17	9	-
Vulcan Shoal	7	-	-	22	9	-
Goeree Shoal	6	-	-	18	8	-
Eugene McDermott Shoal	8	-	-	22	8	-
Heywood Shoal	9	-	-	28	9	-
Echuca Shoal	4	-	-	11	1	-
Holothuria Banks	2	-	-	13	1	-
Montebello Shoals	9	-	-	44	11	-
Beagle Knoll	3	-	-	13	1	-

RPS

	Ningaloo Reef	30	7	-	83	38	-
	North West Reef	12	2	-	45	35	-
	Gee Bank	1	-	-	10	1	-
	Geelvink Channel Shoals	1	-	-	11	1	-
	Assail Bank	3	-	-	11	2	-
	Pelsaert Bank	1	-	-	11	1	-
	Direction Bank	3	-	-	13	1	-
	Exmouth Reef	4	-	-	25	11	-
	Fairway Reef	10	1	-	42	24	-
	Web Reef	10	-	-	29	18	-
	Hood Reef	10	1	-	31	37	-
	Baylis Patches	4	-	-	19	5	-
	Hayman Rock	4	-	-	17	13	-
	Brewis Reef	3	-	-	22	6	-
	Rosily Shoals	8	-	-	33	25	-
	Trap Reef	3	-	-	18	5	-
	Poivre Reef	5	-	-	23	8	-
	Unamed Timor Sea Shoal	40	8	-	76	11	-
	Unnamed Shoal	21	7	-	43	9	-
KEF	Canyons linking the Argo Abyssal Plain with the Scott Plateau	164	78	15	452	83	19

RPS

Glomar Shoals	177	61	18	430	73	21
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	965	96	50	1,483	97	76
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	636	64	27	919	74	44
Ancient coastline at 125 m depth contour	2,477	100	83	4,526	100	96
Wallaby Saddle	15	4	-	82	14	-
Exmouth Plateau	1,119	100	94	1,973	100	97
Carbonate bank and terrace system of the Sahul Shelf	8	-	-	23	7	-
Commonwealth waters adjacent to Ningaloo Reef	100	23	-	311	61	14
Perth Canyon and adjacent shelf break, and other west coast canyons	6	-	-	29	10	-
Commonwealth marine environment within and adjacent to the west coast inshore lagoons	4	-	-	17	3	-
Commonwealth marine environment surrounding the Houtman Abrolhos Islands	4	-	-	28	7	-
Ancient coastline at 90-120m depth	4	-	-	21	6	-
Western demersal slope and associated fish communities	20	4	-	78	27	-

	Western rock lobster	4	-	-	28	6	-
	Continental Slope Demersal Fish Communities	1,989	100	100	4,091	100	100
	Ashmore Reef and Cartier Island and surrounding Commonwealth waters	63	13	-	124	24	2
	Seringapatam Reef and Commonwealth waters in the Scott Reef Complex	100	42	1	196	58	12

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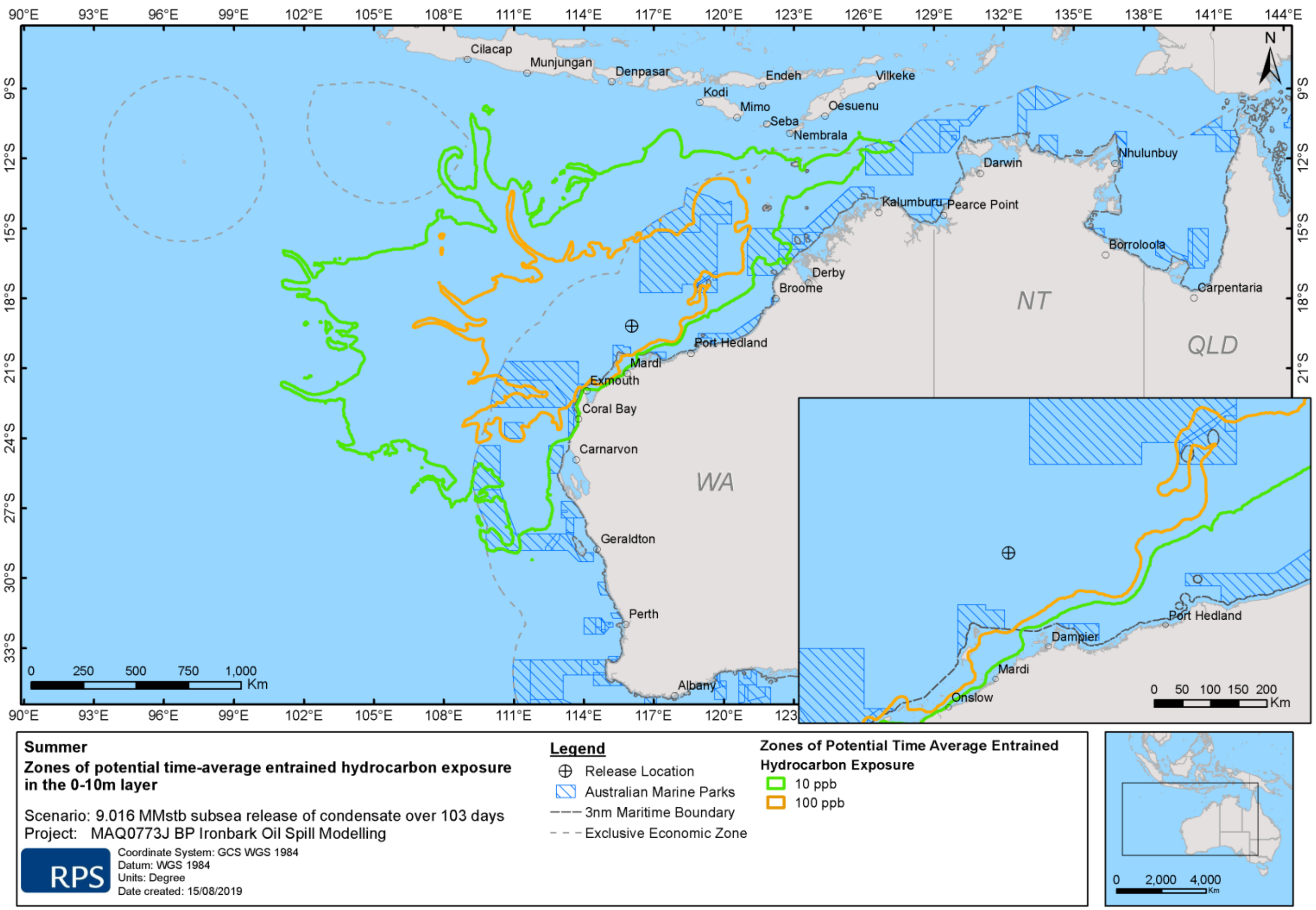

Figure 62 Zones of potential entrained hydrocarbon exposure over a 48 hour window at 0–10 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

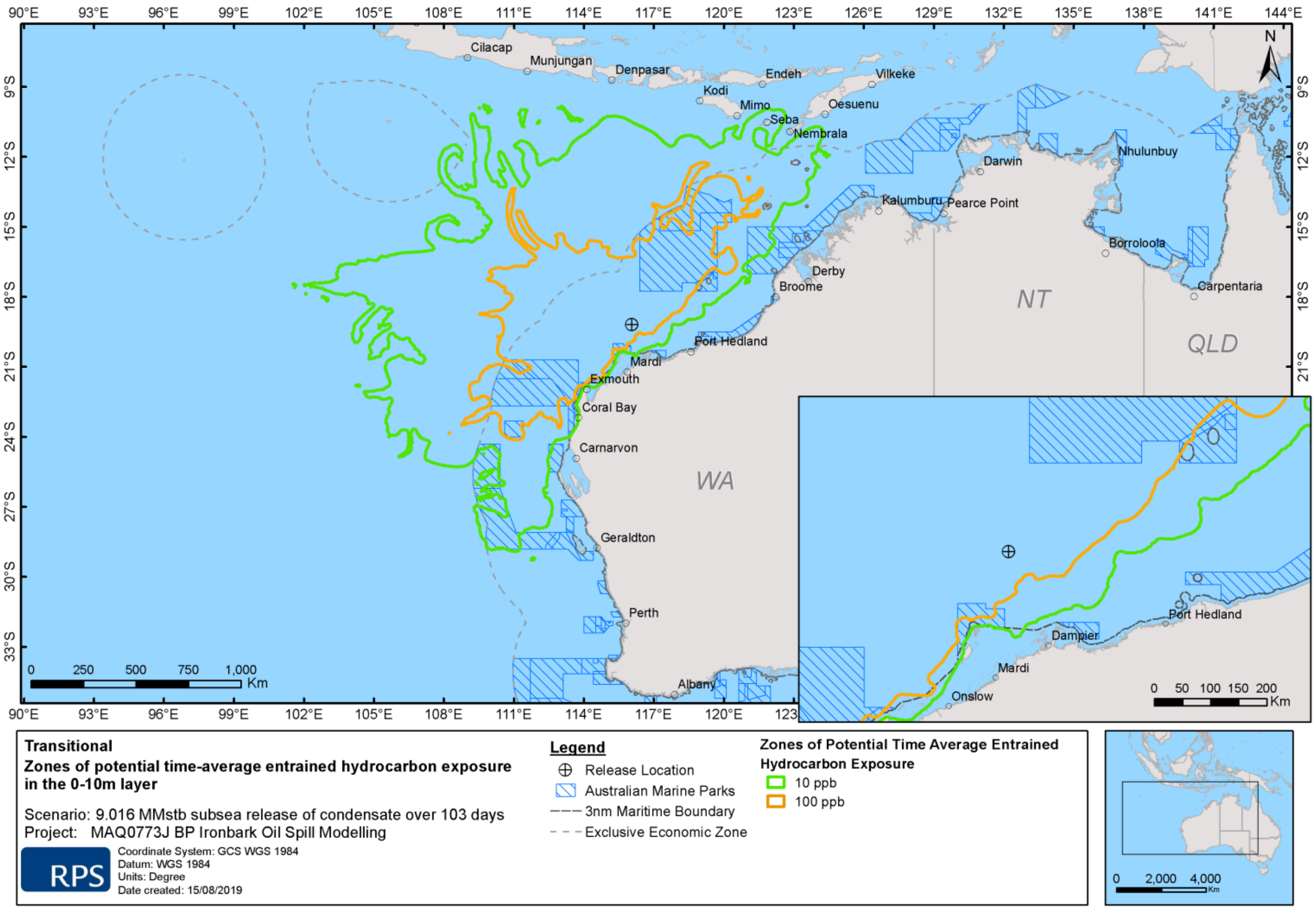

Figure 63 Zones of potential entrained hydrocarbon exposure over a 48 hour window at 0–10 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

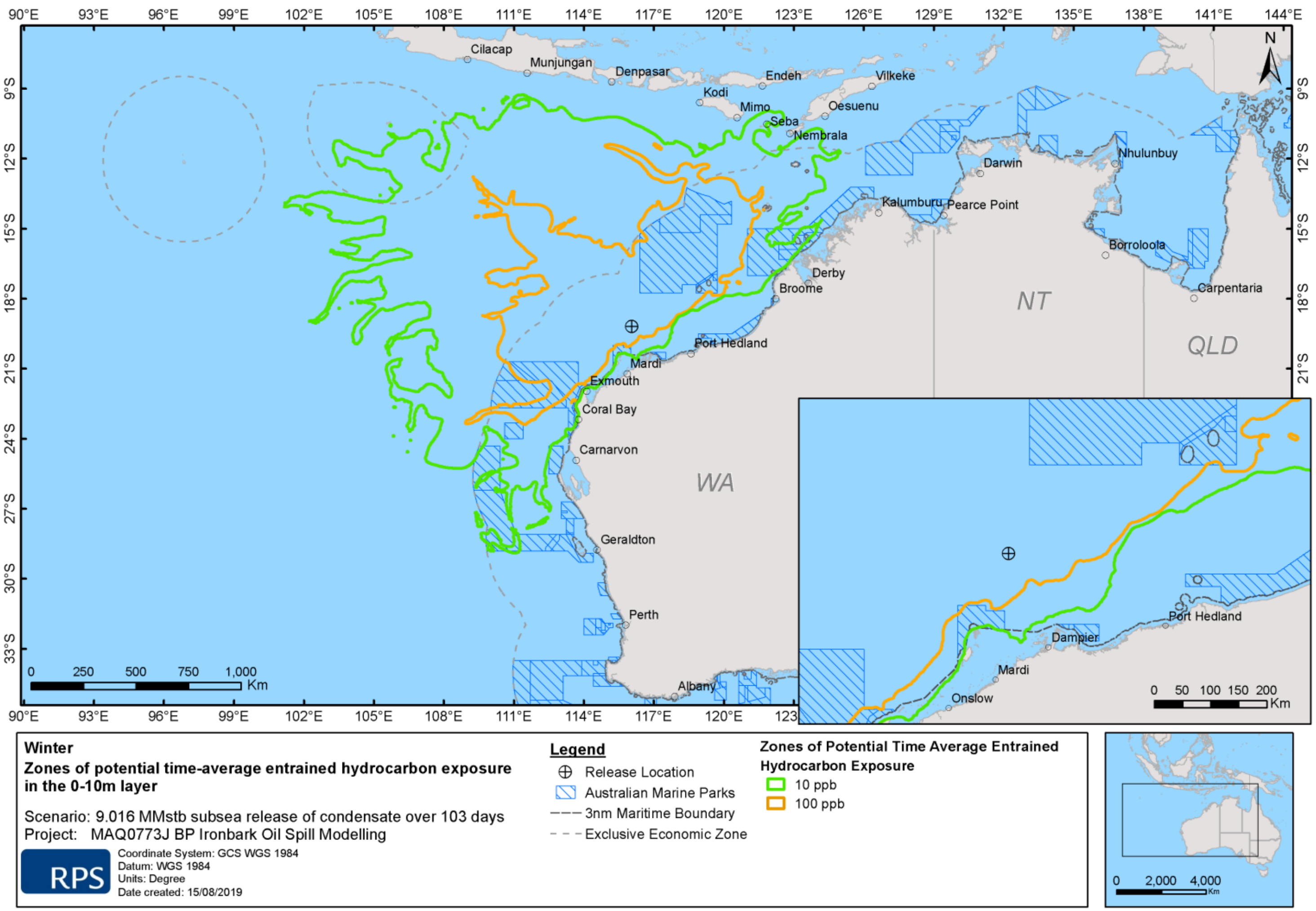

Figure 64 Zones of potential entrained hydrocarbon exposure over a 48 hour window at 0–10 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

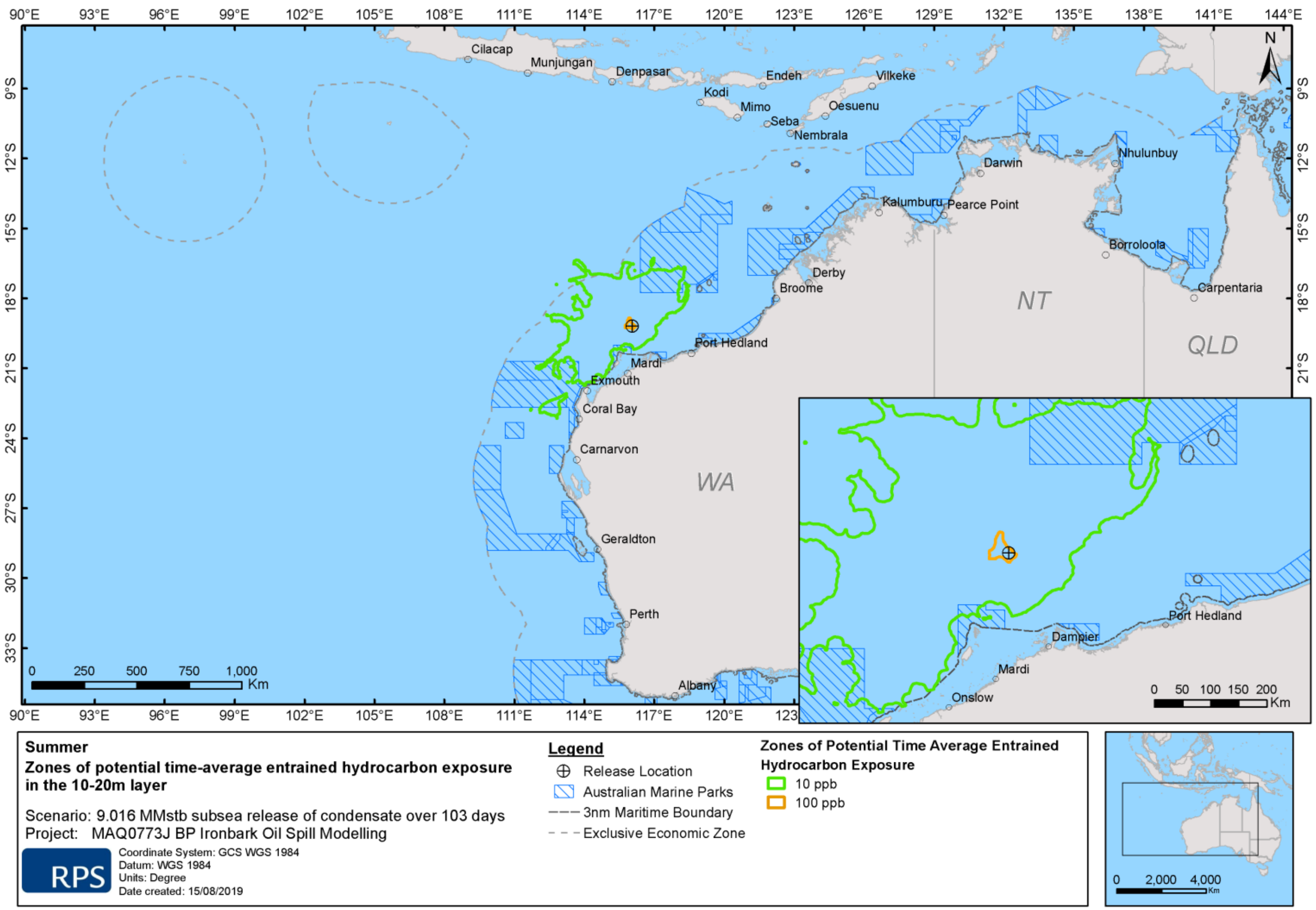

Figure 65 Zones of potential entrained hydrocarbon exposure over a 48 hour window at 10–20 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

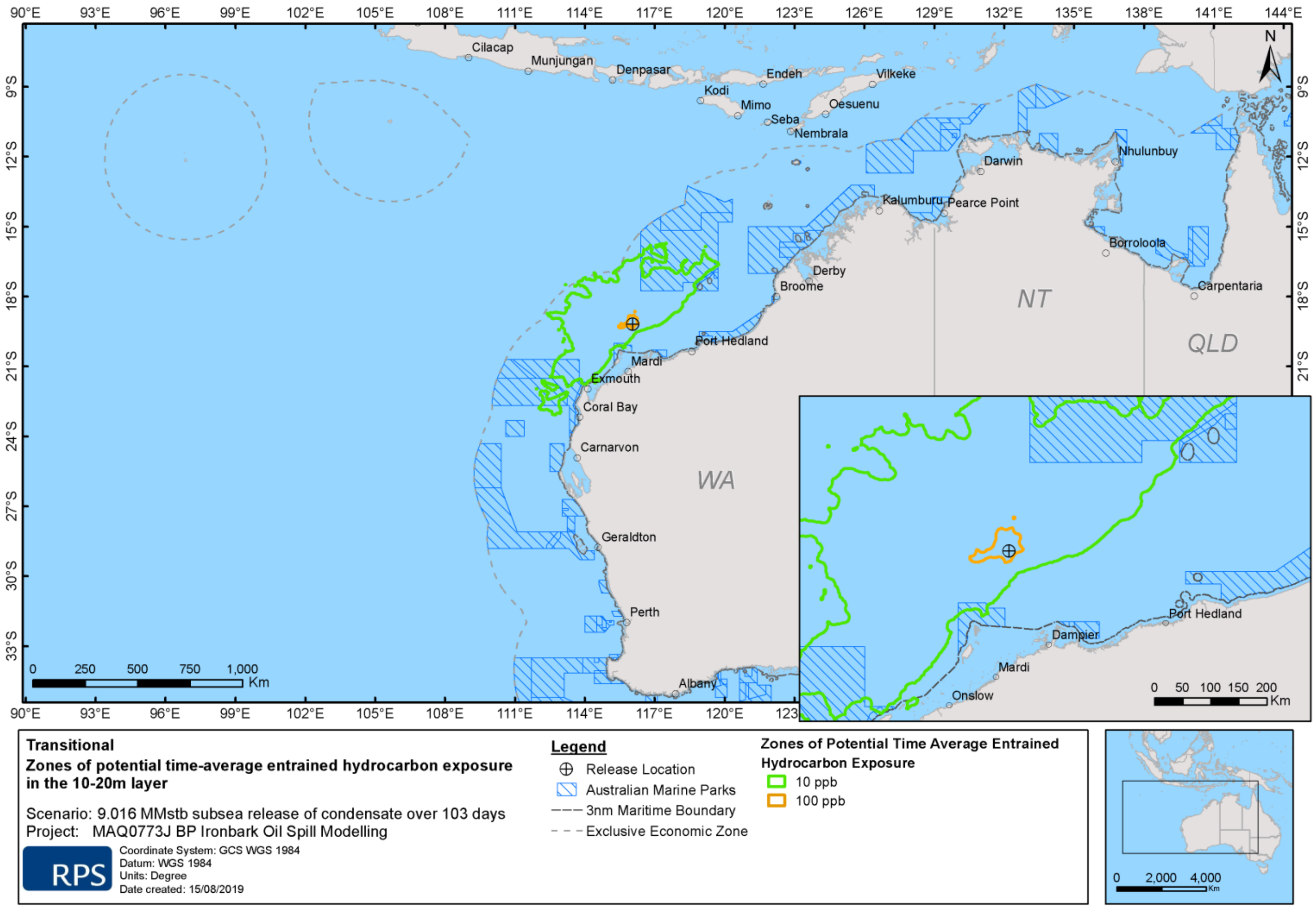

Figure 66 Zones of potential entrained hydrocarbon exposure over a 48 hour window at 10–20 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

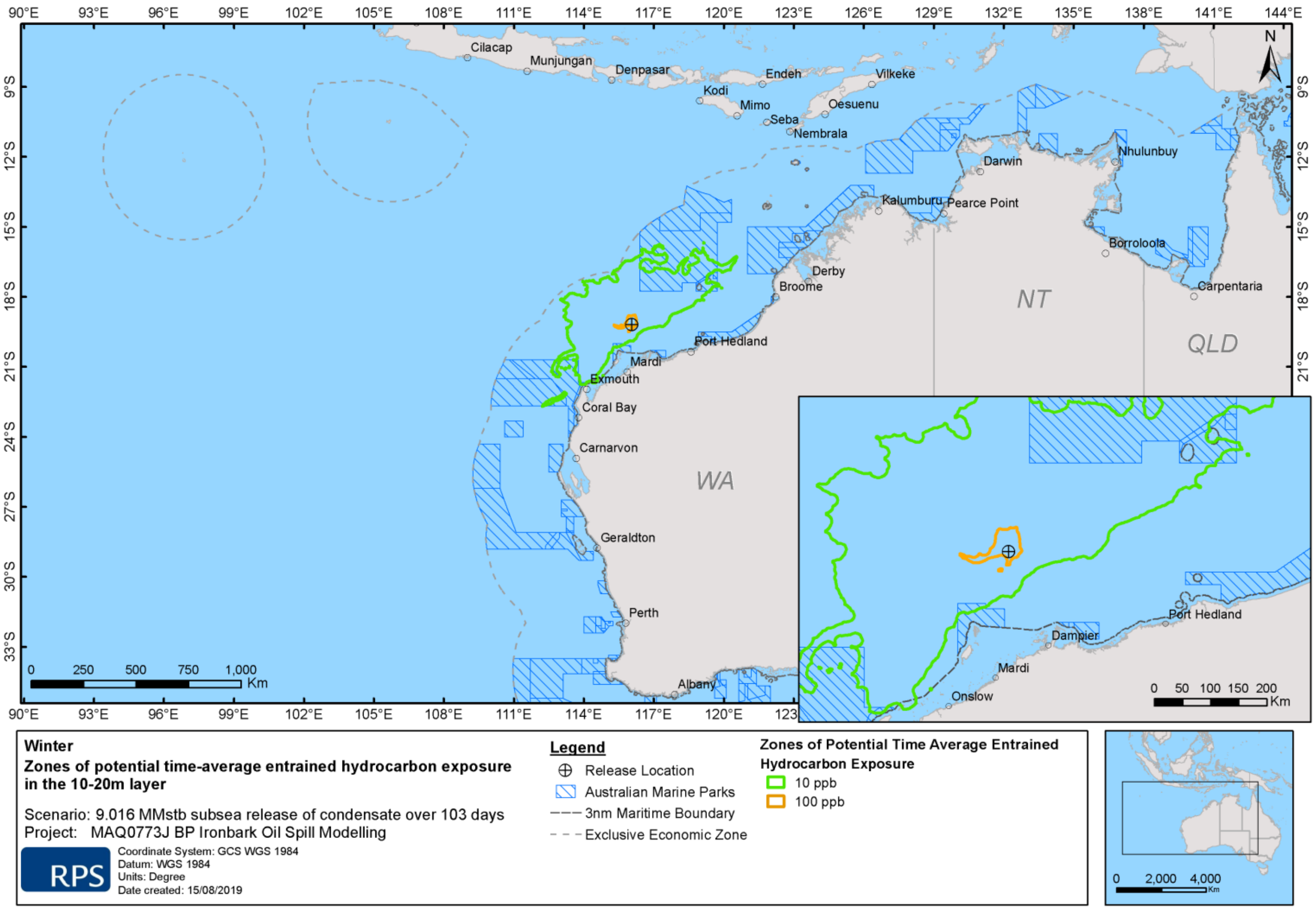

Figure 67 Zones of potential entrained hydrocarbon exposure over a 48 hour window at 10–20 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

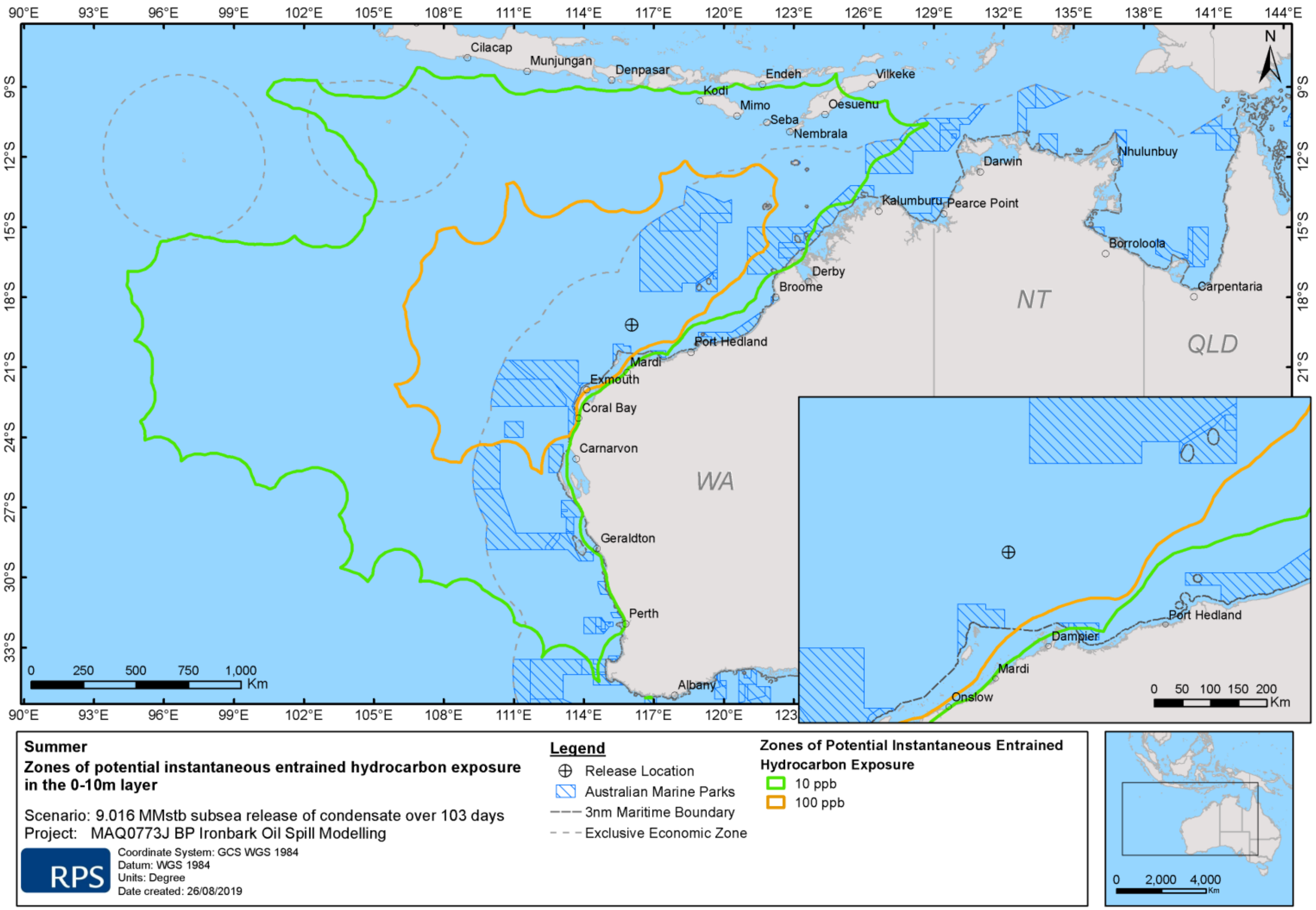

Figure 68 Zones of potential entrained hydrocarbon exposure over a 1 hour window at 0–10 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.

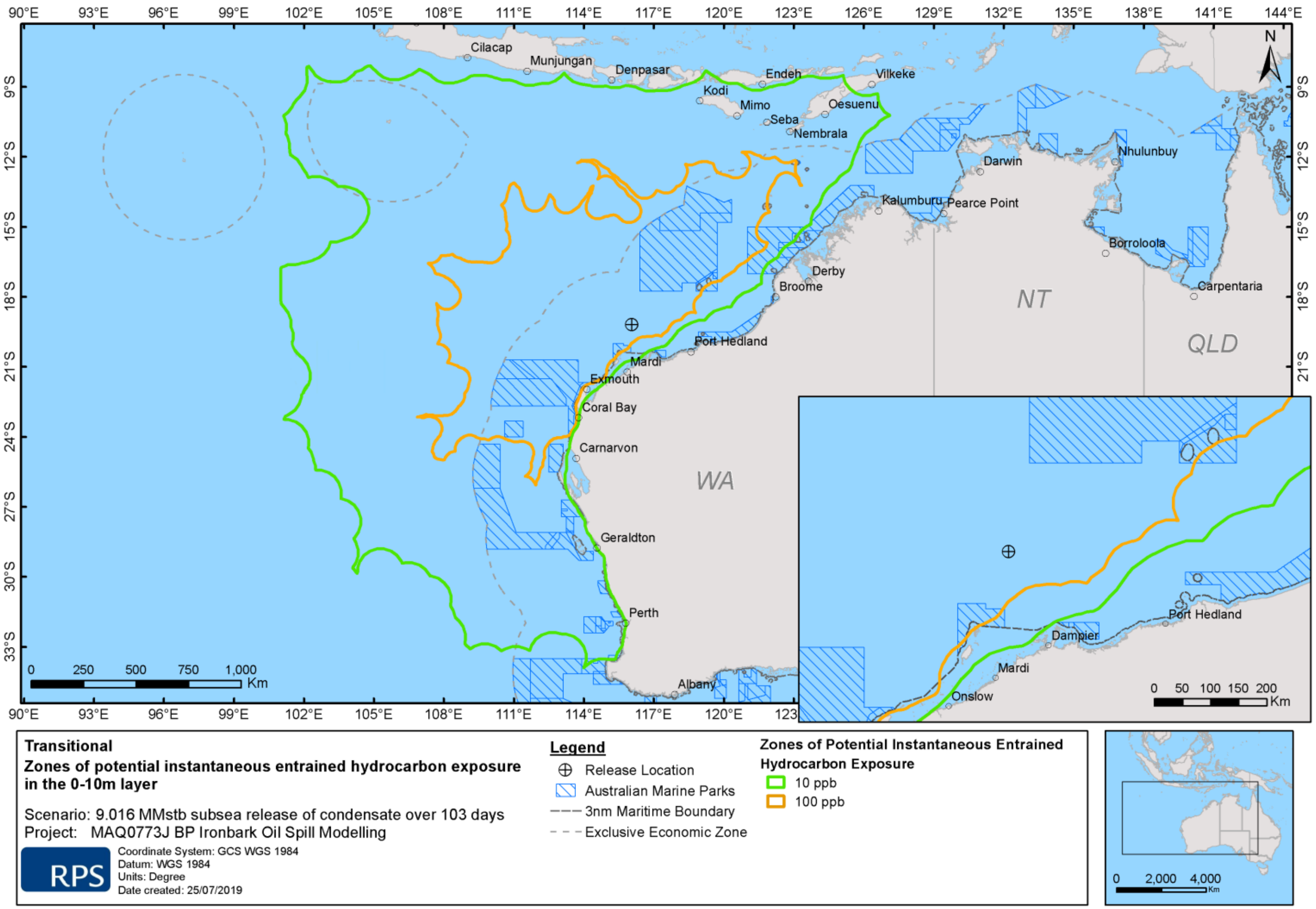

Figure 69 Zones of potential entrained hydrocarbon exposure over a 1 hour window at 0–10 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

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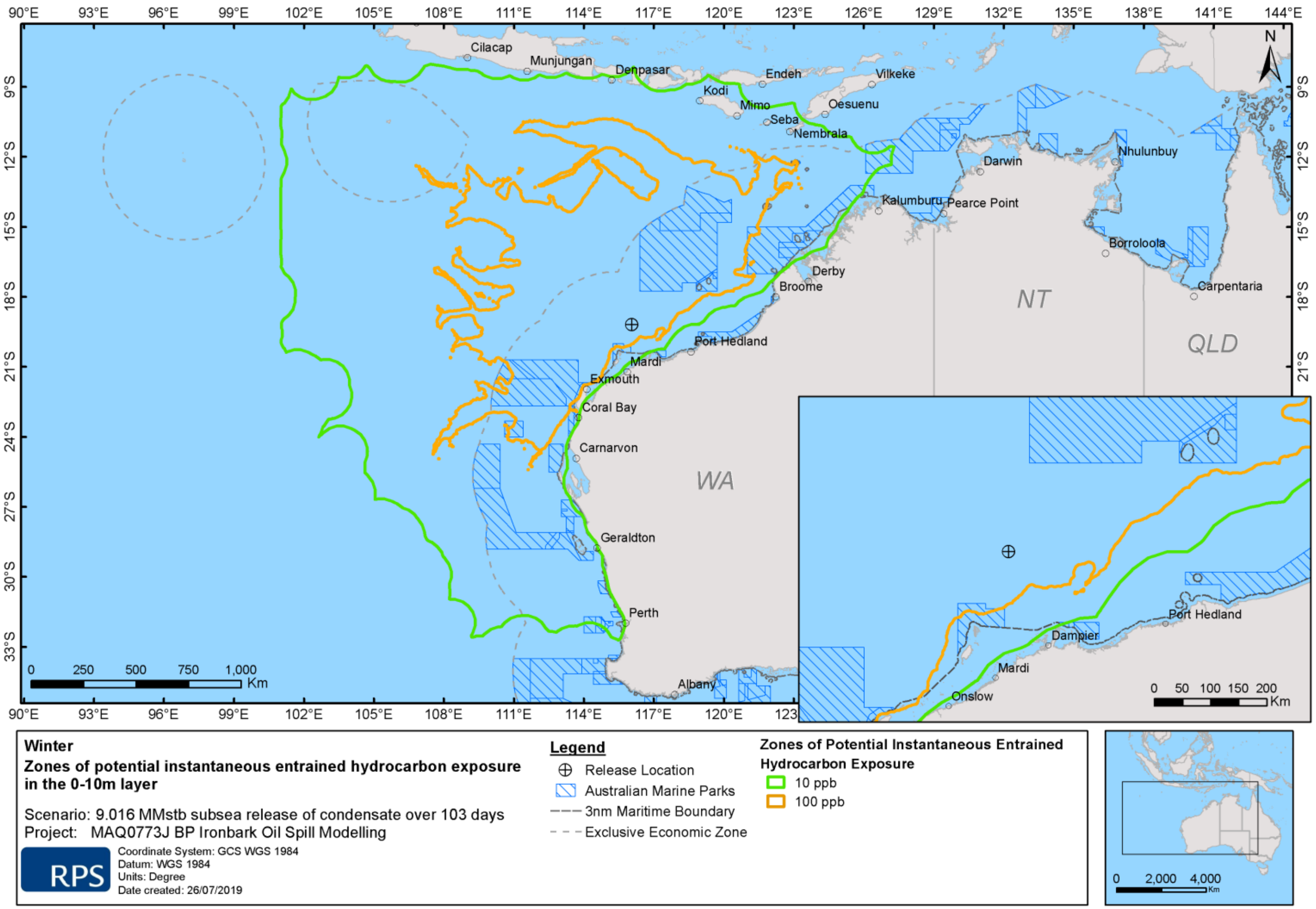

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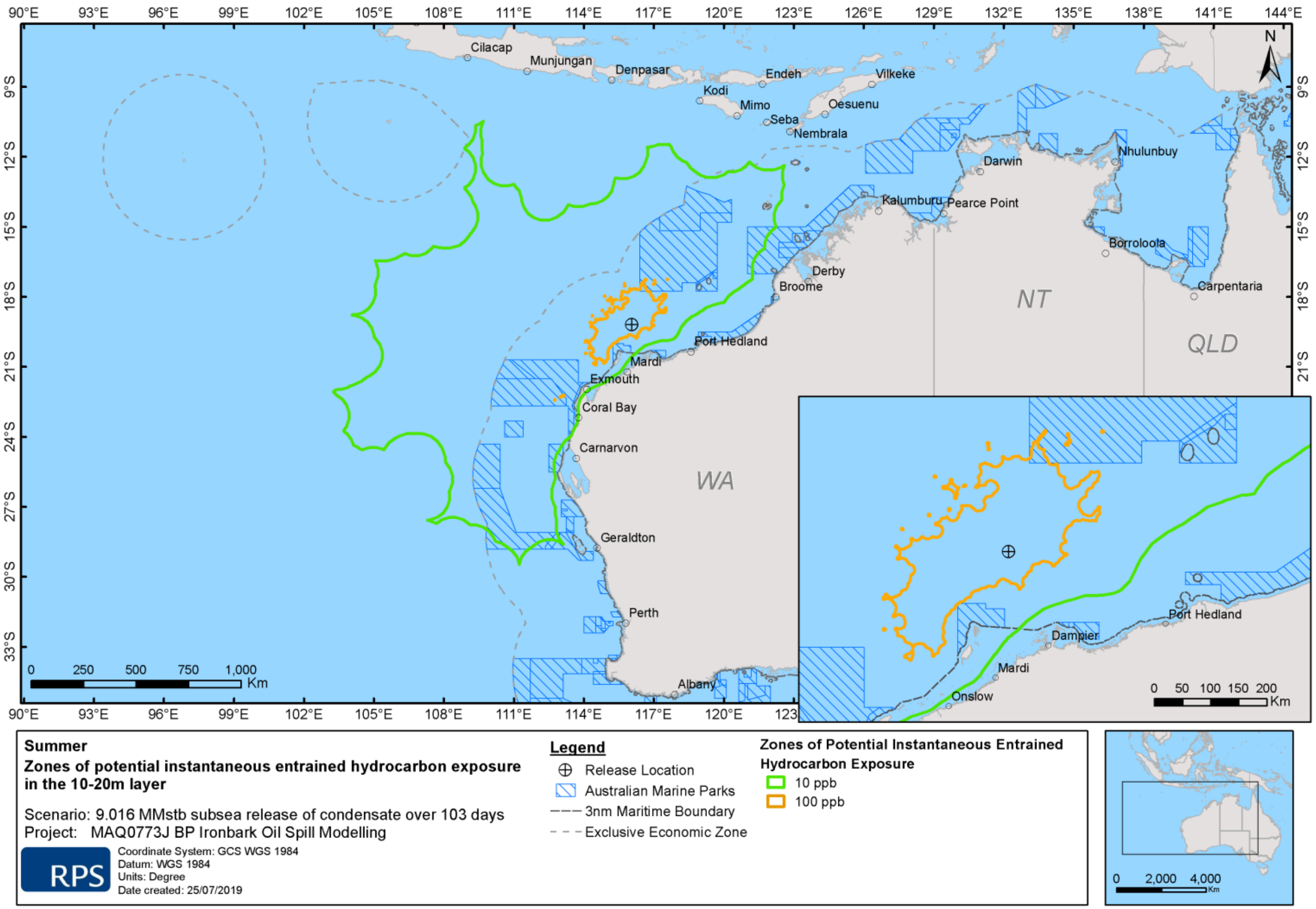
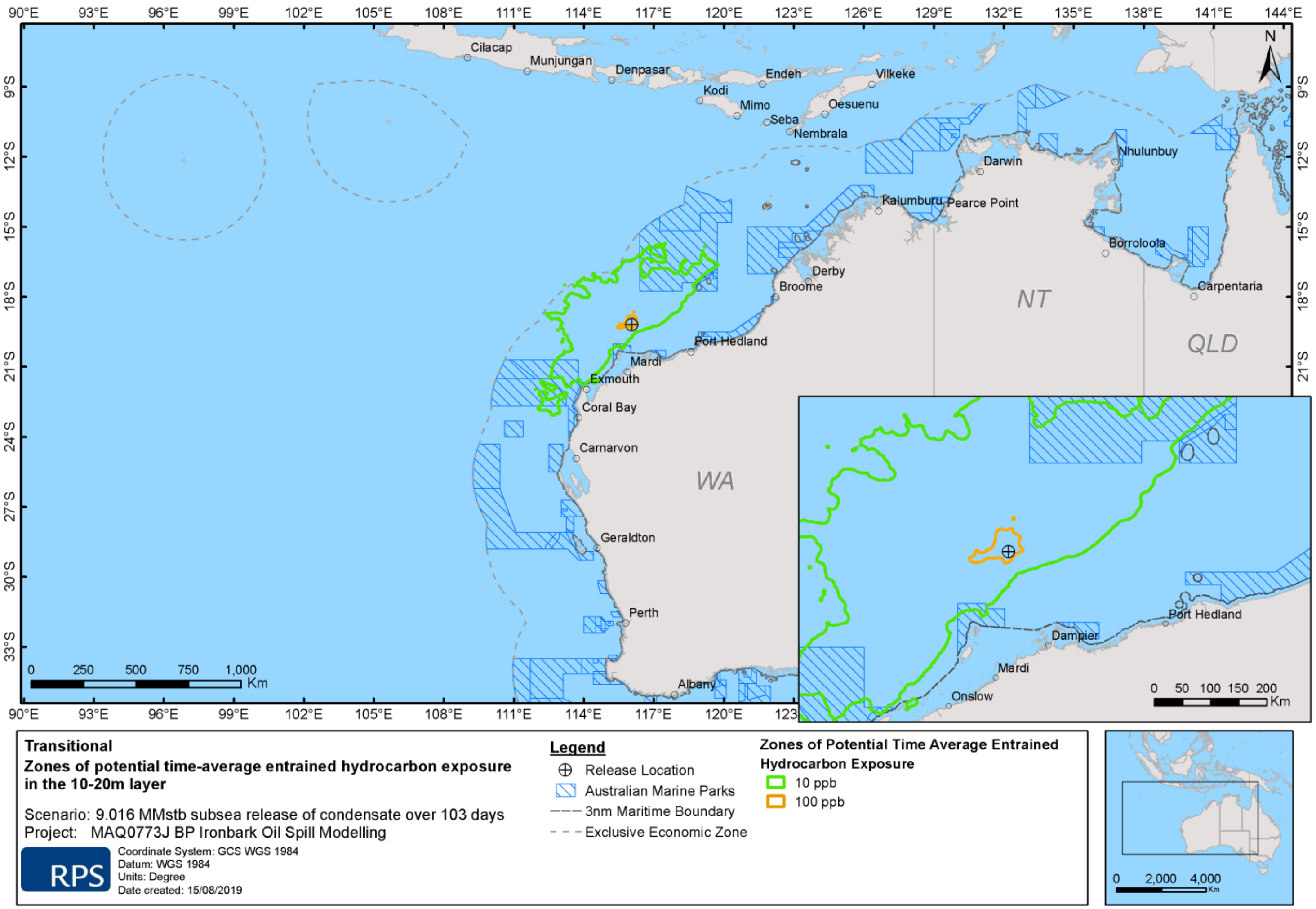


Figure 71 Zones of potential entrained hydrocarbon exposure over a 1 hour window at 10–20 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.



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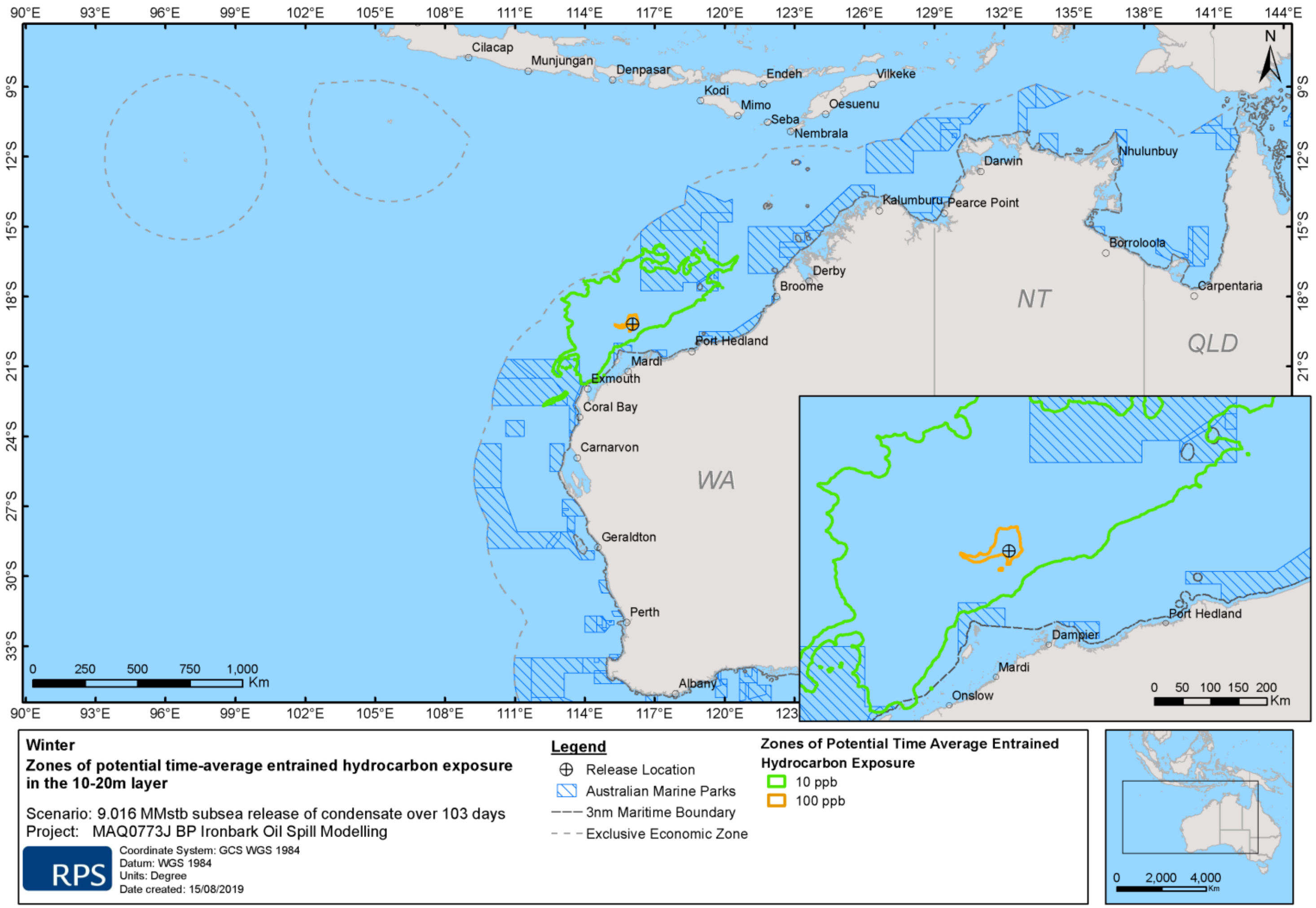

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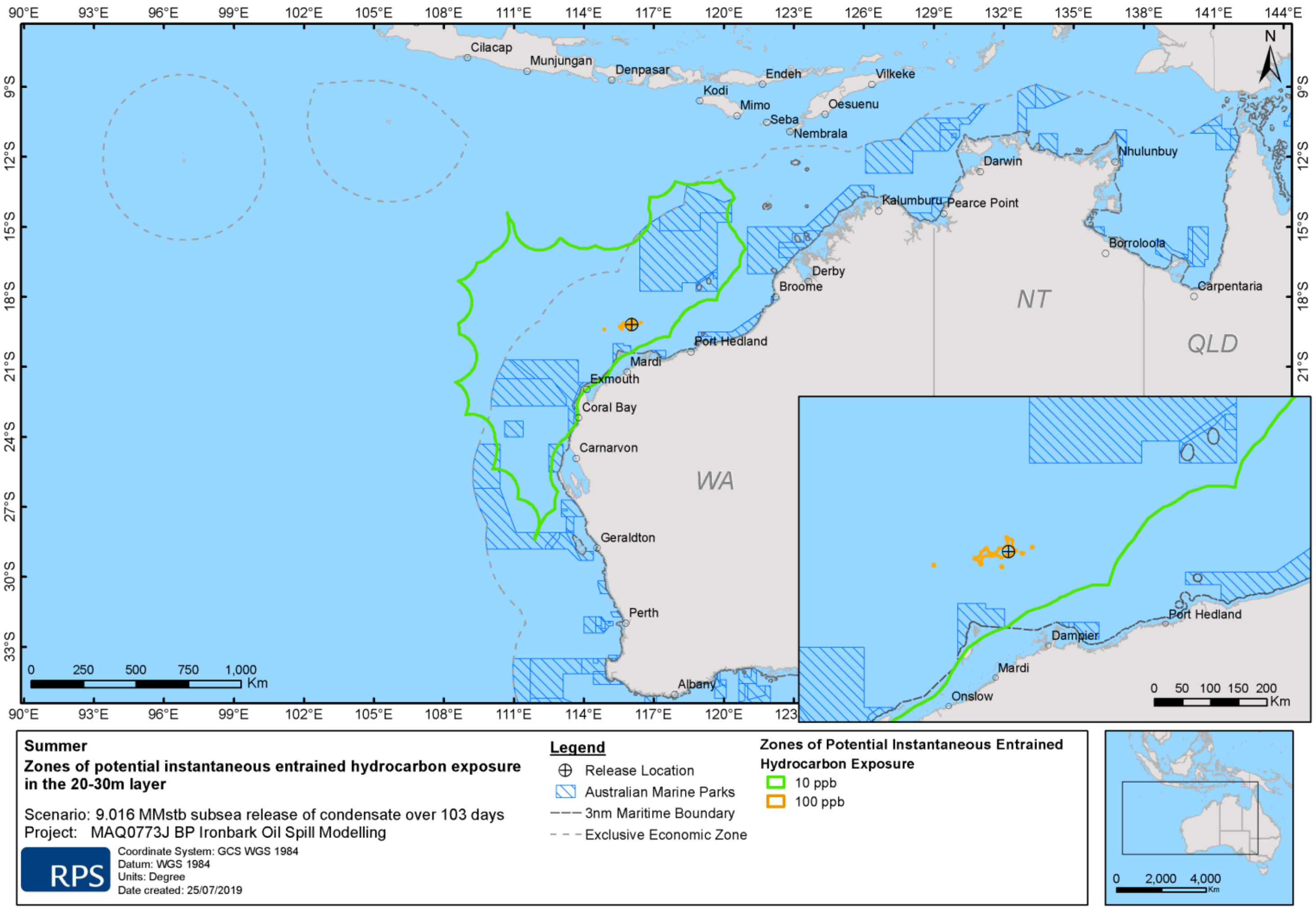

Figure 74 **Zones of potential entrained hydrocarbon exposure over a 1 hour window at 10–20 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during summer (November to March) wind and current conditions.**

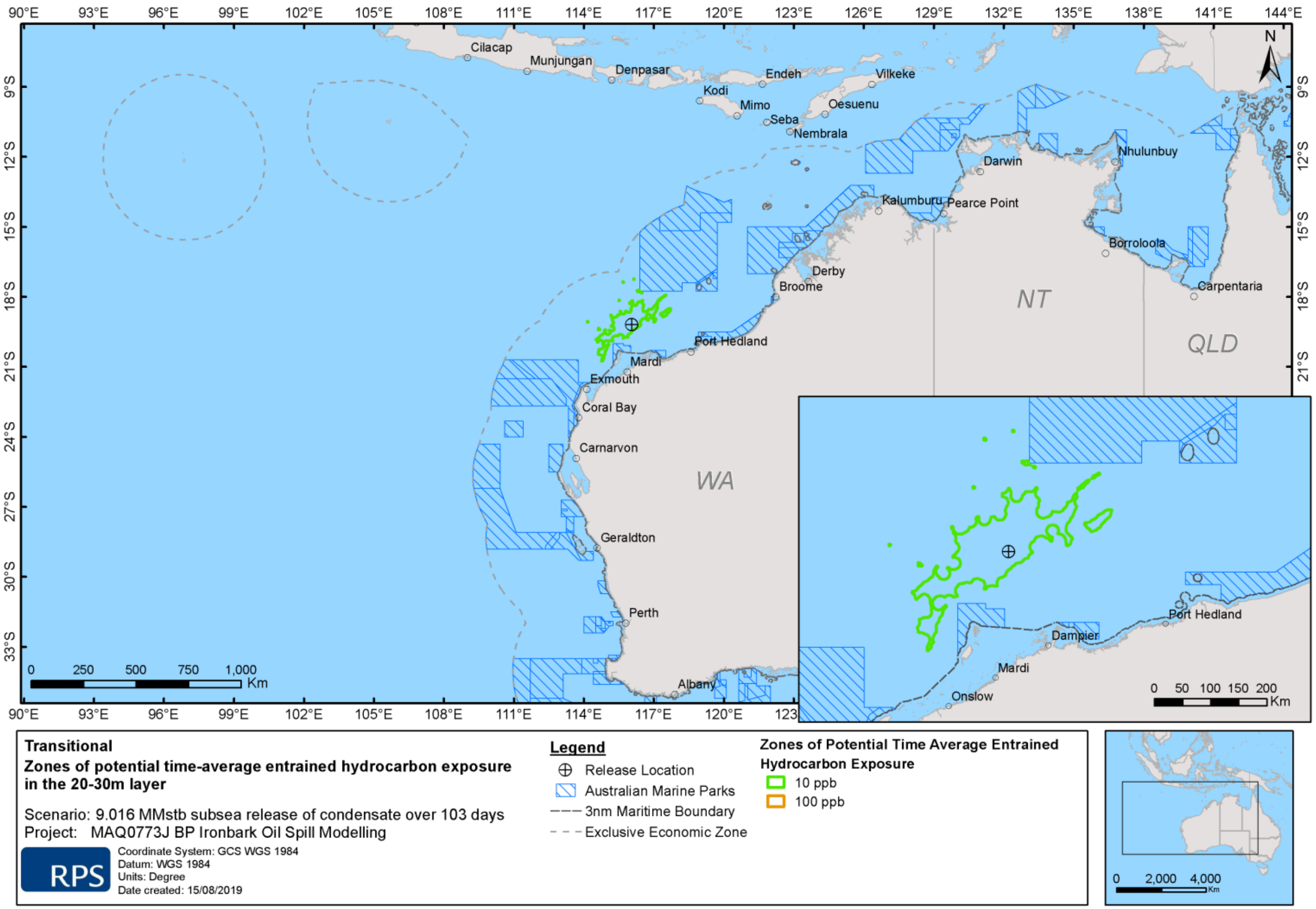

Figure 75 Zones of potential entrained hydrocarbon exposure over a 1 hour window at 20–30 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during transitional (April and September) wind and current conditions.

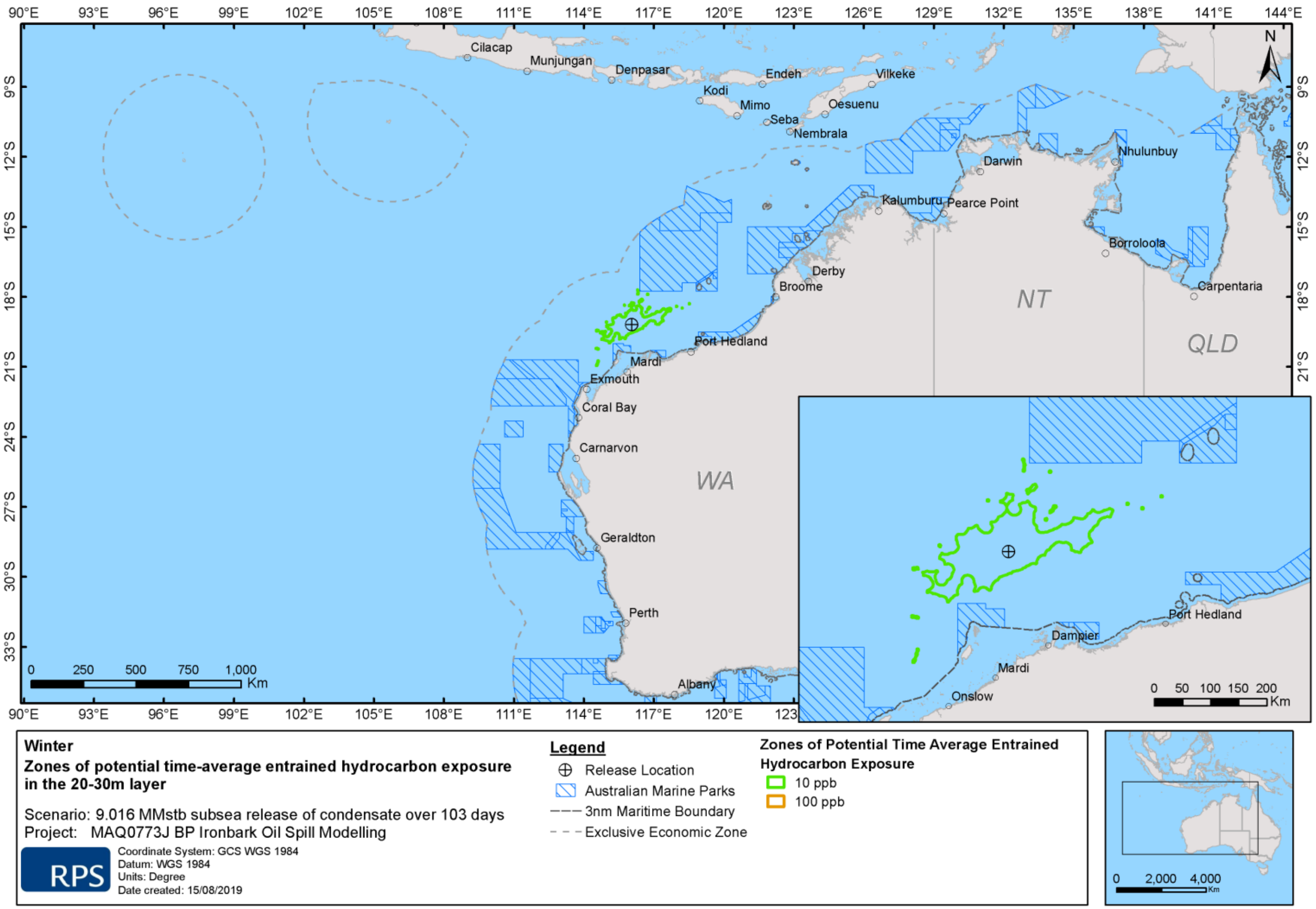

Figure 76 Zones of potential entrained hydrocarbon exposure over a 1 hour window at 20–30 m below the sea surface, in the event of a 9.016 MMstb subsea release of condensate over 103 days, tracked for 133 days. The results were calculated from 100 spill trajectories simulated during winter (May to August) wind and current conditions.

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Appendix D

Oil Pollution Emergency Plan

BP IRONBARK
Exploration Drilling

Oil Pollution Emergency Plan

AU001-HS-PLN-600-00002
Rev.A03

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Abbreviations and Acronyms

AMOSC	Australian Marine Oil Spill Centre
AMSA	Australian Maritime Safety Authority
BIA	Biologically Important Area
BOP	Blowout Preventer
BST	Business Support Team
CAA	Company Authorities AMOSPlan
C&EA	Communication & External Affairs
CBT	Computer Based Training
CST	Country Support Team
DBCA	Department of Biodiversity, Conservation and Attractions
DoT	Department of Transport
DAWE	Department of Agriculture, Water and Environment
EP	Environment Plan
ERP	Emergency Response Plan
EST	Executive Support Team
GDS	Global Dispersant Stockpile
HR	Human Resources
IAP	Incident Action Plan
IC	Incident Commander
ICP	Incident Command Post
ICS	Incident Command System
IMP	Incident Management Plan
IMS	Incident Management System
IMT	Incident Management Team
IPIECA	International Petroleum Industry Environmental Conservation Association
JSCC	Joint Strategic Coordination Committee
LEL	Lower Explosive Limit
LOWC	Loss of Well Control
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978
MDO	Marine Diesel Oil
MEE	Western Australian State Hazard Plan: Maritime Environmental Emergencies
MEER	DoT Maritime Environmental Emergency Response
MES	Monitoring, Evaluation and Surveillance
MRT	Mutual Response Team
NatPlan	Commonwealth National Plan for Maritime Environmental Emergencies
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
OC	On-scene Commander
OIE	Offset Installation Equipment
OIM	Offshore Installation Manager
OMS	Operating Management System
OPEP	Oil Pollution Emergency Plan
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OSRL	Oil Spill Response Limited
OSTM	Oil Spill Trajectory Modelling
OSWMP	Oil Spill Waste Management Plan
OWR	Oil Wildlife Response
ROV	Remotely Operated Vehicle
SFRT	Subsea First Response Toolkit
SIMA	Spill Impact Mitigation Assessment
SSDI	Sub Sea Dispersant Injection
TRP	Tactical Response Plan
UAV	Unmanned Aerial Vehicle

VOC	Volatile Organic Compounds
WA	Western Australia
WSL	Well Site Leader

1. Introduction

1.1 Purpose and Scope

This Oil Pollution Emergency Plan (OPEP) has been prepared to support BP's exploration drilling activities in WA-359-P (Figure 1.1). It has been prepared in accordance with Regulation 14(8) (8AA) (8A) of the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R) to integrate with the Commonwealth National Plan for Maritime Environmental Emergencies (NatPlan) and the Western Australian State Hazard Plan: Maritime Environmental Emergencies (MEE) (Section 1.3).

BP's exploration drilling activities in WA-359-P are described in the BP Ironbark Exploration Drilling Program Environment Plan (EP; AU001-HS-PLN-600-00001). Based on the activities described in the EP, BP has identified several accidental release scenarios that could credibly occur during the undertaking of exploration drilling activities in WA-359-P. These are described in Section 6.4 of the EP. Two of these scenarios have the potential to result in a spill of hydrocarbons to the marine environment which could require activation of the OPEP:

- A vessel loss of containment resulting from a release of Marine Diesel Oil (MDO) to the surface (Figure 1-2).
- A total loss of well control (well blowout; LOWC) resulting in a subsea release of hydrocarbon gas and gas condensate (Figure 1-3).

Table 1-1 summarises the parameters defined for those scenarios which have informed the preparation of this OPEP. Further information regarding spill response strategies applicable to these events is provided in Section 5.1.

The scenario selected for the LOWC represents a highly conservative scenario, used to evaluate the worst-case impacts and risks from a LOWC event in WA-359-P and plan for appropriate spill response measures to respond to such event. However, based on the well design adopted by BP for the Ironbark-1 well, the release of such volumes is not deemed credible. The credible worst-case scenario for LOWC is presented in the EP (Section 6.4.5).

In the event of a spill where the event differs from the scenarios described above, an Incident Action Plan (IAP) will be developed to detail response objectives and applicable strategy (Section 6.2). Initial actions described in Section 2 will remain applicable regardless of the spill event encountered.

Table 1-1: Worst Case Spill Scenarios for OPEP Implementation

Spill Scenario Parameter	Details
Release location	Ironbark-1 Exploration Well
Indicative Coordinates (WGS94)	Long: 116° 04' 35.80 (E); Lat: 19° 09' 34.01" (S)
Scenario 1 – Surface MDO release resulting from vessel loss of containment	
Oil type	MDO
Release depth	Surface
Total volume released	250 m^3
Assumed Release duration	6 hours
Applicable Spill Response Levels *	1, 2
Scenario 2 – Subsea condensate release resulting from a total loss of well control	
Oil type	Gas condensate (Goodwyn analogue)

Release depth	Subsea (approx. 300 m deep)
Total volume of condensate released	9.016 MMstb
Flow rate	91,793 bbl/day (condensate) 11,504 bbl/day (water) 1,541 MMscf/day (gas)
Assumed Release duration	103 days
Applicable Spill Response Levels*	2, 3

*refer to Table 1-2

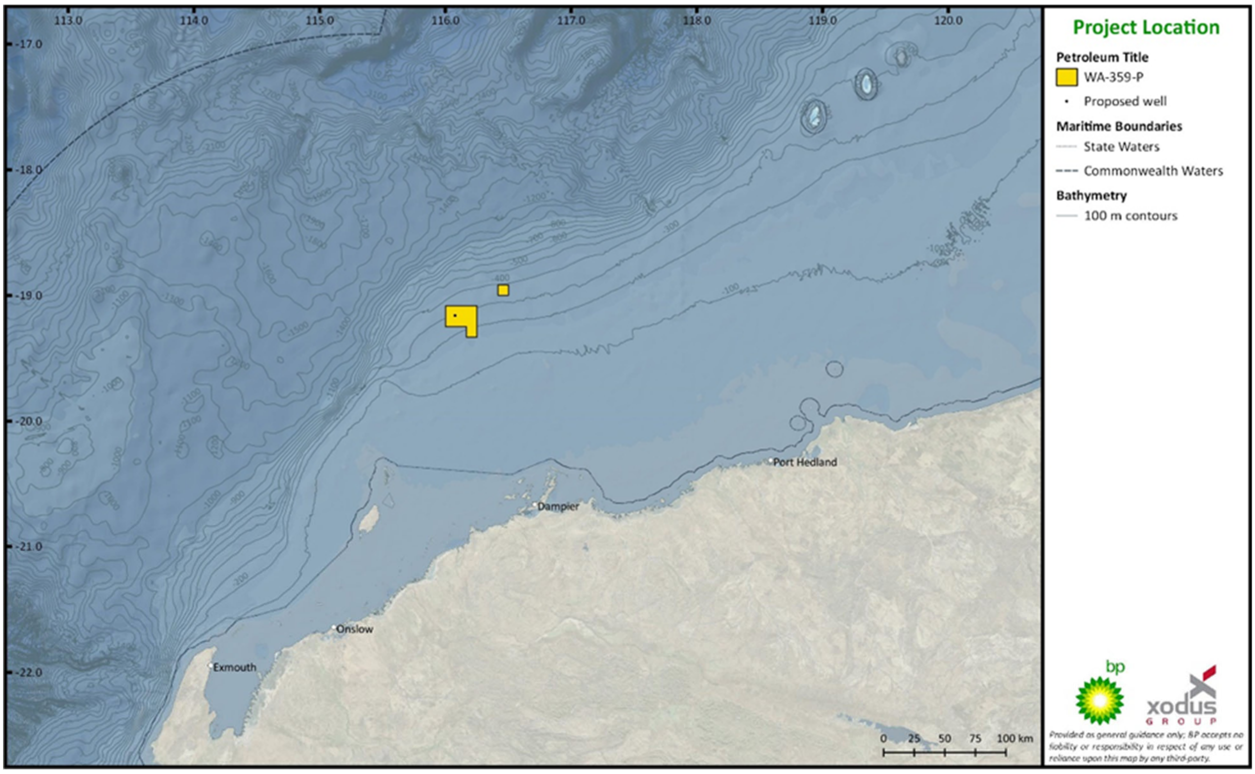


Figure 1-1: Project Location

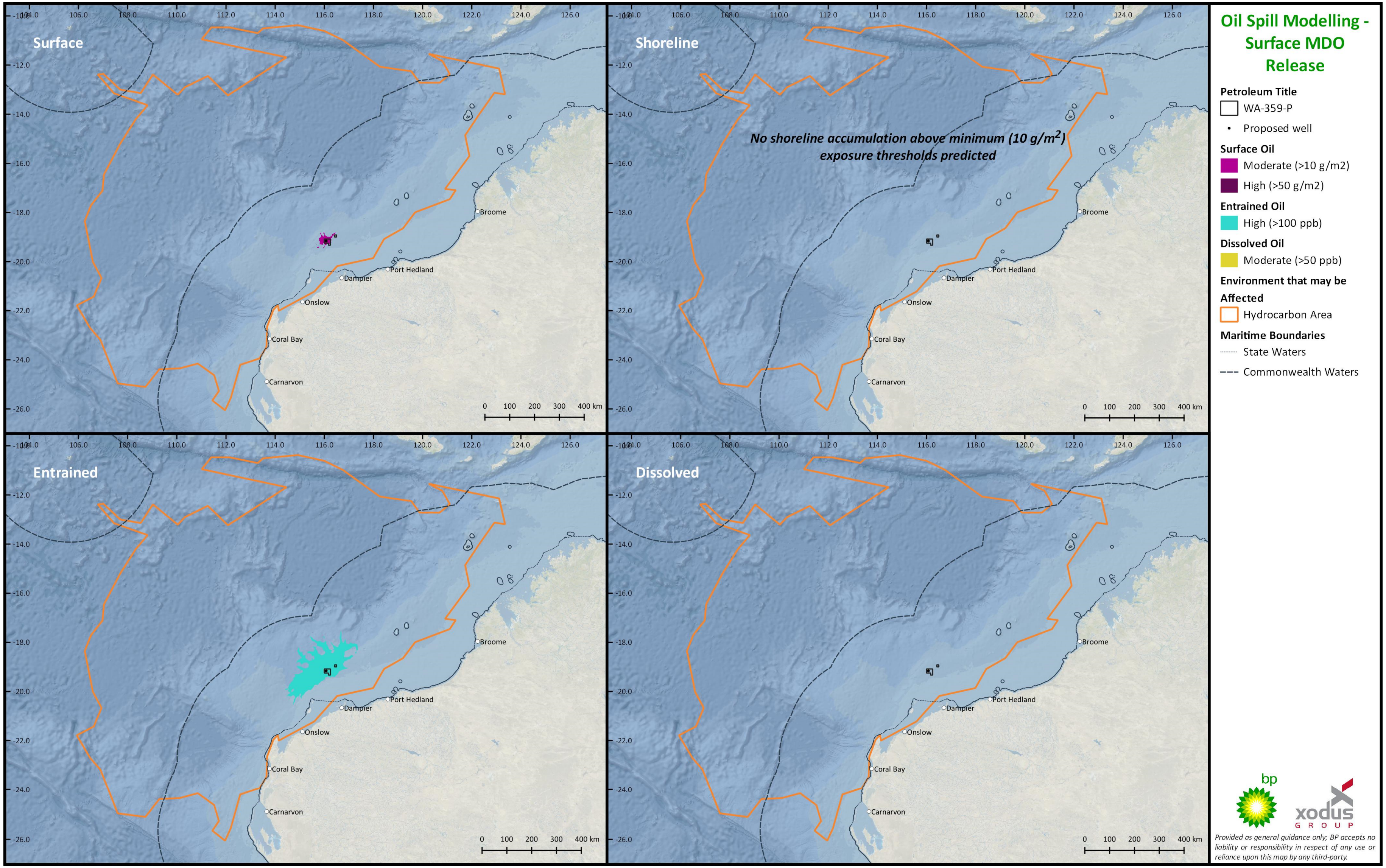


Figure 1-2: Surface Marine Diesel Oil (MDO) release resulting from Vessel Loss of Containment

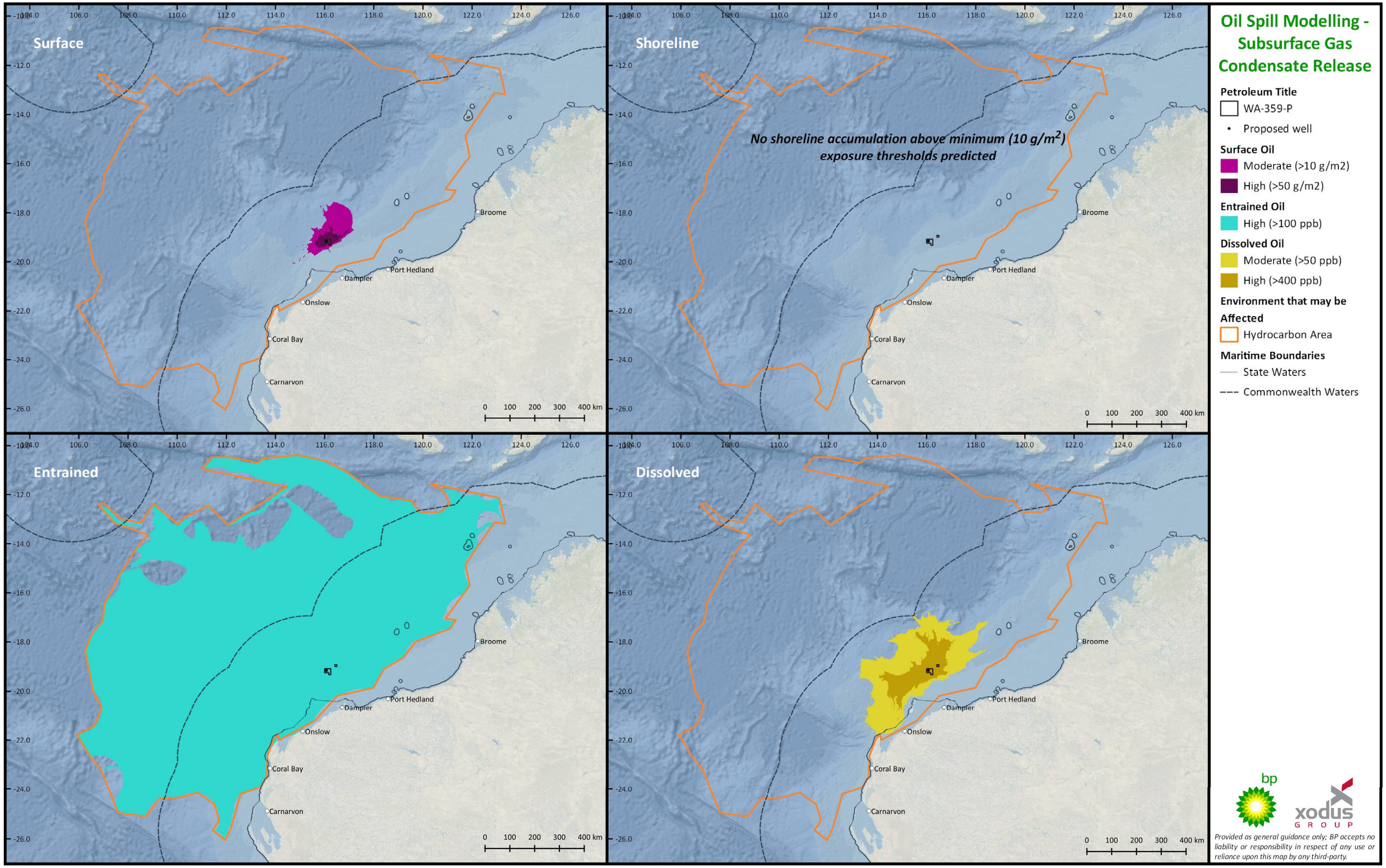


Figure 1-3: Subsurface Gas Condensate release resulting from a total loss of well control (well blowout; LOWC)

1.2 Initial Response Action Guide

This OPEP is organised to follow the general sequence of response activities, as outlined in Figure 1-4.

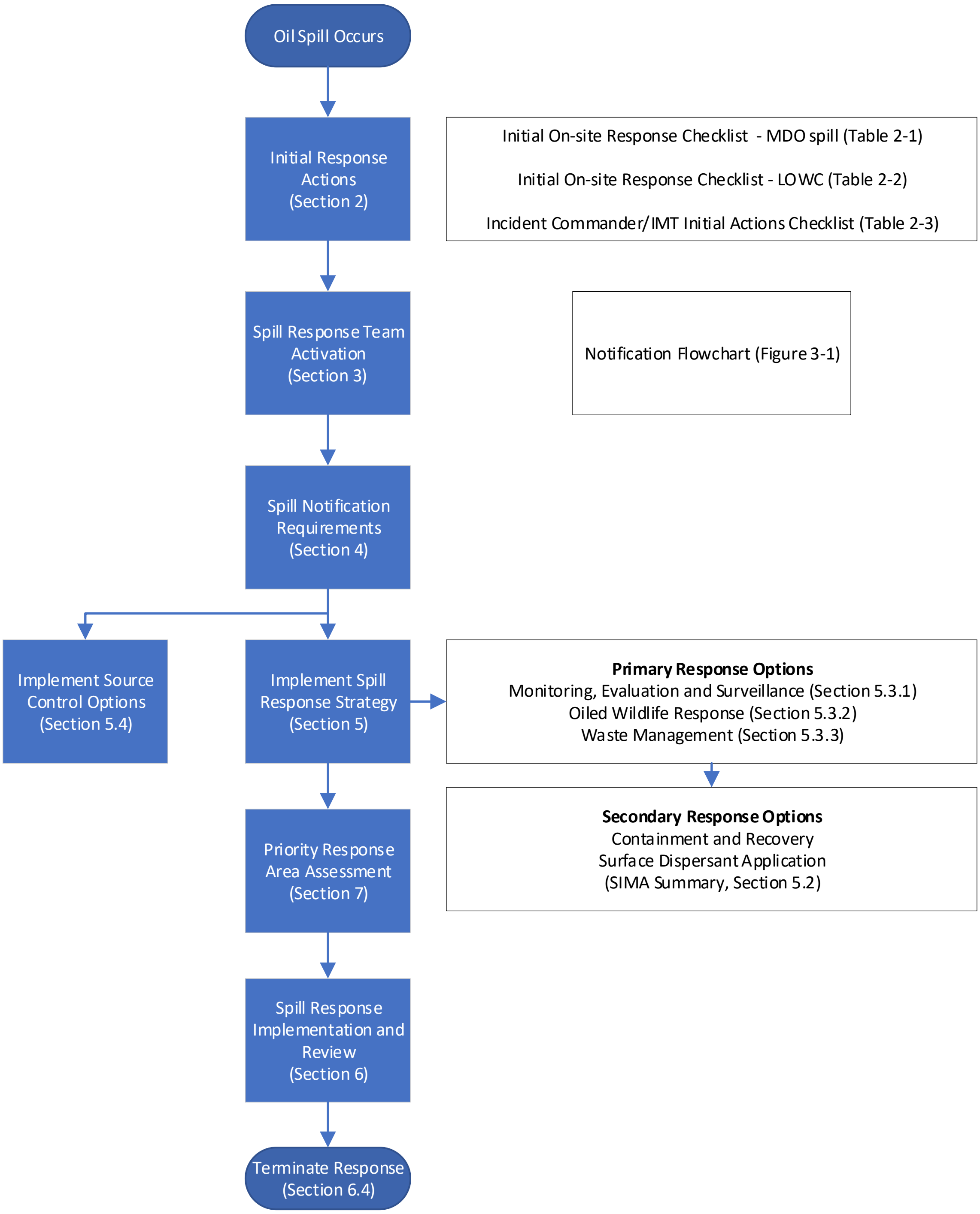


Figure 1-4: Alert Procedures and Initial Response Actions Guide

1.3 Overall Spill Response Framework

1.3.1 Applicable Framework

The OPEP has been prepared to integrate with the NatPlan and the State Hazard Plan: Maritime Environmental Emergencies (MEE) (WA).

The National Plan covers:

- National, regional, state, local and industry contingency planning for oil spill response.

- Pre-positioned spill combat equipment.
- Arrangements for mobilisation of personnel and equipment.
- National oil spill management training programs.
- Awareness by government, media and the community of issues in responding to a major spill.

The National Plan is administered by the Australian Maritime Safety Authority (AMSA), the Commonwealth agency responsible for marine safety, marine environmental protection and sea search and rescue.

The State Hazard Plan for Maritime Environmental Emergencies covers:

- Arrangements for the management of marine oil pollution in Western Australia;
- Prevention, preparedness, response and recovery information.

The Department of Transport (DoT) is the Hazard Management Agency for marine oil pollution and vessel emergencies.

1.3.1 Evaluation of Spill Incident Level

Criteria developed to support the classification of spill levels are provided in the NatPlan and summarised in Table 1-2. These should be used when required to identify the appropriate spill level.

Table 1-2: NATPLAN Guidance on Spill Level Classification

Criteria	Level 1	Level 2	Level 3
Management			
Jurisdiction	Single jurisdiction	Multiple jurisdiction	Multiple jurisdiction including international
Number of Agencies	First Response Agency	Routine multi-agency response	Agencies from across government and industry
Incident Action Plan	Simple/Outline	Outline	Detailed
Resources	Onsite resources required only	Requires intra-state resources	Requires national or international resources
Type of Incident			
Type of response	First Strike	Escalated	Campaign
Duration	Single shift	Multiple shifts Days to weeks	Extended response Weeks to months
Hazard	Single Hazard	Single Hazard	Multiple Hazards
Resource at Risk			
Human	Potential for serious injuries	Potential for loss of life	Potential for multiple loss of life
Environment (Habitat)	Isolated impacts with natural recovery in a few weeks	Significant impacts and recovery may take months. Remediation required.	Significant area and recovery may take months. Remediation required.
Wildlife	Individual fauna	Groups of fauna or threatened fauna	Large numbers of fauna
Economy	Business level disruption	Business failure	Disruption to a sector
Social	Reduced services	Ongoing reduced services	Reduced quality of life
Infrastructure	Short term failure	Medium term failure	Severe impairment
Public Affairs	Local and regional media coverage	National media coverage	International media coverage

1.3.2 BP Incident Management Plan and OPEP

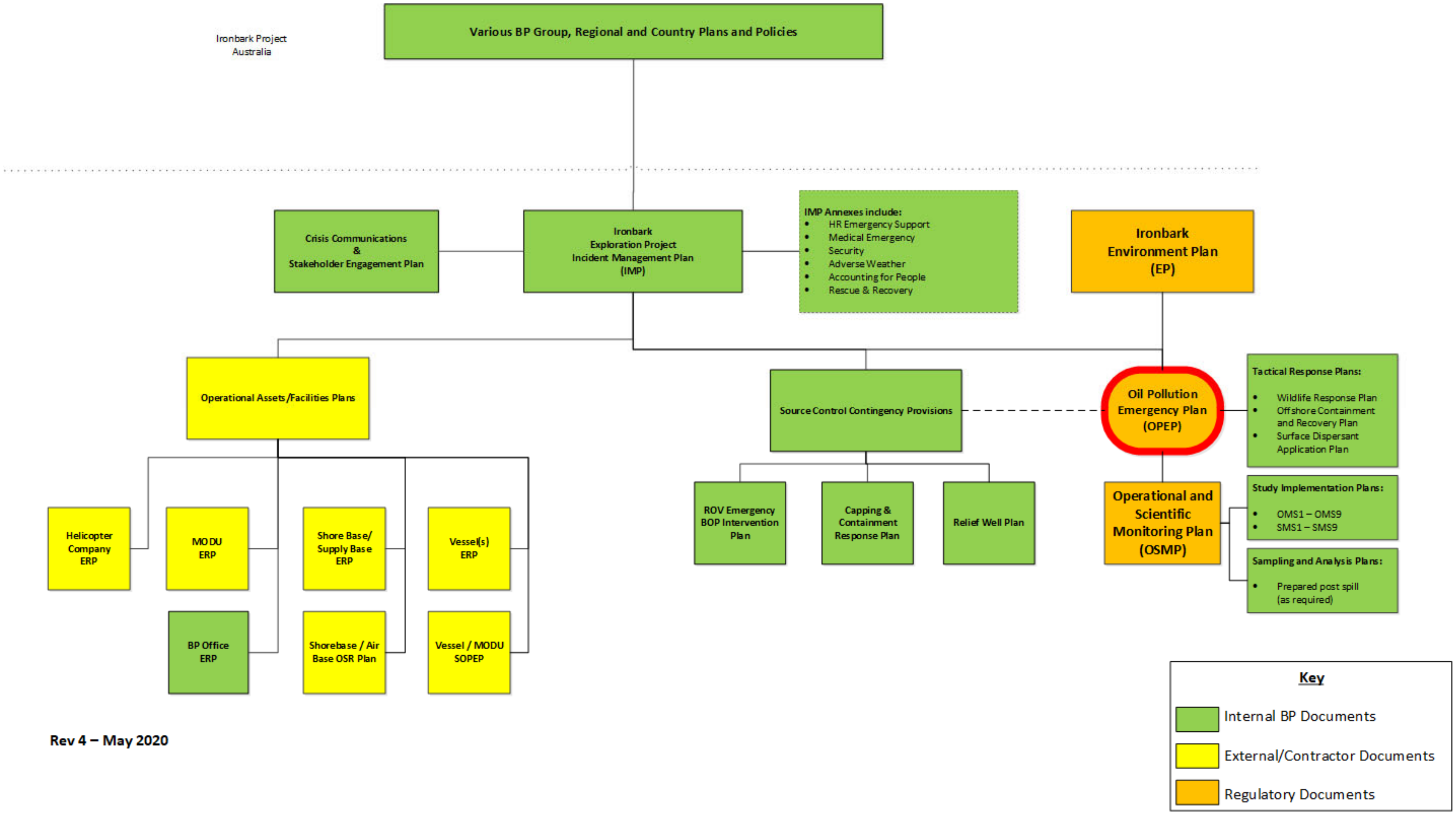
BP manages incidents resulting from its offshore petroleum activities in accordance with a project specific Incident Management Plan (IMP). The purpose of the IMP is to provide the Incident Management Team (IMT) with the necessary information to respond to any emergency, including hydrocarbon spills. The IMP:

- Describes the emergency notification and management process.
- Details the response process.
- Lists the roles and responsibilities for the IMT members.
- Provides useful resources (e.g. forms, templates) that can be used to store and organise information during an emergency situation.

An Ironbark Exploration Drilling Program specific IMP will be prepared prior to the commencement of the drilling activities which will refer to the OPEP as the operational document for use in the event of a spill. The OPEP will be implemented in accordance with BP's Operating Management System (OMS) which is described in detail within the Implementation Strategy section of the EP (EP Section 7).

A suite of other related plans and management documents exist which support an integrated response. The oil spill response management arrangements outlined in this OPEP reflect the Incident Command System (ICS) response organisational structure (described in Section 8) and associated documentation. How all these plans and documents are related, linked and interface within BP is shown in Figure 1-5.

Figure 1-5: Emergency Plans and Spill Response Documentation Interface



1.4 Strategic Response Priorities

The following strategic response priorities have been developed for this OPEP and are consistent with the overall protection priorities detailed in the National Plan and State Hazard Plan – Maritime Environmental Emergencies:

- Priority 1 – Human health and safety;
- Priority 2 – Protected habitats and cultural artefacts;
- Priority 3 – Threatened flora and fauna;
- Priority 4 – Commercial resources; and
- Priority 5 – Recreational and amenity areas.

These priorities provide context to decision making when evaluating spill response options and selecting the overall response strategy, and are continuously reviewed and assessed when reviewing feasibility and effectiveness of response options during an actual spill event.

2. Initial Response to Spill Checklists

Figure 1-4 outlines the sequence of activities to be followed on detection of a spill.

Immediate Response Actions Checklists are provided for:

- On-site response to an MDO spill from vessel (Level 1 or 2) – refer to Table 2-1.
- On-site response to a condensate spill from a loss of well control during drilling activities (Level 2 or 3) – refer to Table 2-2.
- Shore-based response from Incident Commander (IC) and IMT – refer to Table 2-3.

These are to be used as a guide and are subject to change dependent on the specific incident and conditions on the day.

Spill levels are detailed in Table 1-2.

Table 2-1: Initial On-Site Response Checklist – MDO Spill From Vessel

Step	Action	Initiated by	Additional Information	Complete
1	On discovery of a spill from the vessel - notify the Vessel Master	Spill Observer	SOPEP	
2	Manage the safety of all personnel Secure sources of ignition and alert all personnel (appropriate to the level of the spill)	Vessel Master	SOPEP	
3	If safe, stop the spill through source control actions. Assess incident and prevent further spillage.	Vessel Master	SOPEP	
4	Estimate the quantity of oil released Determine Spill Response Level required: Level 1 or 2	Vessel Master	Section 3	
5	Notify BP Wells Superintendent of spill. If Level 1: Vessel Master to act as Incident Commander (IC) and refer to SOPEP If Level 2: BP Wells Superintendent to assume role of IC, with Vessel Master becoming On-scene Commander. Proceed with Steps 6-9	Vessel Master	SOPEP	
6	In the event of a significant (Level 2) spill, deploy the oil spill tracking Buoy(s) following the deployment instructions.	Vessel Master	Section 5.3.1	
7	Provide available spill information to IC: • What is it - oil type/group/properties? • Where is it - lat/long, leading edge (if known)? • How big is it - area/volume? • What is happening to it - status of release i.e. continuing or under control? • Weather conditions at site (wind/currents)?	Vessel Master	Section 5.3.1	
8	Provide regular reports to the IC regarding the appearance and behaviour of surface spill and weather (surface wind speed, direction, sea state, current speed and direction) and tidal conditions and any changes to status of release	Vessel Master	Section 5.3.1	

Table 2-2: Initial On-Site Response Checklist – Loss of Well Control

Step	Action	Initiated by	Additional Information	Complete
1	Immediately notify the Offshore Installation Manager (OIM) of a hydrocarbon release.	Spill Observer	Section 3.1	
2	Manage the safety of all personnel. Secure sources of ignition and alert all personnel (appropriate to the level of the spill).	OIM	-	
3	If safe, stop the spill through source control actions. Assess incident and prevent further spillage.	OIM	Section 5.4	
4	Estimate the quantity of oil released. Determine Spill Response Level required: Level 2 or 3.	OIM	Section 5.3.1	
5	Notify BP Wells Superintendent. Confirm Wells Superintendent will assume IC role with OIM becoming On-scene Commander.	OIM via WSL	Section 3.1	
6	• Deploy the Oil Spill Tracking Buoy following the deployment instructions. • Alert support vessels • Alert supply base • Alert aircraft provider	OIM or delegate	Section 5.3.1	
7	Provide available spill information to IC: • What is it - oil type/group/properties? • Where is it - lat/long, leading edge (if known)? • How big is it - area/volume ? • What is happening to it - status of release i.e. continuing or under control? • Weather conditions at site (wind/currents)?	OIM or delegate	Section 5.3.1	
8	Provide regular reports to the IC (as required) regarding the appearance and behaviour of surface spill and weather (surface wind speed, direction, sea state, current speed and direction) and tidal conditions.	OIM or delegate	Section 5.3.1	

Table 2-3:Incident Commander and IMT Initial Actions Checklist

Step	Action	Initiated by	Additional Information	Complete
1	Upon notification from site (Vessel Master or OIM), determine if IC role being assumed by shoreside (e.g. BP Wells Superintendent). • If yes, proceed below, with Vessel Master/OIM assuming role of On-scene Commander. • If no, BP Wells Superintendent to monitor situation pending change in status of response.	Incident Commander	Section 3.1	
2	Notify Incident Management Team (IMT) members to standby or mobilise to Incident Command Post (ICP).	Incident Commander	Section 3.1	
3	Confirm a reliable communications line with the incident site / On-scene Commander.	Incident Commander	IMP	
4	Confirm with On-scene Commander: • muster numbers and status of personnel. • current situation with release. - shutdown and isolation. - continuing or under control. - material and quantity released.	Incident Commander	IMP	
5	Implement the project Incident Management Plan; establish Incident Command Post.	Incident Commander	IMP	
6	Determine spill trajectory – weather conditions and perform initial vector analysis. • Where is it going - Weather conditions/currents/tides? • What is in the way - Resources at risk? • When will it get there - Weather conditions/currents/tides?	BP Incident Commander or IMT Planning Section	Section 5.3.1	
7	Based on the preliminary spill assessment and operational monitoring data provided from the OIM/Vessel Master: • Assess response required. • Implement spill response commensurate to the size and level of risk.	Incident Commander	Section 5	
8	If a Source Control event (Section 5.4), notify the GWO VP – AsPac, as per the Incident Notification Chart for Subsea Wells in Non-US Waters for mobilisation of Source Control resources.	Incident Commander	Section 3.1	
9	Determine if call out of oil spill response contractor(s) is required based on the potential of the incident to escalate into a higher-level incident. • Activate AMOSC Member Agreement to support the response, if appropriate. • Activate OSRL membership to support the response, if appropriate.	Incident Commander or delegate AMOSPlan (CAA)	Section 5.6	
10	Undertake regulatory notifications and other stakeholder notifications (as required) via the Emergency Contact Directory. Develop press release (if required).	Incident Commander or delegate	Section 4	
11	Notify Business Support Team and GWO VP – AsPac.	Incident Commander	Section 3.1	
12	Put Mutual Response Team (MRT) resources on standby and be ready to mobilise if required.	Incident Commander	Section 3.1	

Step	Action	Initiated by	Additional Information	Complete
13	Prepare for potential evacuation of personnel from the incident site.	Incident Commander	IMP	
14	Obtain all necessary maps/modelling from GIS software and establish sensitivity mapping. Identify protection priorities and confirm response options via SIMA.	Planning Section Chief or delegate	Section 7 Section 5.2 Appendix A.1	
15	Review OSMP to determine which rapid assessments initiation criteria are triggered, and direct personnel to undertake required assessments.	Planning Section Chief or delegate	OSMP	
16	In the event of a vessel spill within Operational Area (6 km radius from the well location), support incident action plan (IAP) (as required) in consultation with AMOSC and Control Agency (AMSA or DoT).	Incident Commander or Delegate	Section 8.2	
17	In the event of a MODU spill, develop and implement incident action plan (IAP) in consultation with AMOSC and other stakeholders as required.	Incident Commander or Delegate	Section 6.2	
18	Ensure essential information is recorded on Events Board.	Incident Commander or delegate	-	

3. Spill Response Team Activation

3.1 Notification Process

All those that may be required to assist in an emergency are to be notified as early as possible. They are to be stood down as per instruction from the Business Support (BST) Team Leader or BP Incident Commander (IC) respectively, only when their level of involvement has been accurately assessed.

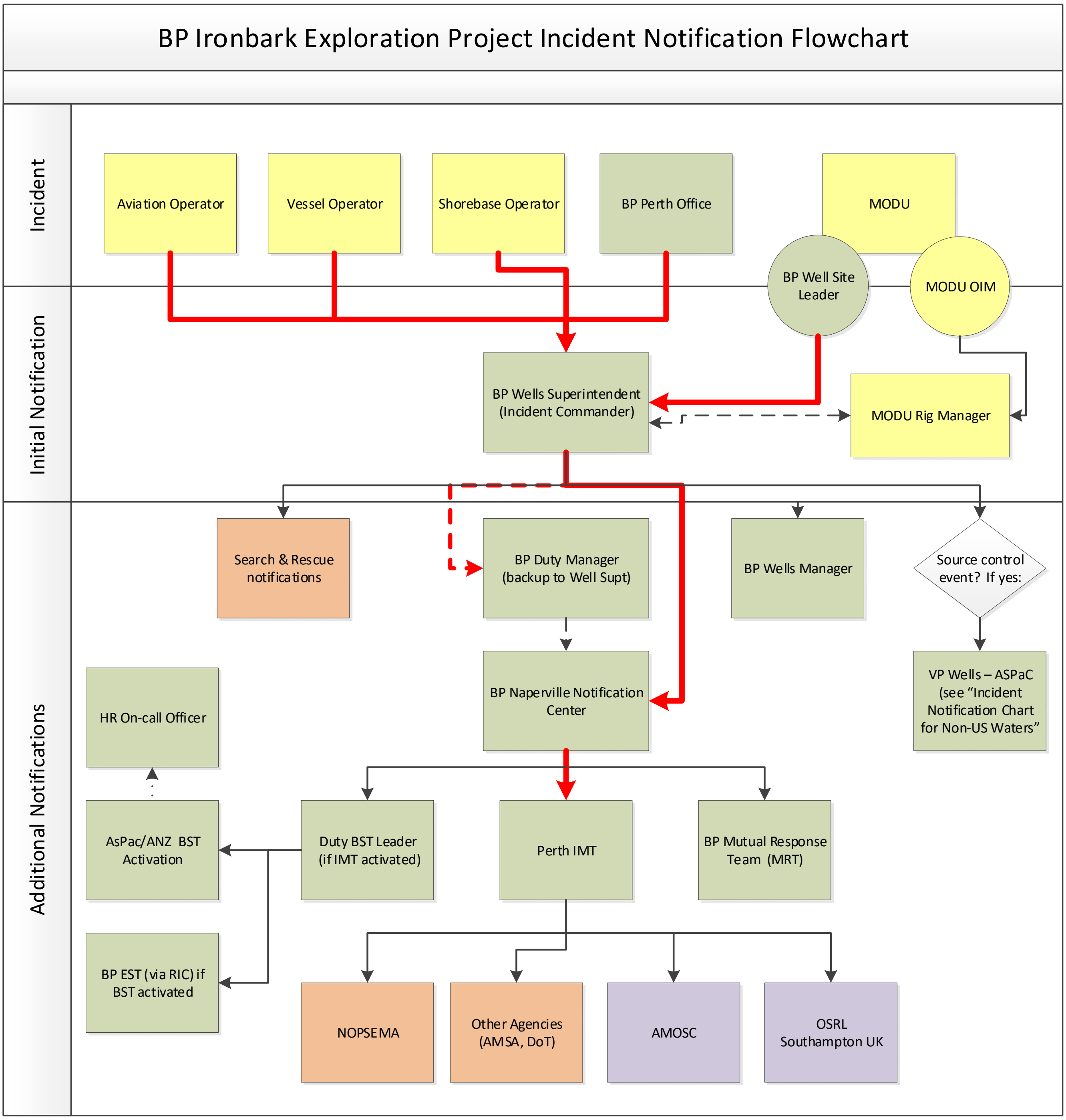


Figure 3-1: Incident Notification Flowchart

The following notification process is to be used, as depicted in Figure 3-1:

1. The incident is reported to the Wells Superintendent via the duty phone number (BP Ironbark Contacts directory). Should the Wells Superintendent not be immediately available, a Duty Manager can be contacted via on-call phone number (BP Ironbark Contacts directory). At this point, if the incident has escalated beyond a Level 1, the person contacted will confirm they are assuming the role of Incident Commander and, as such, becomes accountable for managing the BP response to the incident. The lead in the field (e.g. Vessel Master or OIM) will become the On-Scene Commander.
2. After consulting with the On-scene Commander, the BP Incident Commander will notify the Incident Management Team (IMT) members to either standby or mobilise to Incident Command Post (ICP).
3. If this is a well control event, the IC will notify the VP of Wells for Asia Pacific, as per the BP Incident Notification Chart for Subsea Wells in Non-US Waters for mobilisation of Source Control resources.
4. The IMT will action any appropriate response plans and mobilise the required resources for the incident.
5. If the IMT is activated, the Incident Commander will notify the BST Leader (or alternate) via the BP Naperville Notification Centre using Send Word Now. The Incident Commander and BST Leader will decide if a BST needs to be stood up, and what type of support it would provide. For example, depending on the nature and scale of the incident, the Incident Commander may request additional support from Perth such as HR and C&EA, or MRT support.
6. If the BST mobilises, the BST Leader will notify the Group Duty Manager, by calling the Response Information Centre, who will liaise with the Duty Segment Executive and Head of Region as required.
7. The BST Leader and Group Duty Manager will review the situation and will consider the requirement to mobilise the Executive Support Team (EST) in London.

3.2 Command Structure

The command structure encompasses the high-level, internal BP teams that support an incident response. The Incident Management Team (IMT), Business Support Team (BST) and Executive Support Team (EST) form BP’s tiered response structure (Figure 3-2). Further detail on BP’s ICS within the IMT is provided in Section 8.1. The BST and EST work with the Country Support Team (CST) to support the IMT in managing the incident response, as needed. Further details of these response arrangements are contained within internal BP Incident Management Handbook.

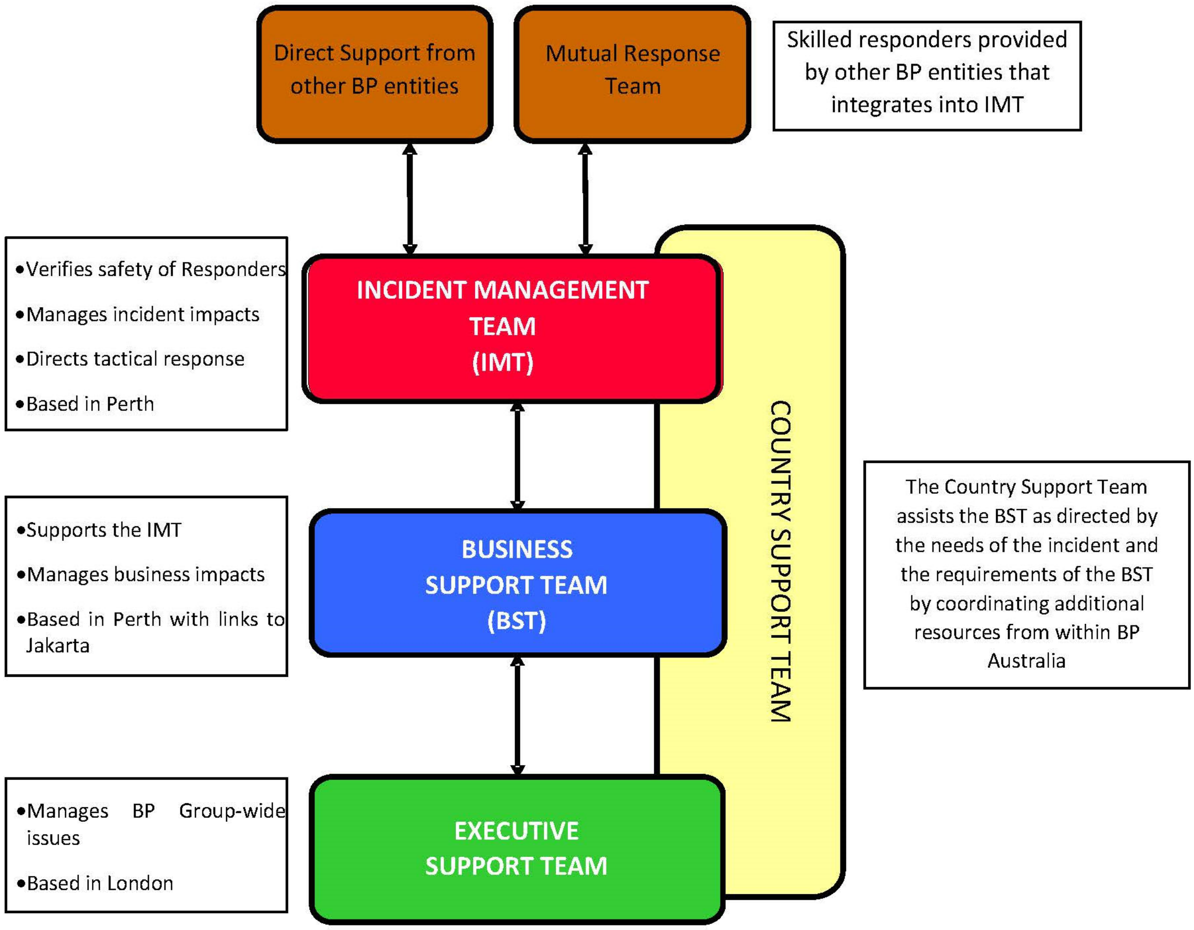


Figure 3-2: Tiered Response Structure

3.3 Local, Regional and BP Global Support

In the event of an incident, the Wells Superintendent will receive the notification and, if the incident requires management beyond the site, will assume the role of IC. The IC will activate the Ironbark IMT, consisting of the Perth-based Ironbark project team, supplemented by key staff from the BP Upstream Australia team in Perth. This IMT is on 24-hour call and can be stood up within one hour. Additional support can be drawn from the BP Kwinana Refinery in WA, which has an established and experienced IMT. Furthermore, BP also has other experienced IMT staff within the Australian Downstream businesses outside of WA, who, in the event of an incident, will support the response. Additional in-country support can be drawn from the AMOSC Core Group, which can supply up to 30 additional staff to support the IMT.

As required, the response will be supported by additional personnel, from within BP's Asia-Pacific region, from BP offices in Sunbury, UK and /or Houston, TX, USA (for source control support) and globally, from BP's Mutual Response Team (MRT). The MRT has been established specifically to provide business units working to resolve complex incidents with experienced personnel, familiar with incident response. Upon notification of a Level 2 or 3 incident, the IMT will scale appropriately in size and scope (all operational and tactical levels across the maritime, shoreline and aerial domains, as applicable) to manage the impending work load that such an incident will require.

4. External Notification and Reporting

A spill which may result from BP's exploration drilling activities is required to be reported to a range of stakeholders. Table 4-1 lists additional information relevant to external notification and reporting requirements, including the relevant legislation and the responsible party. Notifications and reporting should be undertaken by the Incident Commander or delegate. Links to spill notification and reporting forms are also included.

Table 4-1: Spill-specific Notification Requirements

Spill type	From	To	Reporting Trigger	Type	Timing	Supporting Information
Level 1 spill	Vessel Master or OIM	BP Wells Superintendent	All spills	Verbal	Immediately	-
		AMSA – Commonwealth Waters (> 3nm)	Level 1 vessel spills in Commonwealth waters	Verbal	Immediately	Report verbally or by email if phone contact is not possible to AMSA immediately: Ph: +61 2 62306811 Email: mdo@amsa.gov.au
			Level 1 vessel spills in Commonwealth waters	Written notification	ASAP	POLREP available at: https://amsa-forms.nogginoca.com/public/
			Level 1 vessel spills in Commonwealth waters	Written updates	As requested or every 24 hours	SITREP / POLREP available at https://amsa-forms.nogginoca.com/public/ and IAP
		Port Authorities	Level 1 vessel spills (threatening State waters)	Telephone	ASAP	Port authorities details available at: https://www.transport.wa.gov.au/Freight-Ports/port-authorities.asp
Level 2 MDO spill from vessel	Vessel Master	BP Wells Superintendent	All spills	Verbal	Immediately	-
	BP Incident Commander (or delegate)	AMSA – Commonwealth Waters (> 3nm)	Level 2 vessel spills in Commonwealth waters	Verbal	Immediately	Report verbally or by email if phone contact is not possible to AMSA immediately: Ph: +61 2 62306811 Email: mdo@amsa.gov.au
			Level 2 vessel spills in Commonwealth waters	Written notification	ASAP	POLREP form available at: https://amsa-forms.nogginoca.com/public/

Spill type	From	To	Reporting Trigger	Type	Timing	Supporting Information
			Level 2 vessel spills in Commonwealth waters	Written updates	As requested or every 24 hours	SITREP / POLREP form available at https://amsa-forms.nogginoca.com/public/ and IAP
		Port Authorities	Level 2 vessel spills (threatening State waters)	Verbal	ASAP	Port authorities details available at: https://www.transport.wa.gov.au/Freight-Ports/port-authorities.asp
Level 2/3 spill from MODU	Offshore Installation Manager (OIM)	BP Incident Commander	All spills	Verbal	immediately	IMT Duty Roster
	BP IC or delegate	NOPSEMA Commonwealth Waters (> 3 nm)	Level 2/3 spill or Spill has caused, or has the potential to cause, moderate to more serious than moderate environmental damage (refer to activity-specific spill risk assessment in EP)	Verbal	As soon as practicable and no later than 2 hours	Ph: 08 6461 7090
			Level 2/3 spill or Spill has caused, or has the potential to cause, moderate to more serious than moderate environmental damage (refer to activity-specific spill risk assessment in EP)	Written notification	As soon as practicable after oral notification	Email: submissions@nopsema.gov.au Copy also to NOPTA Email: info@nopta.gov.au
			Level 2/3 spill or Spill has caused, or has the potential to cause, moderate to more serious than moderate environmental damage (refer to activity-specific spill risk assessment in EP)	Written report	As soon as practicable, but within 3 days of incident	NOPSEMA Form N-03000-FM0831 Email: submissions@nopsema.gov.au Copy also to NOPTA Email: info@nopta.gov.au
		DoT Maritime Environmental	Level 2/3 spill or	Verbal and Written	As soon as practicable	DoT MEER Unit: Ph: (08) 9480 9924 (24 hours)

Spill type	From	To	Reporting Trigger	Type	Timing	Supporting Information
		Emergency Response (MEER) Unit State Waters (< 3nm)	Spill has caused, or has the potential to cause, moderate to more serious than moderate environmental damage (refer to activity-specific EP spill risk assessment)			Email: marine.pollution@transport.wa.gov.au
		Internal BP notifications (including BST/CST Leader, as needed)	Level 2/3 spill	Verbal	As soon as practicable	Initial reports on incident; Incident Potential Worksheet, if possible
		Resources/Contractors	Level 2/3 spill	Verbal	As directed	BP Ironbark Contacts directory
		Marine Stakeholders (Fisherpersons, AHO, adjacent titleholders)	Level 2/3 spill	Verbal	As directed	BP Ironbark Contacts directory

5. Spill Response Strategy Selection

5.1 Summary of Oil Spill Response Strategies

The oil spill response strategy is the implementation of one or several spill response options, at various times and locations, identified to be feasible and effective through the Spill Impact Mitigation Assessment (SIMA) process (see Section 5.2 and Appendix A).

The response strategy selected in this OPEP for an MDO release from a vessel/MODU consists of the following response options:

- Establishing a robust situational awareness;
- Implementing any necessary wildlife response.

The oil spill response strategy selected in this OPEP for a loss of well control (LOWC) event consists of the following primary response options:

- A comprehensive situational awareness (monitoring, evaluation and surveillance) from many different platforms;
- A robust oiled wildlife response, including measures to keep wildlife from the oil to the extent practicable;
- A monitoring/sampling program as described in the OSMP;
- A waste management program implemented to properly handle, track, and document any wastes.

While not primary response options, strategic aerial application of dispersant and deployment of containment and recovery equipment on isolated patches of condensate residue that may occur are considered as secondary response options (see Appendix A).

It should be noted that BP considers two distinct aspects of a response for a LOWC event:

1. Oil spill response – those actions implemented to monitor, remove, and/or mitigate the effects of hydrocarbons that have been released. Details on these selected options are provided in Section 5.3 of this OPEP.
2. Source control – the steps implemented to stop the flow/release of hydrocarbons to the environment, which include ROV emergency BOP intervention, capping and containment and drilling of a relief well. A summary of the Source Control steps to be implemented by BP for a LOWC event are summarized in Section 5.4 of this OPEP.

Both aspects (oil spill response and source control) occur simultaneously and are managed by the same IMT; however, they have distinct resources and expertise and, therefore, are addressed separately in this OPEP.

5.2 Spill Impact Mitigation Assessment Summary

A Spill Impact Mitigation Assessment (SIMA) (IPIECA 2018) is a structured, scientific and consensus-based tool used by BP to help select the most effective and feasible oil spill response option(s) that will yield the greatest benefit with the least net environmental and socio-economic effects.

The SIMA conducted for this project utilised project specific stochastic modelling outputs to help determine the full geographic area for response. The results of the planning SIMA for this project are summarised below. For more details regarding the SIMA process, refer to the Appendix A of this OPEP.

Key considerations and operational limitations and assumptions identified in the Project SIMA include:

- No shoreline contact above modelled thresholds is predicted. Due to the low waxy content expected for the condensate (less than 5%, compared to 11% for Montara hydrocarbons), waxy residues are not expected to form. Therefore, shoreline protection and cleanup response strategies are not applicable for this type of spill event.
- Given gas condensate has limited persistence and upon release the surface expression is expected to rapidly evaporate and disperse, in situ burning is not considered suitable for this type of spill event.
- On-water recovery is considered to only be effective on isolated patches of heavier/waxier residual hydrocarbons that may form (although this is not expected to occur); therefore this is considered as a secondary response option.
- If effective, dispersant use (surface or subsurface) would increase the amount of hydrocarbons entrained in the water column, negatively affecting both the water column and seabed in nearshore (<30m depth) areas.
- Any incremental worker safety increases that might be realised by use of dispersants near the release site (surface or subsurface) would be limited to the immediate area of release, and are likely to be masked by risks posed by high volumes of gas.
- Therefore, subsurface dispersant injection (SSDI) is not considered an applicable response option for this type of spill event.
- Surface application of dispersants may have some limited effect on any patches of waxy residue present away from the source that threaten sensitive receptors (although this is not expected). Therefore, this is considered as a secondary response option.

It should be noted that, in the unlikely event of an actual spill, an incident-specific expedited SIMA will be conducted, with appropriate stakeholder input to confirm and/or modify the response strategy to reflect the specific circumstances at the time of the spill. The review and verification process is detailed in Section 7.

5.3 Primary Response Options

Primary spill response options to be implemented in the event of a spill include monitoring, evaluation and surveillance (MES) (Section 5.3.1), oiled wildlife response (Section 5.3.2) and waste management (Section 5.3.3).

5.3.1 Monitoring, Evaluation and Surveillance

Monitoring, Evaluation and Surveillance (MES) is important for anticipating resources at risk of exposure, directing response resources, and evaluating the effectiveness of response techniques. MES should be conducted throughout the response duration, along with other response options, as determined by the SIMA process.

MES assists in determining whether further action is required, helps inform the decision-making for prioritisation of protection of sensitive receptors, and provides valuable information for conducting a SIMA, coordinating other response options, and continually assessing the effectiveness of those spill response options.

This OPEP includes MES tactics that may be used to evaluate the parameters and potential trajectory of the spill and may include one or more of the following:

- Fate and weathering modelling – uses computer modelling and computational techniques to estimate the weathering of an oil spill;
- Trajectory modelling – uses computer models and computational techniques to estimate the speed and direction of movement, weathering spread patterns, and impacts of an oil spill;
- Visual observation (from aircraft and/or vessels) – observers on aircraft or vessels use standard references to characterise oil slicks. Visual observation is the most common surveillance and reconnaissance tactic. Observers onboard the vessel (i.e. the source of potential spill) would be best placed to provide information;
- Remote sensing – uses remote sensing technologies, including tracking buoys and satellite imagery, to identify and track oil slicks.

The Operational and Scientific Monitoring Plan (AU001-HS-PLN-600-00003) is triggered when initiation criteria for the various assessment components are met. Those MES tactics that are associated with protecting environmental receptors are addressed in the OSMP and are not discussed further in this OPEP, with initiation and termination triggers provided in the OSMP.

Table 5-1 provides action guidance for implementing MES for this activity (noting this is guidance only and the Incident Commander may vary tasks). MES tactics will be terminated in accordance with the process detailed in Section 6.4.

Table 5-1: Monitoring, Evaluation, and Surveillance Implementation Guide

MES Tactic	Implementation / Activation Guide	Complete
Information gathering	Obtain weather data via of the Bureau of Meteorology (http://www.bom.gov.au/) for the spill location.	
Hydrocarbon, distribution, fate and weathering assessment	If necessary, conduct hydrocarbon distribution, fate and weathering assessment to further develop response strategies. This may include: • Spill fates, weathering and trajectory (for marine spills) modelling – conduct internally; through AMOSC; or conduct through AMSA National Plan arrangements. - If using AMSA, complete then email the AMSA Oil Spill Trajectory Modelling (OSTM) request form, available from: http://www.amsa.gov.au/environment/maritime-environmental-emergencies/national-plan/General-Information/SPILLREQUEST/index.asp - If using AMOSC – Initiate via AMOSC Duty Manager. - If internally, through BP Upstream HSE Team. • Undertake ADIOS modelling using hydrocarbon characteristics detailed in the EP: https://response.restoration.noaa.gov/adios.	
Vectoring	Use vectoring to identify predicted spill trajectory. A description regarding vectoring (along with a method for its implementation) can be found here: https://response.restoration.noaa.gov/sites/default/files/Trajectory_Analysis_Handbook.pdf	

MES Tactic	Implementation / Activation Guide	Complete
Tracking Buoy Monitoring	Access oil spill tracking buoy live feed data if a buoy has been deployed from the vessel: • Buoy service will be activated prior to spudding well and vessel and rig operators will be trained on their deployment. • BP – through Metocean Services - can log into the tracking buoy account and monitor location.	
Aerial Observation	Mobilise Aerial Observation aircraft (if Level 2/3 incident) to commence operations in daylight hours (through AMOSC or BP internally). Initial aerial observation to be conducted from crew change helicopter supplier followed by AOO identified through AMOSC and/or OSRL.	
Marine Observation	Obtain vessel observations and confirm deployment of satellite tracking buoys (as appropriate if Level 2/3 incident). Access oil spill tracking buoy live feed data from buoy deployed from the vessel / MODU.	
Satellite Imagery Observation	Access satellite imagery through AMOSC and/or OSRL.	

5.3.2 Oiled Wildlife Response

Any release of oil into the marine environment has the potential to immediately impact wildlife. As such, rapid establishment of the Wildlife Branch, activation of an oiled wildlife response contractor, and the immediate implementation of wildlife response actions are in the best interest of prevention and mitigation of impact to wildlife and responding to oiled animals through capture and rehabilitation.

The level of escalation of the OWR is determined by the IMT, informed by advice from BP, Parks and Wildlife Oiled Wildlife Advisors and data collected via initial MES tactics. The OWR will be conducted in accordance with the WA Oiled Wildlife Response Plan (Parks and Wildlife & AMOSC 2014). This overarching document provides the framework for OWR, with the regional context and detail required to carry out an OWR provided in seven regional response plans. The relevant Regional Oiled Wildlife Response Plan(s) will be enacted following initial MES information.

Table 5-2: Oiled Wildlife Response Implementation Guide

Tactic	Implementation / Activation Guide	Complete
OWR Activation and Escalation	Activate the relevant Regional Oiled Wildlife Response Plan(s) in accordance with the WA Oiled Wildlife Response Plan (Parks and Wildlife & AMOSC 2014). https://www.dpaw.wa.gov.au/images/documents/conservation-management/marine/wildlife/West_Australian_Oiled_Wildlife_Response_Plan_V1.1.pdf Notify key stakeholders as outlined in the relevant regional OWR plan, based on preliminary reports and trajectory information.	
Wildlife First Strike Response	Activate the relevant Regional Oiled Wildlife Response Plan in accordance with the WA Oiled Wildlife Response Plan. Undertake the Wildlife First Strike Response steps outlined in the WA Oiled Wildlife Response Plan.	
Mobilisation of Resources	Mobilise personnel, equipment and facilities in coordination with AMOSC and Parks and Wildlife.	

Wildlife Reconnaissance	Determine potential wildlife resources at risk based on initial MES data (aerial and marine observation). Mobilise personnel to conduct shoreline observations. Focus resources on potential populations at risk, based on trajectory analysis (MES tactics). Information gained from these surveys is key to mounting effective deterrence, search and capture, and response efforts and will be used to determine the scope and scale of wildlife response.	
Incident Action Plan Wildlife Sub-Plan	Develop the incident action plan wildlife sub-plan in coordination with regulatory agencies (DAWE, DBCA, WA DoT) and AMOSC based on known conditions and information gathered from wildlife reconnaissance and MES. The sub-plan is to be modified or amended throughout the incident as needed when conditions change. The sub-plan is to include the appropriate response options: • Wildlife priorities for protection from oiling, • Deterrence measures, • Recovery and treatment of oiled wildlife; resourcing of equipment and personnel.	
Wildlife Rescue and Staging	Based on daily wildlife monitoring observations and assessment of oil-impacted wildlife, determine location of wildlife rescue effort locations (where there are known concentrations of impacted animals) and appropriate rescue methods based on individual animal health condition or potential for rapidly declining health secondary to oiling. Mobilise OWR kit(s) and containers managed by AMSA, AMOSC to site.	
Wildlife Rehabilitation	Rehabilitate oiled wildlife immediately after an incident. Guiding best practice documents include the following: • IPIECA, 2014. Wildlife Response Preparedness: Good Practice Guidelines for Incident Management and Emergency Response Personnel; • IPIECA, 2017. Key Principles for the Protection and Care of Animals in an Oiled Wildlife Response; • USFWS, 200. Best Practices for Migratory Bird Care During Oil Spill Response, 2003; • ECCC-CWS (in draft). National Policy on Wildlife Emergency Response; • NOAA, 2015. Pinniped and Cetacean Oil Spill Response Guidelines; • NOAA, 2010. Oil and Sea Turtles: Biology, Planning and Response; • Oiled Wildlife Care Network–UC Davis Wildlife Health Center, 2016. Protocols for the Care of Oil-Affected Birds; • NWRA/IWRC 2012. Minimum Standards for Wildlife Rehabilitation 3rd edition.	
Oiled wildlife carcass collection	Recover dead oiled wildlife at sea as part of ongoing oil recovery operations. Oiled wildlife carcasses will be bagged and labelled and transported in accordance with approved wildlife response plan.	
Marine mammal and turtle sampling/necropsy	Investigate marine mammal and turtle strandings, collect samples and conduct carcass necropsy as determined on a case-by-case basis. BP to request AMOSC assistance whenever needed.	
Waste Management	Refrigerate carcasses to preserve for pathology studies and reduce potential for further contamination. Oil contaminated wastes and carcasses to be managed in accordance with local council and waste contractor requirements.	

5.3.3 Waste Management

Oil spills to the marine environment can generate significant amounts of oily waste that need to be collected and disposed of properly, in accordance with MARPOL 73/78 Annex V – Garbage, relevant Commonwealth and State/Territory laws and regulations.

Immediately upon knowledge of an oil spill, BP will develop an Oil Spill Waste Management Plan (OSWMP) in consultation with AMOSC and the relevant control agency. The OSWMP will ensure the ongoing supply and backload of appropriate waste management equipment.

Based on the predicted outcomes of the modelling of worst case spill scenarios (Section 1.1), large volumes of waste are not expected to be generated. Waste generated from the spill is anticipated to be managed and contained within small transportable waste receptables, suitable for the storage capacity on support vessels and port waste reception facilities at the Port of Dampier and Port of Port Hedland.

All waste stored or transferred will be fully documented, including details of exact volume and nature of the waste, date and time, receiver of the waste and destination of the waste, in accordance with vessel Garbage Management Plans and the onshore licenced waste contractor's waste tracking process.

5.4 Source Control

Source control tactics for consideration in this plan include:

- ROV emergency BOP intervention
- Well capping and containment
- Relief well installation

The feasibility/effectiveness of ROV emergency BOP intervention, well capping and containment and relief well installation is provided in Table 5-3. Source control tactics will be terminated in accordance with the process detailed in Table 6-2.

Table 5-3: Source Control Response Option Suitability / Feasibility / Effectiveness Evaluation

Parameter	ROV Emergency BOP Intervention	Well Capping and Containment (including Offset Installation Equipment (OIE))	Relief Well Operations
Suitability/Feasibility - Is the response option suitable for the spill scenario / hydrocarbon type?	ROV emergency BOP Intervention involves secondary efforts to activate the existing BOP barriers to achieve well control using a ROV. Secondary BOP activation relies on delivering hydraulic fluid directly to the BOP stack using a Remotely Operated Vehicle. This is to mitigate any problems that may have arisen with the BOP control system as a result of the LOWC event. Secondary BOP activation allows the delivery of the BOP control fluid direct to the stack. If the existing barriers are fully compromised then this route would not be effective. If these are potentially operable then BP would utilise the nominated BOP intervention vessel, with ROV installed complete with an API Standard 53 compliant skid (ROV tooling package), to attempt secondary activation of the BOP following risk assessment and authorisation. To determine if BOP intervention is feasible, a detailed ROV intervention plan is prepared prior to the drilling of the critical reservoir sections, specific to ROV intervention panel on the BOP and the tooling package present on the nominated BOP intervention vessel. This plan is reviewed by BP, the ROV provider and the drilling contractor prior to the drilling of the critical reservoir sections. In the event of a loss of well control, an initial survey of the incident site would be conducted during daylight. This would include an initial ROV survey, which is critical to understanding the condition of the blowing out well and inform source control activities. This would also include an assessment of the risk associated with the gas plume, which would be managed throughout the response using a combination of weather forecasting, current	Potential well capping methods are largely dependent on the specific event conditions encountered. In terms of the Ironbark-1 well, the effectiveness of capping a condensate well with a high gas component in 300 m water depth is scenario dependent and consequentially uncertain. However, successful capping offers significant benefits from a source control point of view, greatly reducing the operational scope of the response and consequentially the duration of the spill. BP would mobilise all relevant equipment if the conditions were suitable for an effective response. The potential well capping options available to BP include vertical access capping deployment or offset installation equipment (OIE). If vertical well access is available, then vertical access capping deployment can be implemented. Scenario specific landing analysis has been performed using the Capping Stack Uplift Calculator developed for BP by Stress Engineering Services, Inc. to determine the feasibility of a vertical capping operation. This confirms no issues for cap landing (based on uplift forces) using the OSRL 18 ¾" 15K capping stack. Based on landing studies conducted for the 18 ¾" capping stack, the uplift force is not considered the limiting factor for capping. However, a subsea plume dispersion study has been conducted based on the worst-case credible discharge volumes to characterise the dimension and position of the surface plume and associated gas cloud. This modelling indicates that the maximum surface plume radius predicted would not allow vertical access with a crane vessel in the event of a worst case LOWC event. However, BP does not rule out the use of a vertical access cap at this stage of the planning process. Although the worst-case credible discharge predicted would not allow for vertical access, less severe LOWCs resulting in smaller releases may occur. In this situation, vertical access may be possible. In the event	Dynamic kill modelling has been completed internally by BP specialists and validated by Wild Well Control. Simulation results verify that the Ironbark-1 well can be dynamically killed using a single relief well without risk of fracturing the formation and inducing downhole losses. BP requested Wild Well Control independently verify the dynamic kill requirements and propose a technical strategy for responding to a blowout event. BP requested that Wild Well Control focus on solutions utilising a single relief well and single MODU to manage the complexity associated with the emergency response. Based on high-level assessments of local MODU capability and other known equipment limitations, Wild Well Control concluded it was feasible to dynamically kill the well using a single relief well MODU. The dynamic kill strategy presented by Wild Well Control provides for a useable kill volume of 40,000 bbls and pump rates of up to 140 bpm, which is in excess of the dynamic kill requirements estimated for the Ironbark-1 well.

Parameter	ROV Emergency BOP Intervention	Well Capping and Containment (including Offset Installation Equipment (OIE))	Relief Well Operations
	modelling, real time gas monitoring, and vessel positioning/manoeuvring. The captain of the vessel is ultimately in command and would only proceed with ROV emergency BOP intervention once all mitigation measures were fully operational.	of a LOWC, a visual estimate of the boil size would also be provided by on-site vessels, which would support feasibility assessment of the deployment of the vertical access cap. For well capping to be deemed viable, validations would be performed post incident based on incident specific criteria, specific vessel capabilities and prevailing environmental conditions. In the event the water depth and flow rates prohibit vertical access over the incident well, OIE is an alternative method to install a capping stack. Results of a gas flow rate study conducted by BP identified that capping would require OSRL's 18 3/4'' cap together with the OIE system which is rated for use on wells up to 1.3 Bcf/day blowout rates. The OIE method is considered appropriate for the Ironbark-1 well given the worst-case flowrate of 0.9 Bcf/day is less than 1.3 Bcf/day. The OIE method requires between 4 and 7 vessels for deployment, which would represent a significant number of vessels required in addition to those needed to support the drilling of the relief well, affecting vessel availability in the region. The requirement for vessels would also create challenges in accessing the well location for simultaneous operations on capping and the relief well drilling operations. BP acknowledges that the OIE method has never been used in a real LOWC scenario, and the prompt spudding of the relief well remains BP's priority, as it is considered the most effective way of killing the blowing out well. Therefore, the use of OIE equipment would only be sanctioned by BP if an assessment post LOWC event concluded the deployment of the OIE would not affect relief well drilling operations. In addition, other pre-incident verifications have been performed as per standard BP practice to validate the BP capping strategy: • specific clash check drawings showing the OSRL cap installed on the Ocean Apex BOP. This confirmed	

<table>
<tr><th>Parameter</th><th>ROV Emergency BOP Intervention</th><th>Well Capping and Containment (including Offset Installation Equipment (OIE))</th><th>Relief Well Operations</th></tr>
<tr><td></td><td></td><td>the required cap configuration and absence of any clash points with BOP structure;
• Strategy for secondary lower marine riser package (LMRP) removal to ensure access to primary BOP capping point;
• Logistics survey to confirm the ability to air-freight the capping stack and transfer quayside for loadout.</td><td></td></tr>
<tr><td>Dependencies - Does the response option rely on other systems to perform its intended function?</td><td>ROV emergency BOP intervention is dependent on the availability of the following equipment required:
• Nominated BOP intervention vessel:
- The nominated BOP intervention vessel acts as an anchor handler, part time supply boat and part time standby vessel when it is on station in the field.
- The nominated BOP intervention vessel is equipped with the required equipment prior to the drilling of the critical reservoir sections.
• ROV tooling package:
- A full work class ROV with a 1,000 m tether;
- An integral pumping skid with capacity to provide the fluid volume required to close the blind shear rams (BSR), with a continuous pumping pressure equal to the certified shear pressure as listed on the BSR certificate;
- The pumping skid would be fitted API 17H compliant male hot stab technology to interface with the BOP manifold, and allow activation of the BOP's critical functions. These include:
• blind shear rams close and lock;</td><td>The key dependencies in implementing vertical access capping and OIE are:
• Vertical access capping - equipment required includes sourcing a 15 kpsi full capping stack, transport of equipment to location, ROV support vessel (for site inspection and verification of installation) and access to one capping deployment vessel to transport and deploy the sourced capping stack to the Ironbark-1 well location. In the event debris clearance was required, the capping deployment vessel would be used for debris clearance.
• OIE - equipment required includes sourcing a 15 kpsi full capping stack, sourcing an OIE system toolkit, transport of equipment to location, ROV support vessel (for site inspection and verification of installation) and access to at least one OIE deployment vessel to transport capping stack and OIE system toolkit to Ironbark-1 well location, and other support vessels as required.
• Access to equipment specialists to support deployment operations.
For both methods, the capping stack is delivered to the field by a capping deployment vessel. Once the capping deployment vessel and ROV support vessel are on site, the capping stack would be lowered either onto the BOP, guided by ROVs (vertical capping) or onto the seabed (OIE).</td><td>Response is dependent on the availability of trained and experienced resources to undertake activities, the identification of an appropriate relief well location, the sourcing of a suitable rig, the acceptance of the required safety case revision for the relief well rig, and sourcing of long lead drilling items.
<u>Availability of trained and experienced resources</u>
BP employs marine and mooring technical specialists that would be used to assist in the rapid redeployment of one of these MODUs at the selected relief well location and provide assurance and technical oversight to any third-party work undertaken during this process.
<u>Relief well location</u>
As per BP policy, two contingency relief well spud locations have been identified and screened for suitability as part of BP's relief well planning process. There is no existing subsea infrastructure at either relief well location, which have been selected 700 m away from the planned Ironbark-1 spud location. However, debris from the blowout incident could result in increasing the surface offset if using a moored rig to expedite operations. This would be assessed at the time of incident when more information becomes available.
<u>Sourcing of suitable rigs</u>
BP has identified several MODUs that are scheduled to be operating offshore in Western Australia during the Ironbark drilling program. Of these MODUs the Maersk Deliverer (INPEX), Valaris DPS-1 (Woodside), and GSF Development Driller 1 (Chevron) are expected to be suitable for Ironbark relief well drilling operations and be accessible via the APPEA MoU, which BP is a signatory.
Detailed planning work has been conducted and based on the current drilling schedule for the identified relief well MODUs and dialogue with</td></tr>
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<table>
<tr><th>Parameter</th><th>ROV Emergency BOP Intervention</th><th>Well Capping and Containment (including Offset Installation Equipment (OIE))</th><th>Relief Well Operations</th></tr>
<tr><td></td><td>
casing shear ram close;
designated hang-off pipe ram close and lock; and
lower marine riser package unlatch.
Gas detection and monitoring system, present on the vessel, to perform real time monitoring for volatile organic compounds during spill response activities;
Stationary and portable Thermo or TSI PM data logging monitors, mobilised on the nominated BOP intervention vessel, to perform real time particulate matter monitoring;
An ROV crew and specialist air monitoring personnel are mobilised to Karratha post LOWC event so that BOP intervention can be attempted within 48 hours of a LOWC event.
<u>Nominated BOP intervention vessel</u>
lans to install the ROV tooling package on one of the anchor handler vessels to be contracted for the drilling program. This allows:
The installation and commissioning of the BOP intervention equipment prior to the drilling of the critical reservoir sections.
The review of the BOP activation program by BP, the drilling contractor and the ROV operator prior to the drilling of the reservoir section.
The mobilisation of BP-owned gas monitoring sensors as part of the BOP intervention response package. These sensors are currently in Brazil and will be mobilised to Karratha, where they will be stored prior to being positioned on the nominated BOP
</td><td>
The OIE deployment strategy however assumes that no vessel can enter the gas plume safely. Instead, the OIE system requires the establishment of an array of anchors on the seabed. These anchors are connected to a set of modified buoyancy modules using an integrated work class ROV and an assortment of lifting hooks. The OIE can be moved laterally using winches attached to the seabed anchors. Vertical movement and lift are controlled by adjusting the buoyancy of the buoyancy modules. The OIE can be used to lift debris from the seabed when in debris clearance mode.

Once the debris clearance operations are complete, the OIE is used to pick up the capping stack from the seabed. The OIE and capping stack would be positioned near the wellhead as close to the seabed as possible to avoid the effects of the gas plume higher in the water column. The capping stack is then winched into position and through the gas plume before being placed onto the well. Once the stack is engaged on the well the capping stack can be closed to seal off the flow of hydrocarbons.

In some instances, debris clearance activities (including LMRP removal) may be required. Depending on the amount of debris clearance required or complexity of the operation, these activities may delay capping deployment timeframes. Suitability criteria for vessel monitoring include LMRP removal capability and ROV equipment; if needed, these activities would feature in the associated Safety Case Revision.

For both methods, the ROV will verify the capping stack is properly connected to the BOP prior to closing the capping stack to control the well.

<u>Sourcing capping stacks and transport of equipment to location</u>

BP has access to two suitable capping stacks via active membership with OSRL. The two OSRL 15kpsi stacks (in Norway and Brazil) are nominated for Ironbark use due to pressure rating and OIE compatibility. Additionally,
</td><td>
other members of APPEA, access and relocation for any of the above MODUs would be possible within 21 days. To ensure understanding of the availability and operability remains current, regular (monthly) communication will be maintained with the relevant titleholders prior to and during the Ironbark drilling program. These arrangements allow BP to verify a suitable MODU can be mobilised within a timeframe considered ALARP. Where necessary, contingency plans will be updated to maintain viability.

<u>Safety case revision</u>

Where appropriate, BP would plan to utilise the well specific information reviewed during the assessment of the Ocean Apex Safety Case revision to accelerate development of a new Safety Case revision for the relief well MODU. This approach is intended to limit the volume of new data that the regulator is required to review. It is also intended to reduce the risk of extensive additional validation being required prior to acceptance of the revision.

BP has contracted RPS to facilitate preparation of the Ocean Apex Safety Case revision in collaboration with Diamond and BP would engage RPS during the preparation of a relief well MODU Safety Case revision to leverage their existing knowledge of the drilling program.

BP also has access to extensive numbers of specialists globally that would be used to expedite preparation of a Safety Case revision submission. Based on feedback from RPS it is considered reasonable to assume that a Safety Case revision submission could be prepared in a compressed timeframe, assuming the use of one of the identified relief well MODUs from an APPEA titleholder, through the APPEA MoU. An estimate of the time required to prepare the Safety Case revision submission is outlined below.
<table>
<tr><th><u>Task</u></th><th><u>Estimated Duration</u></th><th><u>Assumption</u></th></tr>
<tr><td>HAZID</td><td>2 days</td><td>Rig crew available for workshops and studies. Data gathering for safety case revision</td></tr>
<tr><td>Prepare and submit scope of validation</td><td>1 day</td><td>Assumes the relief well equipment is part of the existing Safety Case.</td></tr>
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<table>
<tr><th>Parameter</th><th>ROV Emergency BOP Intervention</th><th>Well Capping and Containment (including Offset Installation Equipment (OIE))</th><th>Relief Well Operations</th></tr>
<tr><td></td><td>intervention vessel ahead of the drilling of the critical reservoir sections.

<u>ROV Tooling Package</u>

BP will include the ROV tooling package requirements as part of the contracting process for the anchor handler vessel nominated as the BOP intervention vessel. The required ROV tooling package consists of a work class ROV with an integral pumping skid and 1,000 m tether. The pumping skid will be rated to the shear rating of the BOP shear rams. This equipment will be fully commissioned prior to the drilling of the critical reservoir sections. Although BP also subscribes to the AMOSC SFRT equipment and the OSRL SIRT equipment, timeframes for mobilising this equipment to conduct BOP intervention would not allow BP to attempt BOP intervention within 48 hours.

<u>Gas detection and monitoring system</u>

BP requires real time gas monitoring sensors to be present on the BOP intervention vessel. The sensor package identified by BP for the Ironbark drilling program is currently located in Brazil, and will be mobilised to Karratha for installation on the nominated BOP intervention vessel prior to the drilling of the critical reservoir sections.

<u>Stationary and portable Thermo or TSI PM data logging monitors</u>

Logging monitors will be sourced through BP's existing operations in WA (e.g. Kwinana refinery) or through alternate sources if not available locally. This equipment will be mobilised to Karratha ahead of the commencement of the drilling program to allow it to be detailed in the ROV intervention plan. It will be installed on the vessel prior to drilling of the critical reservoir sections. This equipment would also be used for capping operations as required.</td><td>to improve response times, the Norway stack can be air freighted without being first broken down into sub-components. This capability was physically demonstrated on a trial flight from Norway by OSRL.

The OSRL equipment is comprehensive and adopts an integrated approach catering for escalation of an incident. This ranges from subsea toolkits to the OIE System held in Trieste, Italy. Furthermore, the access includes containment legs to interface the capping stacks should concerns exist regarding well integrity during shut in. This hardware is designed to interface seamlessly with each other.

An alternative 15kpsi capping stack is available in Singapore through Wild Well Control. However, this cannot be air freighted assembled and is incompatible with the OIE system required for cap installation on the Ironbark-1 well; therefore, access to this cap has not been pursued by BP.

<u>Sourcing suitable vessels for transport/deployment of capping stack</u>

Monitoring the location of suitable vessels is conducted by BP on a monthly basis, through access to the "Sea/Response" portal from Maritech Services Limited (part of Clarkson's Plc Group). This portal provides real-time confirmation of vessel availability. A supplementary contract with Maritech Services will be implemented by BP prior to commencement of drilling to ensure that the vessel monitoring takes into consideration capacity to operate under an existing Australian Safety case. This information will be assessed monthly and prior to drilling of the critical reservoir sections. Both subscriptions will be maintained throughout the drilling program to enable ongoing monitoring of vessel availability.

Furthermore, the well capping tabletop exercise scheduled in Q3 2020 will include testing and validation of the vessel monitoring process to confirm it is well understood and effective on commencement</td><td><table><tr><td>Prepare formal safety assessment</td><td>3 days</td><td rowspan="2">24hr continuous activities executed concurrently.</td></tr><tr><td>Prepare Safety Case revision submission</td><td>7 days</td></tr><tr><td>Review and sign-off submission documentation</td><td>2 days</td><td></td></tr><tr><td>Total</td><td>12 days</td><td></td></tr></table>
Following submission of the Safety Case revision, BP will use all available resources to aid review of the material by NOPSEMA and provide prompt responses to any requests for clarification.

<u>Long lead relief well drilling items</u>

BP has an extensive logistics organisation with experience mobilising equipment at short notice from global locations. BP also has existing global contracts in place with vessel and aircraft suppliers as well as global freight forwarding companies to expedite the movement of materials and equipment. A drill for the mobilisation of relief well equipment will be conducted prior to commencement of the drilling program as outlined in the EP.

BP maintains a complete stock of contingency wellheads, running tools and tubulars in Houston, Texas specifically to minimise relief well response times. This equipment is standardised and was developed to meet the requirements of BP's operations globally. The materials are of a comparable or higher specification than those planned for the Ironbark-1 well and have been assessed as suitable during the relief well planning process. All equipment is maintained in a state of readiness to mobilise at very short notice (within days). Furthermore, it is also possible that the locally held back-up (re-spud) wellhead and tubulars would be immediately available to mobilise as part of a relief well response. Based on the suitability and availability of long lead drilling items at BP's disposal, as well as the logistical readiness confirmed through testing and exercises prior to the campaign, BP has assessed that the procurement and mobilisation of long lead equipment does not lie on the critical path compared to the relief well MODU mobilisation times outlined previously.</td></tr>
</table>

Parameter	ROV Emergency BOP Intervention	Well Capping and Containment (including Offset Installation Equipment (OIE))	Relief Well Operations
	ROV crew including BOP-competent engineers The review of the ROV intervention plan prior to the drilling of the critical reservoir sections will enable the ROV intervention team, comprising the BP senior ROV technical authority and nominated members of the BP and Offshore Diamond subsea teams to review in detail the specific ROV intervention panel for the Ocean Apex ahead of any incident occurring. BP will mobilise specialist air monitoring personnel post LOWC event so that BOP intervention can be attempted within 48 hours of a LOWC event. Air monitoring personnel will support the vessel master with approaching the blowing out well in a LOWC scenario. The ROV crew onboard the nominated BOP intervention vessel will be equipped with a detailed procedure providing the sequencing and fluids volumes required to activate the necessary BOP functions on the ROV intervention panel of the Diamond Apex BOP. A real time video feed from the ROV control van to the BP IMT and Diamond Offshore Subsea Engineering department would allow for remote specialist technical support (whereby no site mobilisation maximises the window of time available on site to attempt BOP activation). Additional specialists would support the operation in BP's operational hubs to support the source control branch.	of the drilling program. Suitable vessel locations will be further confirmed prior to the drilling of the critical reservoir sections. BP has been monitoring locations of suitable vessels for the past three months, based on defined criteria, including: • capacity to operate under existing Australian Safety Case; • fitted with a minimum 250t crane (to ensure maximised capacity for debris clearance activities including capability for LMRP removal to ensure primary capping point access on the BOP); • capable of minimum 25 m crane reach; • located within 15-day sail radius from Dampier. Based on current vessel monitoring information, there are multiple vessels meeting minimum selection criteria that could be mobilised to support a capping operation within the estimated deployment timeframes. Since BP has commenced monitoring, vessel location has remained constant. BP considers it highly unlikely that vessels currently being identified as available would all become unavailable concurrently prior to the drilling of the critical reservoir sections. For the vertical access capping method, BP will actively monitor location of suitable vessels with existing safety cases (in parallel with airfreighting the OSRL cap from Stavanger, Norway), contract a deployment vessel post incident and develop a Safety Case Revision for NOPSEMA approval. Capping is forecast to commence Day 20 in this scenario (contingent on debris clearance requirements, predicted plume size and weather conditions). Capping deployment specialists would be mobilised to Australia and the Ironbark-1 well has been nominated to OSRL to ensure capping service access. For the OIE method, multiple vessels (between 4 and 7) are required for the response. On the assumption	In addition, BP has an active subscription with OSRL to access specialist relief well and capping equipment. This equipment is also accessible at short notice and depending on the nature of the unplanned event may be used to supplement source control operations

Parameter	ROV Emergency BOP Intervention	Well Capping and Containment (including Offset Installation Equipment (OIE))	Relief Well Operations
		the Safety Case requirement is applicable to the OIE method, BP would progress the Safety Case revision process in parallel with the forecast 62-day mobilisation timeframe for OIE. BP are subscribers to the OIE suite of equipment, and specialist personnel for OIE operation would be mobilised from Saipem. BP has further considered the key elements of a Safety Case Revision and identified that the risk assessment process is a critical element and key building block in the preparation of such document. BP will therefore conduct an internal risk review prior to the drilling of critical reservoir sections. Through ongoing discussions with Woodside, BP will consider and apply in the BP risk review the learnings from the risk assessment process conducted by Woodside as part of the generic Safety Case Revision development process. This internal risk review will leverage BP's Marine department expertise, the Central Well Control Team which includes BP personnel directly involved with the capping operation for the Macondo well, to identify those aspects specific to the Ironbark capping deployment operation characteristics that will be required to be addressed in a Safety Case Revision. This work would focus specifically on the risk associated with a vertical capping operation. The emphasis would be on managing the safety of the personnel onboard the capping deployment vessel, to supplement the work being conducted by Woodside which focuses on the deployment of the capping stack to the flowing well. This includes considerations for: • gas detection, monitoring and gas level response tactics; • hull and accommodation intakes and exhausts; • engine management system and reliability and dynamic positioning system redundancy; • safe approach/egress to the gas plume/cloud;	

<table>
<tr><th>Parameter</th><th>ROV Emergency BOP Intervention</th><th>Well Capping and Containment (including Offset Installation Equipment (OIE))</th><th>Relief Well Operations</th></tr>
<tr><td></td><td></td><td>

operational exposure time;
equipment preparation procedures and safe locations;
SIMOPs between the ROV intervention vessel and the capping deployment vessel.

The risk review will then be reviewed by specialist service providers (including safety case preparation, capping operations and vessel providers) to validate the assessment process and management approach.
In addition, BP will assess vessel specifications used as part of the generic Safety Case Revision risk assessment with the characteristics of those vessels being monitored by BP for their suitability and position to deploy a capping stack. This will help identify, well ahead of a Safety Case Revision being required, the vessel aspects that may require further assessment or mitigation, therefore further reducing the timeframes required to develop a Safety Case Revision.
BP has also 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 expectations.
A tentative schedule for the Safety Case Revision process is:
<table>
<tr><th>Activity</th><th>Timeframe (post incident)</th></tr>
<tr><td>Define available vessel</td><td>Day 0-1</td></tr>
<tr><td>ROV survey to identify status and inform response plan. Initial engagement with NOPSEMA and specialist agency to define Safety Case Revision requirements and timings.</td><td>Day 1-2</td></tr>
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<tr><th>Parameter</th><th>ROV Emergency BOP Intervention</th><th>Well Capping and Containment (including Offset Installation Equipment (OIE))</th><th>Relief Well Operations</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><td>Safety Case Revision developed and assessed with interested parties</td><td>Day 2-10</td></tr>
<tr><td>Safety Case Revision submitted to NOPSEMA</td><td>Day 10</td></tr>
<tr><td>Safety Case Revision RFFWI received</td><td>Day 10-17</td></tr>
<tr><td>Safety Case Revision resubmitted to NOPSEMA</td><td>Day 19</td></tr>
<tr><td>Safety Case Revision accepted by NOPSEMA</td><td>Day 20</td></tr>
</table>
Concurrent with the Safety Case Revision process schedule, the deployment vessel would transit to Dampier to uplift the capping stack and deployment procedures would be developed and risk assessed. The vessel would be onsite by Day 20 in alignment with the forecast Safety Case Revision process timings, ready to safely commence operations.
<u>Sourcing suitable vessels for ROV support and debris clearance</u>
Clear access to the wellhead/LMRP connector is required prior to any attempt to deploy the capping stack. The scope and complexity of the debris clearance operation will largely be dependent upon the position of the MODU, the mooring lines and the riser. The capping durations quoted in the EP assume that debris clearance is not required.
The nominated BOP intervention vessel will be first to intervene on the BOP. In addition to the BOP activation attempts, this vessel will be used to perform surveys of the debris field but will not participate in debris clearance. If required, debris clearance would be conducted using the capping deployment vessel with an approved safety case, with ROV capability onboard.
</td><td></td></tr>
</table>

<table>
<tr><th>Parameter</th><th>ROV Emergency BOP Intervention</th><th>Well Capping and Containment (including Offset Installation Equipment (OIE))</th><th>Relief Well Operations</th></tr>
<tr><td></td><td></td><td>For heavier duty debris clearance requirements, BP maintain access to the comprehensive suite of debris clearance tools available within the OSRL SIRT package. This is complemented by access to AMOSC hardware. These tools include grinders, cleaning tools, cameras, ROV torque tools, chop-saws, diamond cutters and dredging tools. Neither packages include super shears capable of heavy-duty pipe shearing. BP has implemented a separate contract with Wild Well Control for access to Genesis 2500 Super Shears – these would be mobilised by air from Houston if required.</td><td></td></tr>
<tr><td>Availability – When is the earliest the response option is available to be implemented?</td><td>It is best practice within BP that BOP intervention is attempted within 48 hours of a loss of well control incident. This is to ensure prompt intervention to maximise the ROV team's chance of successfully activating the BOP while minimising potential exposure to personnel and the environment.

The nominated BOP intervention vessel will be equipped with the equipment and personnel detailed above to enable BOP intervention within the BP standard 48 hour window.

The timing of the actual intervention would be at the discretion of the vessel master, and would be dependent on weather forecast, predicted wind conditions, prevailing currents and remaining daylight. BOP intervention operations would only proceed when the conditions were considered suitable, the equipment was fully operational and all involved crew prepared and ready for the planned intervention.</td><td>For the vertical access capping method, capping implementation is forecast by Day 20 (contingent on debris clearance requirements, predicted plume size and weather conditions). This is inclusive of cap mobilisation from Stavanger, Norway together with sourcing a capping deployment vessel within 15-day sail radius of Dampier. The OSRL Stavanger cap would be air freighted to Port Hedland for onward transfer to the Ironbark-1 well location, arriving on site for deployment on Day 20 (contingent on debris clearance requirements, predicted plume size and weather conditions). Well control and salvage specialists will be mobilised from Singapore and the USA ahead of the capping equipment arriving. The AMOSC SFRT would be mobilised by road from Fremantle to Dampier, arriving within 3 days. The OSRL SIRT would be mobilised by air and road from Norway or Brazil to Dampier, arriving within 5 to 7 days to assist with debris clearance activities.

For the OIE method, capping implementation is forecast to commence by Day 62 (contingent on debris clearance requirements, predicted plume size and weather conditions). This is significantly shorter than the duration of relief well drilling that would be pursued in parallel. The cap would be available for deployment by Day 20; however, would await arrival</td><td>Relief well installation timeframe is estimated to take 83 days based upon drill rig availability in the Australasian region with an approved Safety Case and using agreements in place with other operators (e.g. APPEA Memorandum of Understanding). The 83 day relief well installation timeframe is estimated based on the following assumptions:
<table>
<tr><th>Activity</th><th>Time (Days)</th></tr>
<tr><td colspan="2">Mobilisation</td></tr>
<tr><td>Access relief well MODU via APPEA MoU
Suspend current MODU operations, pull anchors and prepare to rig move
Prepare/mobilise relief well spud equipment
Complete relief well design</td><td>8</td></tr>
<tr><td>Transit to relief well location (assuming mobilisation from North West Shelf region)</td><td>2</td></tr>
<tr><td>Complete pre-spud load outs and bulk transfers
Sign off and issue relief well drilling program</td><td>2</td></tr>
<tr><td>Contingency allowance for mobilisation delays e.g. weather, non-productive time (NPT) during suspension operations</td><td>9</td></tr>
<tr><td colspan="2">Operations</td></tr>
<tr><td>Moor rig at relief well site and prepare to spud</td><td>1</td></tr>
<tr><td>Drill relief well to ranging depth c. 4300mMD</td><td>36</td></tr>
<tr><td>Drill and range to shoe setting depth.</td><td>7</td></tr>
<tr><td>Run, cement and test the 13-5/8" and seal assembly</td><td>5</td></tr>
<tr><td>Suspend well (install and test shallow plug)</td><td>1</td></tr>
<tr><td>Pull BOP and marine riser</td><td>1</td></tr>
</table></td></tr>
</table>

Parameter	ROV Emergency BOP Intervention	Well Capping and Containment (including Offset Installation Equipment (OIE))	Relief Well Operations
		of the OIE system from Trieste, Italy. The complex OIE system would be mobilised using the most expedient route available and vessels would be sourced to aid the installation. Vessel sourcing will be conducted by BP using the "Sea/Response" portal from Maritech Services Limited (part of Clarkson's Plc Group). Additionally, strategic alliances have been adopted between OSRL and key service providers to ensure subscribers like BP can access the necessary expertise during a response. These include Trendsetter (capping stack OEM); Oceaneering (ROV tooling); Saipem (OIE). Detailed logistics plans for mobilisation are included with the project capping plans.	Run injection spool (capping stack) — 1 Run BOP on marine riser and test. — 3 Intercept well and perform dynamic kill. — 7 Total — 83 Timeline assumes that a Safety Case revision can be prepared off the critical path, during rig mobilisation and preparation to spud.

Implementation and activation guidelines for each of the source control tactics are detailed in the following plans:

- Ironbark-1 ROV Emergency BOP Intervention Plan;
- Ironbark-1 Capping and Containment Plan;
- Ironbark-1 Relief Well Plan.

5.5 Implementation Timeline

Timeframes for implementation of primary and secondary spill response strategies, as well as source control strategies are presented in Table 5-4.

Table 5-4: Response strategy and implementation timeline

Strategies	Type	Week 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	N *
Primary Oil Spill Response	Monitoring, Evaluation and Surveillance*																
	Oiled Wildlife Response*																
	Waste Management*																
Secondary Oil Spill Response (if implemented)	On-water Containment and Recovery*																
	Surface Dispersant Application*																
Source Control	ROV Emergency BOP Intervention																
	Relief Well																
	Capping Stack - OIE																
	Capping Stack - Conventional																

*Spill response strategy implemented until termination criteria met.

5.6 Response Strategy Arrangements

The response arrangements to meet the proposed response strategy are detailed in Table 5-5.

Table 5-5: Response Strategy Arrangements

Response Options	Type	Arrangements	Capability	Activation process
Primary Oil Spill Response	**Monitoring, Evaluation and Surveillance**	BP Internal Capability / BP Mutual Response Team	• Spill fates, weathering and trajectory (for marine spills) modelling • ADIOS modelling • Vectoring • Satellite tracking buoys (on vessels/MODU)	IMT via the BP Ironbark Emergency Contacts Directory Buoys deployed by vessels
		AMOSC Services Agreement	• Spill fates, weathering and trajectory (for marine spills) modelling • Hindcast modelling • ADIOS modelling • OSTM tracking buoys • Aerial surveillance • Satellite imagery via KSAT • Trained observers	Notify AMOSC Duty Manager +61 (0) 438 379 328
		AMSA	• Spill fates, weathering and trajectory (for marine spills) modelling • Satellite/optical imagery • OSTM tracking buoys	Notify AMSA Search and Rescue (02) 6230 6811
		Operational and scientific monitoring contractors (to be selected)	• Operational and scientific monitoring personnel and services	Activation of Master Service Agreement with service providers
		OSRL	• Aerial surveillance (trained observers and access to aircraft) • Satellite imagery • Unmanned Aerial Vehicle available to support containment and recovery	Notify OSRL Duty Manager + 44 (0) 23 8033 1551
	Oiled Wildlife Response	BP Internal Capability / BP Mutual Response Team	IMT support and field operations	IMT via the BP Ironbark Emergency Contacts Directory
		AMOSC Services Agreement	• Training instructors and oiled wildlife response training programs • Industry Team Mutual Aid personnel (10 personnel trained to Level 2-4 [WA Department of Parks and Wildlife]) Trained personnel to assist in response AMOSC developed relationship with: • Blue Planet Marine (Capacity 10-20 OWR responders) • Massey University (Capacity 4-6 OWR responders);	Notify AMOSC Duty Manager +61 (0) 438 379 328

Response Options	Type	Arrangements	Capability	Activation process
			• International Bird Rescue (Capacity 4 OWR responders) Oiled Wildlife Response Kits (Fremantle, Geelong) – 50 units per day • Oiled Wildlife Response Containers (Fremantle, Geelong) – 100 units per day	
		OSRL Membership	• Training instructors and oiled wildlife response training programs • Field response through Sea Alarm Foundation	Notify OSRL Duty Manager + 44 (0) 23 8033 1551
		Department of Parks and Wildlife	• Oiled Wildlife Advisory (OWA) - advisory role to IMP • Personnel to assist in coordination of wildlife response (advisors, licencing)	Notify DPaW State Duty Officer +61 (0) 8 9219 9108
		AMSA	Through activation of the National Plan: • Response personnel, including management and operational staff • Oiled Wildlife Response Containers (Dampier, Darwin, Townsville) – 100 units per day	IMT via the BP Ironbark Emergency Contacts Directory
		Waste Management Services	Refer to Waste Management Spill Response Option	IMT via the BP Ironbark Emergency Contacts Directory
	Waste Management	Licensed waste contractor (to be selected)	• Waste receptacles • Waste disposal • Helicopters • Vessels • Manifesting • Tracking • Disposal	IMT via the BP Ironbark Emergency Contacts Directory
Secondary Oil Spill Response	**Containment and Recovery**	*BP Internal Capability / BP Mutual Response Team*	• *BP Perth Incident Management Team to cover initial actions, activation.* • *BP Mutual Response Team available to supply personnel for larger/extended response*	IMT via the BP Ironbark Emergency Contacts Directory
		AMOSC Services Agreement	• *Boom* • *Skimmers* • *Waste storage* • *Trained responders in field and IMT (Core team)*	*Notify AMOSC Duty Manager* *+61 (0) 438 379 328*
		OSRL	• *Boom, skimmers, waste storage, trained response personnel in IMT*	*Notify OSRL Duty Manager* *+ 44 (0) 23 8033 1551*

Response Options	Type	Arrangements	Capability	Activation process
		Vessels	• *Vessels of opportunity from Clarkson's subscription search and consultation with AMOSC* • *PSVs to provide logistical support*	IMT via the BP Ironbark Emergency Contacts Directory
		Waste Contracting Services	• *Refer to Waste Management Spill Response Option*	IMT via the BP Ironbark Emergency Contacts Directory
	Surface Dispersant Application	*BP Internal Capability / BP Mutual Response Team*	*IMT support and field operations*	IMT via the BP Ironbark Emergency Contacts Directory
		AMOSC Services Agreement	• *AMOSC dispersant stockpile (>750m3 of dispersant in-country) -Dasic Slickgone NS, Corexit 9500 and ARDROX 6120, suitable for ship-board or aerial spray application.* • *Trained responders in field and IMT (Core Group)*	*Notify AMOSC Duty Manager* *+61 (0) 438 379 328*
		OSRL Membership	• *Aircraft* • *Dispersant through Global Dispersant Stockpile* • *Trained responders in field and IMT*	*Notify OSRL Duty Manager* *+ 44 (0) 23 8033 1551*
		Aircraft	*Minimum of one aircraft available within WA (Jandakot)*	IMT via the BP Ironbark Emergency Contacts Directory
		BP Internal dispersant stockpiles	*>3000m3 Corexit 9500*	IMT via the BP Ironbark Emergency Contacts Directory
		AMSA stockpiles	*Dasic Slickgone EW stockpile*	IMT via the BP Ironbark Emergency Contacts Directory
		SMART Monitoring	*Refer to OSMP*	IMT via the BP Ironbark Emergency Contacts Directory
Source Control	**BOP Activation**	BP Internal Capability / BP Mutual Response Group	• Trained source control personnel • Air monitoring personnel • ROV crew	IMT via the BP Ironbark Emergency Contacts Directory
		Vessels	• Vessels of opportunity from AMOSC list and Clarkson's search • Anchor handler with ROV package to be used as nominated BOP intervention vessel for the duration of Ironbark drilling program.	IMT via the BP Ironbark Emergency Contacts Directory
		BOP intervention equipment	• Subsea first responders kit • Air monitoring equipment	IMT via the BP Ironbark Emergency Contacts Directory

Response Options	Type	Arrangements	Capability	Activation process
			• ROV package present on nominated BOP intervention vessel during the drilling of critical reservoir sections.	
	Relief Well	BP Internal Capability / BP Mutual Response Group	Trained source control personnel	IMT via the BP Ironbark Emergency Contacts Directory
		Global master services agreements are in place with Wild Well Control and Boots and Coots. Wild Well Control are the preferred well control company.	• Relief well kill modelling and validation • Trained source control personnel.	IMT via the BP Ironbark Emergency Contacts Directory
		Mutual Aid Resources	APPEA MOU: mutual assistance for transfer of drilling units for emergency situations.	IMT via the BP Ironbark Emergency Contacts Directory
	Capping Stack & Offset Installation Equipment	OSRL Membership • Capping Equipment & Toolkits • Offset Installation Equipment • Deployed specialists	• Access to the capping stacks located in Stavanger, Norway, and Rio De Janeiro, Brazil. • Access to the OIE located in Italy.	Notify OSRL Duty Manager + 44 (0) 23 8033 1551

6. Implement, Review and Revise Response

Section 5 presents the initial planned response strategy for a worst case spill event; however in the event of a spill during BP's exploration drilling program, the assessment of response options will be reviewed and verified prior to implementation to ensure that the assumptions made in the planning process are valid and the response strategy will be effective.

6.1 Response Strategy Verification Process

The process for reviewing response options is illustrated in Figure 6-1. The purpose of including this process in the OPEP is to ensure effective and efficient decision making into selecting response options which are suitable to the conditions at the location at the time of the spill event. Outputs from this process are captured using the SIMA assessment process (Appendix A).

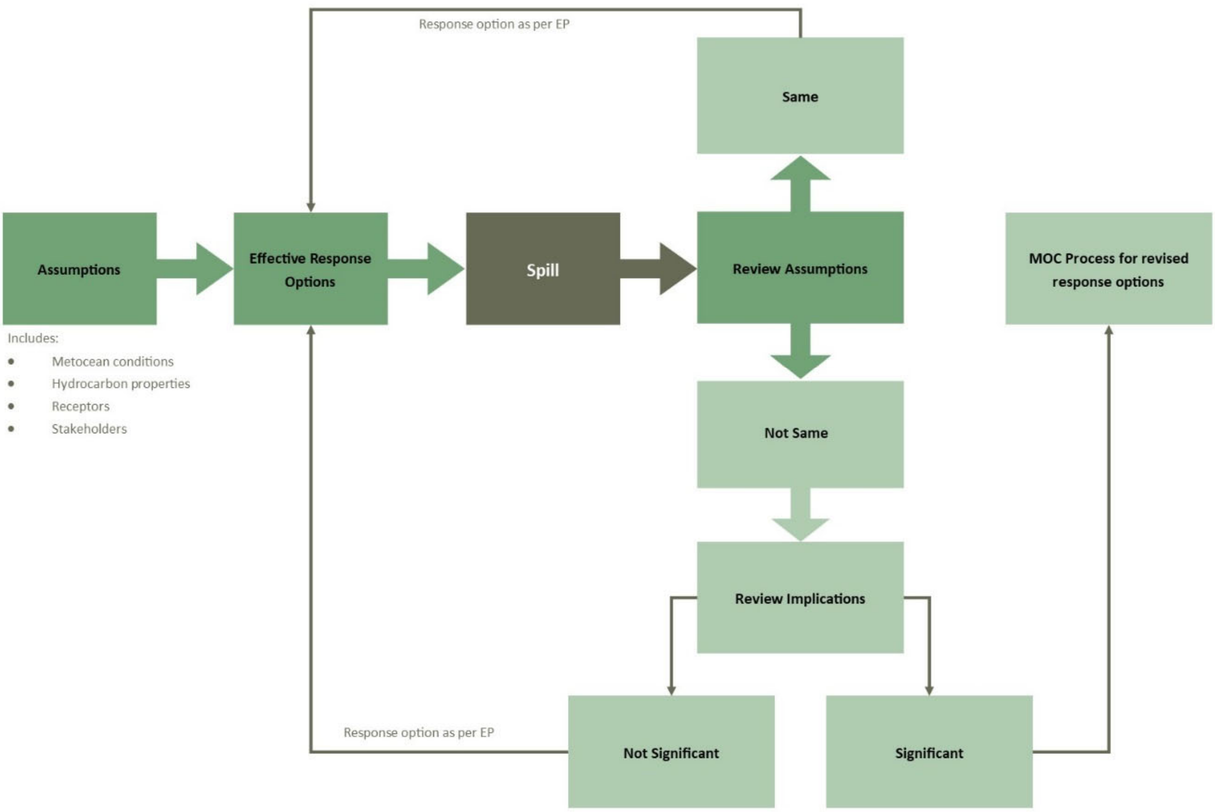

Figure 6-1: Process for Verifying Response Strategy Effectiveness in the Event of a Spill

6.2 Incident Action Plan (IAP)

As the incident moves from the "reactive phase" to the "proactive phase", an Incident Action Plan (IAP) will be prepared for each Operational Period, as defined by the IMT (typically within 24 hours). The IAP specifies the objectives, tactics, resources and work assignments for the next operational period. It details the response mechanisms and priority areas for protection based on the actual circumstances of the event, considering the spill trajectory and weather conditions, but also importantly safety considerations. Incident management template plans, including the IAP, are developed and made available to BP's IMT. The templates are designed to provide a starting point to facilitate the generation of the plan during an incident. These templates are maintained internally and regularly reviewed.

The main steps in planning the response and preparing the IAP are detailed in Table 6-1.

Table 6-1: Incident Action Plan Steps

Step	Examples
1. Setting the incident objectives	• Control the source of the spill • Contain and recover spilled materials • Recover and rehabilitate injured wildlife • Terminate the response
2. Describe the strategies required to meet the objectives	• Improve situational awareness • Evaluate dispersant use and prepare for potential activation • Containment/recovery of hydrocarbons to avoid affecting sensitive on-water and nearshore resources • Initiate waste management • Collection and treatment of oiled wildlife
3. Develop the tactics	• As per tactics identified in OPEP
4. Detail the implementation strategy	• Resources required • Equipment required • Location, timing and duration of mobilisation

It is the responsibility of the Planning Section Chief to prepare an IAP under the direction of the IC for his endorsement. The IMT will implement and monitor the effectiveness of the IAP ensuring regular updates to the plan are made as appropriate. The IAP process utilised by BP is detailed within the BP Incident Management Handbook.

To ensure that the IAP is appropriate for the nature of the spill, BP will seek the advisory support of technical experts or liaison officers from DoT, AMSA, DBCA and DAWE (Oiled Wildlife), and/or AMOSC.

6.3 Effectiveness Monitoring

During the incident response, the effectiveness of the response will be assessed every Operational Period (24 hours or as set by the IC). This assessment will be based on predictive modelling results, received monitoring data in the context of the affected environment, the environmental conditions and the level of hydrocarbons released. Where a change to operational conditions has occurred, the effectiveness review process may be conducted using the SIMA process (Appendix A). Where a change to response options is required (to ensure ongoing effectiveness of spill response), BP will update the relevant documentation in accordance with the BP Management of Change process (Section 7.1.2 of EP).

Effectiveness monitoring will be conducted until the termination criteria have been met. SIMA will be used to inform the decision to terminate the response (Appendix A). Outcomes of the effectiveness monitoring will inform the IAP process.

6.4 Response Termination

Generally, the decision to stop the spill response will be made by the Control Agency when response efforts are not returning any tangible benefit. This may include a gradual downsizing of response teams and resources or complete termination of the response. BP will undertake a SIMA with the relevant response team members / liaison officers to inform the decision to terminate the response in line with the SIMA format used in formulating the spill response strategy.

Decision factors will include:

- The efficacy and benefit of the response options implemented against natural cleaning;
- The significance of the environmental receptor impacted;
- Potential for environmental damage caused by further clean-up efforts weighed up against other factors such as response team risk in undertaking the activity.

Table 6-2 provides indicative termination criteria which may be amended because of response team advice and/or the outcomes of stakeholder engagement during a spill event. Although indicative, it provides a guide for the purpose of capability planning.

For spill clean-up operations in Western Australian waters, termination of response will be taken by the State Incident Commander.

The Incident Commander will ensure that all relevant organisations and personnel are notified to stand down once the termination criteria have been satisfied. Upon conclusion of the response, the Incident Commander must:

- Inform all personnel involved in the response;
- Advise all government authorities involved in the response;
- Provide an incident brief internally and to all government authorities involved in the response;
- Instigate an investigation into the cause of the spill;
- Prepare reports and collate all documents including statements concerning the incident; and
- Undertake an inventory of all consumables and prepare accounts for dissemination.

Table 6-2: Spill Response Termination Criteria

Response Option	Termination Criteria
Monitoring, Evaluation and Surveillance	Termination occurs when the following criteria are fulfilled: • The spill has ceased; • The spill is no longer visible to human observers. Specifically, a silver/grey sheen as defined by the Bonn Agreement (BAOAC 2007) is not observable and 24 hours has elapsed since the last confirmed observation of surface hydrocarbons; • Modeling results do not predict surface exposures at visible levels. Termination criteria to be agreed with DoT in State waters.
Oiled wildlife response	To be determined in consultation with WA Department of Water and Environmental Regulation. Suggested criteria: • Response is discontinued when all affected/recovered animals are cleaned and rehabilitated as advised by relevant expert bodies.
Waste management	Termination occurs when the following criteria are fulfilled: • Response is discontinued when all waste generated from spill response activities has been appropriately disposed of by selected waste contractors. Termination criteria to be agreed with DoT in State waters.
On-water containment and recovery	Termination occurs when the following criteria are fulfilled: • The spill is no longer observable to human observers; • Slick thickness and characteristics mean that on-water containment and recovery equipment will not be effective as determined by the SIMA; • SIMA concludes that continued activity will not produce any net environmental benefit.

Response Option	Termination Criteria
	• SIMA has been signed off by IC. Termination criteria to be agreed with DoT in State waters.
Surface Dispersants	Termination occurs when the following criteria are fulfilled: • The spill is no longer observable to human observers; • Slick thickness and characteristics mean that surface dispersants will not be effective as determined by the SIMA; • SIMA concludes that continued activity will not produce any net environmental benefit. • SIMA has been signed off by IC. Termination criteria to be agreed with DoT in State waters.
Source Control	Termination criteria varies according to the incident and spill level: • For vessels, the spill source has been eliminated (e.g. fuel tank is secure (tank rupture)) or the leak has been contained and controlled on-board; • For a well incident, the hydrocarbon release has been contained and well control re-established.

7. Tactical Response Planning

Tactical response plans (TRPs) are detailed spill response work instructions for specific locations that describe how specific sensitivities will be protected or response options implemented to enable a rapid, effective and targeted response to those areas ranked as having a high protection priority or higher.

7.1 Tactical Response Plan Development Process

To determine BP's priority response areas for this activity, BP initially estimated the time it would take to develop and finalise a location specific TRP along with estimated equipment and personnel mobilisation times to locations.

Consequently, BP estimates that the timeframe for developing and implementing a TRP is **seven days** based upon:

- 1 day to complete hindcast modelling,
- 2 days to draft plan,
- 1 day to review plan with relevant people and regulators, and
- 3 days to mobilise equipment and personnel.

This process assists BP, in the event of a spill, in focusing its spill response strategy, where required, on sensitive areas or receptors that are considered to have a higher protection priority.

7.2 Protection Priority Ranking Process

The Department of Transport (DoT, 2018) has ranked protection priorities for the entire Western Australian coastline. They have completed this activity through the following process:

- Identifying sensitive receptors;
- Assigning receptors a ranking from Very Low to Very High (Table 7-1);
- Rank their priority for protection in the event of an oil spill.

Table 7-1: DoT Protection Priority Ranking

Protection Priority	Ranking
Very High	5
High	4
Medium	3
Low	2
Very Low	1

BP has adopted the same protection priority ranking developed by DoT so that areas identified as high protection priority and above will be prioritised by BP in the event of a spill.

7.3 Priority Response Area Identification

7.3.1 Overview

In order to identify priority response areas, stochastic modelling is analysed to identify nearshore areas that have the potential to be exposed to surface hydrocarbon concentrations above ecological impact thresholds within the timeframe required to develop TRPs, i.e. seven days.

This process enables BP to identify nearshore areas that have a risk of exposure in a timeframe for which detailed TRPs cannot feasibly be developed or implemented.

Once this is complete, ecological and socio-economic receptors are identified, and their priority ranked based on rankings presented in Table 7-1 (DoT, 2018).

Those areas that have been identified as having High to Very High protection priority are then considered to be the priority response areas for which a TRP is required to be developed prior to commencement of drilling activities.

7.4 Outcome

Stochastic modelling did not predict exposure to surface hydrocarbon concentrations above ecological impact thresholds within seven days for any nearshore areas (Appendix C of EP).

Therefore no areas ranked as High to Very High protection priority were identified to require a TRP to be developed prior to the drilling program commencing.

TRPs will therefore be developed in the event of a spill, based on the outcomes of the operational monitoring program (Section 5.3.1).

8. Emergency Response Organisation

8.1 BP's Incident Command System

BP utilise the Incident Command System (ICS), as the company's preferred incident management system (IMS). As a result, ICS has been adopted as the IMS that BP will use to manage events under this OPEP.

There are a number of advantages to using this system critical for BP to successfully manage all incidents, including Level 3 incidents:

- It offers a standardised and systematic approach to command, control and coordination of BP's (and its contractors and other parties) efforts towards the resolution of an incident or emergency;
- It allows for the easy integration of BP's global Mutual Response Team for Level 3 incidents;
- It includes methods of consultation and coordination for different controlling agencies to come together under a single incident management structure (unified command); and
- It allows for easy upscaling, adoption and flexibility of new response needs as the response changes (i.e. adaption to requirements for on-water containment & recovery, oiled wildlife response branches, etc.).

The greatest advantage of using the ICS for a Level 3 incident is that it allows for BP to respond to a dynamic, changing scenario in a deliberate, decisive fashion. This allows BP to use the pre-planned oil spill scenarios in this OPEP and select, adapt and vary the spill response options, to an optimal level that reduces the consequences of the spill and reduces/prevents environmental damage, specific to the conditions at the time.

8.2 Control Agency

The control agency is determined based on the source of the spill and whether the spill takes place in Commonwealth or State waters. Control agencies for the spill scenarios within the scope of this OPEP are detailed in Table 8-1.

Where a spill originates in Commonwealth waters but has the potential to impact State waters or lands, the WA Department of Transport (DoT) would establish an IMT and may assume control of response activities within State jurisdiction. Where response activities are implemented in Commonwealth jurisdiction, the control agency remains either AMSA for vessel spills or BP for spills relating to their exploration drilling activities.

Table 8-1: Jurisdictional Authorities and Control Agencies during Oil Spill Response

Location	Source of Oil Pollution	Jurisdictional Authority	Control Agency		
			Level 1 Spill	Level 2 Spill	Level 3 Spill
Commonwealth Waters	Vessel	AMSA	AMSA	AMSA	AMSA
	Offshore petroleum activity	NOPSEMA	BP	BP	BP
State Waters	Vessel	DoT	DoT	DoT	DoT
	Offshore petroleum activity	DoT*	BP	DoT	DoT

8.2.1 Commonwealth Jurisdiction

BP will be the Control Agency for spill incidents arising from their petroleum activities, in Commonwealth waters. BP will initiate the operational structure shown in Figure 8-1 and Figure 8-2 for all spill incidents that have the potential to be considered as a level 3 incident and either escalate or de-escalate depending on the size of the spill.

8.2.2 State Jurisdiction

In the event of a Level 3 spill, and if oil is predicted to enter State waters, BP will establish a Joint Strategic Coordination Committee (JSCC). This will expand the IMT as needed to encapsulate the Western Australian DoT's (State agency) need to maintain control of their respective area of remit under a common response organisation. The JSCC as an expansion of the ICS organisation structure brings together the "Incident Commanders/Controllers" of BP along with the State of WA to coordinate an effective response while carrying each agency's jurisdictional responsibility. The organisational structure (Figure 8-1 and Figure 8-2) allows for integration of the relevant DoT personnel.

This structure allows for each jurisdiction – as well as other key agencies – to make consensus decisions and blend resources throughout the organisation to create an integrated response team. In respecting each jurisdiction's positions to remain in control of their territorial areas, BP will support other control agencies through the provision of resources, technical advice, systems and other supporting mechanisms through Strategic Coordination.

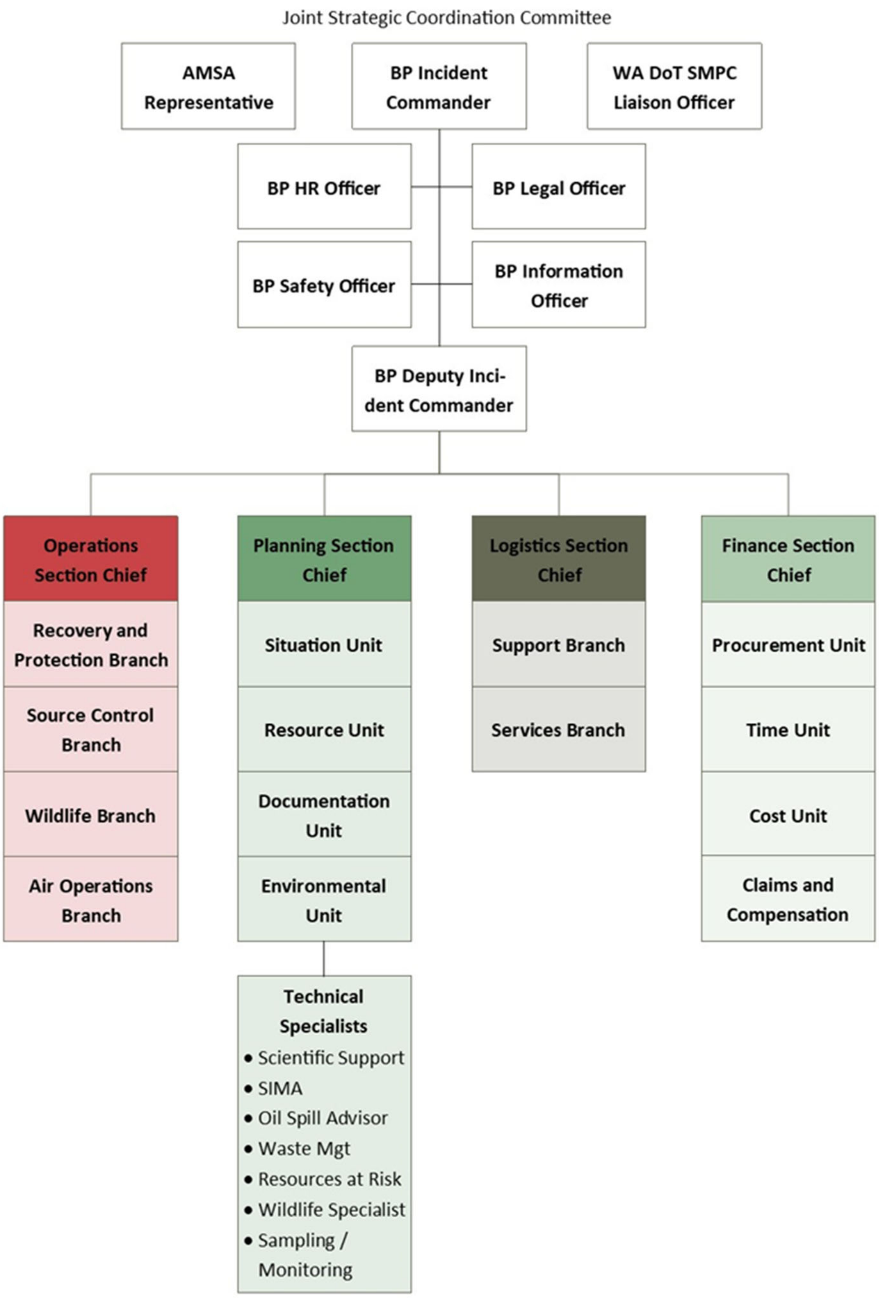

Figure 8-1: Example IMT Organisation Chart for Level 3 Spill Events

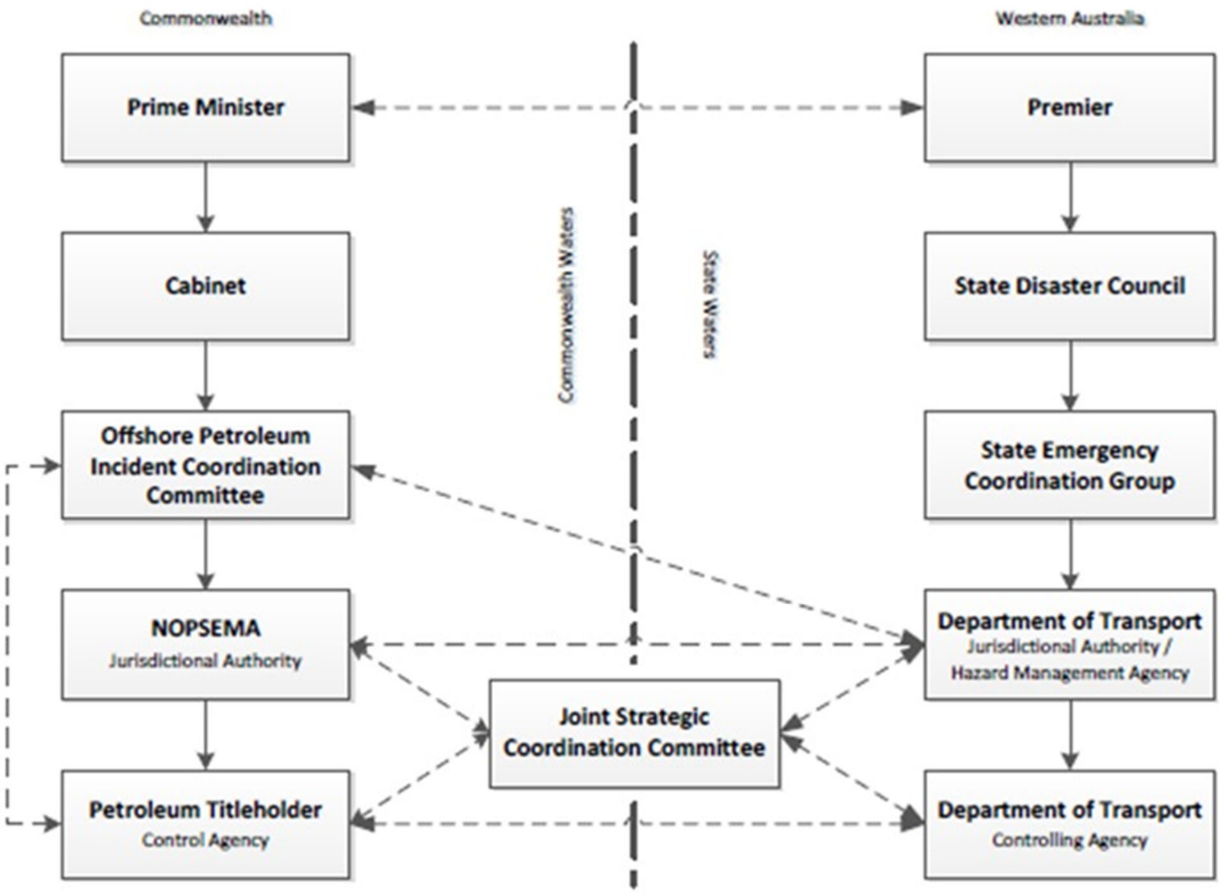

Figure 8-2: Overall Control and Coordination Structure – Offshore Petroleum Cross Jurisdiction Incident

8.3 Roles, Responsibilities and Competencies

8.3.1 Resourcing

The initial BP IMT resourcing strategy, and the responsibilities for these key roles is provided in Table 8-2. Surge capacity resources are also nominated together with the role competency requirements.

In the event of a prolonged large-scale oil spill event, additional resources would be sourced from external agencies to fulfil the necessary roles.

Table 8-2 provides competency details of a Level 3 oil spill support organisation. Each unit within the Planning, Operations, Logistics and Finance/ Administration functional area is headed by trained Section Chief.

Table 8-2: IMT (Oil Spill) Resourcing Matrix

Initial Responder (Role)	Responsibilities	Initial Responder (Competency)	Surge
Incident Commander (IC)	The management of all activities necessary for the resolution of an incident.	Internal competencies*	BP
Operations Section Chief	The tasking and application of resources to achieve resolution of an incident.	Internal competencies*	AMOSC Core Group, AMSA NRT BP MRT

Initial Responder (Role)	Responsibilities	Initial Responder (Competency)	Surge
Planning Section Chief (PSC)	The collection, analysis and dissemination of information and the development of plans for the resolution of an incident.	Internal competencies*	AMOSC Core Group, AMSA NRT BP MRT
Logistics Section Chief	The acquisition and provision of human and physical resources, facilities, services and materials to support achievement of incident objectives.	Internal competencies*	AMOSC Core Group, AMSA NRT BP MRT
Finance Section Chief	The management of all financial and administrative activities to enable and record the incident.	Internal competencies*	BP
Environmental Unit Leader (EUL)	The management of all activities necessary for activation, continuation and termination of OSMP and compliance with environmental regulator.	Internal competencies*	BP

*defined for role and maintained as part of BP's training and competence matrix.

8.3.2 OPEP Testing - Training and Exercises

The Training and Exercise Program is a critical component of BP's oil spill preparedness. Training sessions and exercises are conducted regularly to improve and evaluate BP capability to execute one or more portions of its response plans. They are used to improve both individual skills and the overall emergency management system. A comprehensive program is made up of progressively more complex and demanding situations, each one building on the previous; culminating into an exercise that is as close to reality as possible to measure the capabilities of the team. An outline of the oil spill response–related training and exercise elements is presented in Table 8-3.

The emergency response training program for the Ironbark Exploration Drilling Program will consist of a variety of formats focused on the local Incident Management Team to increase their capability and competency to respond to and support any incident. This will include computer-based training on basic ICS process, classroom sessions focused on adapting the general process to the Ironbark Exploration Drilling Program, including specific roles and responsibilities, one-on-one sessions to walk through the specific duties, for each person and role, and a series of tabletop exercises to test these roles in a variety of emergency response scenarios.

In addition to the tabletop exercises above, the overall exercise program will consist of a variety of progressively complex exercises including multiple source control exercises to test and validate the various timing and logistics assumptions in the plans for ROV intervention, capping & containment, and relief well drilling. The program will culminate in an oil spill response exercise utilising the Perth-based IMT as well as MRT support, either in-person or remote, as appropriate and practicable.

Table 8-3: Training and Exercises planned for the Ironbark Exploration Drilling Program

Training / Exercise	Timing	Scenario	Duration	Exercise Level (Notification/ Tabletop / Training & Exercise)	Summary of Exercise/Training Objectives	Target audience
Training	Q1-Q2 2020	N/A	3 hour	N/A	ICS 100 Introduction to the Incident Command System (Dept. of Homeland Security. Federal Emergency Management Agency certified).	Ironbark IMT
Training	Q2-Q3 2020	N/A	3 hour	N/A	Classroom session (including virtual), adapting and applying ICS 100 to the project including IMT Foundation / Fundamentals and role specific training.	Ironbark IMT
Training	Q2-Q4 2020	N/A	30 mins	N/A	One-on-one sessions with individual IMT members, Q&A, skills building	Ironbark IMT
Training	Q2-Q3 2020	N/A	½-day	N/A	Provide Ironbark-specific awareness training to Upstream and ANZ BST	BSTs
Exercise	Monthly	Test of IMT call-out messaging	30 mins	Notification	Test call-out process – quarterly and in conjunction with exercise program	Ironbark IMT
Exercise	Q2-Q3 2020	Tabletops (3)	2-3 hour	Tabletop	Activation of IMT, ICP setup, scenarios may include notifications, security, medivac, de-manning	Ironbark IMT
Exercises	Q3 2020	Tabletops (3)	2-3 hour	Tabletop	Source control branch (Sunbury-based with Perth support) each focused on aspect of source control – ROV intervention, capping & containment, relief well drilling support mechanisms including Source Control	Perth and Sunbury Office
Exercise	Q3 2020	Aviation incident	½-day	Tabletop	Helicopter ditching, includes activation/notification. ICP set up, people in roles, simulated calls with MODU. Facilitated with injects, HR-related aspects	Ironbark IMT/Rig/ Base, key stakeholders
Exercise	Q3 2020	Loss of Well Control	1 day	Training & Exercise	Multi-faceted command- post exercise, with participation of Perth IMT, MRT & Source Control Teams, and relevant external support (AMOSC/OSRL etc.) and agencies based on WCD scenario. Includes life/safety and source control/spill response aspects with intervening tabletops and training	IMT, MRT, Response Organisations, Agencies / stakeholders
Training	Q3 2020	Various	1 hour	N/A	Awareness training on applicable BP plans and notification/reporting requirements	Rig/Base/ BP Office BP field personnel, key support (OIM, Vessel Masters)

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APPENDIX A - Spill Impact Mitigation Assessment Process

A.1 SIMA Process

This Appendix details the process and output used to identify and select the feasible and effective oil spill response options that make up the oil spill response strategy in this OPEP, in accordance with the Spill Impact Mitigation Assessment (SIMA) process documented by IPIECA (2018).

The SIMA process comprises 4 stages of assessment, as depicted in Figure A.9-1:

- Stage 1: Data evaluation
- Stage 2: Predicting outcomes
- Stage 3: Balancing trade-offs
- Stage 4: Selecting best options.

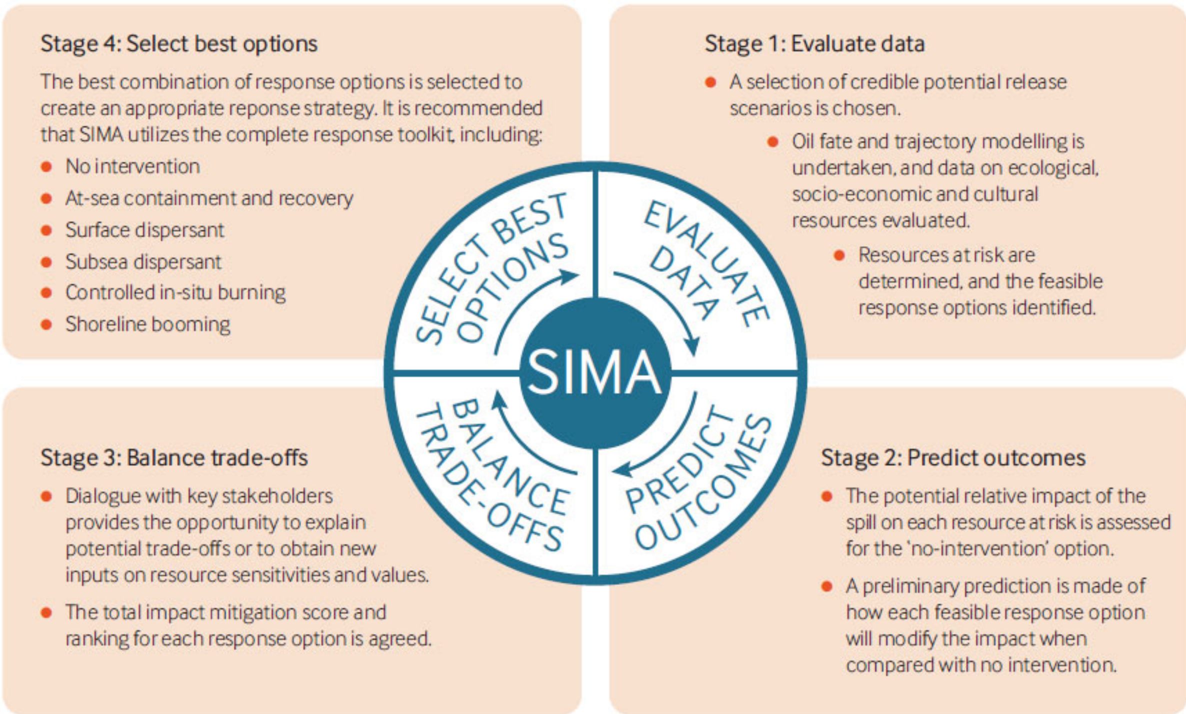

Figure A.9-1: IPIECA Spill Impact Mitigation Assessment Process (IPIECA 2017)

The outcomes of all four stages of the SIMA completed as part of the planning process supporting the BP exploration drilling activities in WA-359-P are detailed in the following sections.

A.1.1 Data Evaluation

As per section 6.4 of the EP, the credible spill scenarios, outcomes of spill modelling and values and sensitivities have been detailed for the identified worst credible spill scenarios. A summary of this information is included in Table A.1 and Table A.2.

Table A.1: Modelling outcomes and resulting exposure to values and sensitivities – vessel collision

Spill scenario	A vessel collision resulting in a surface release of 250 m^3 of MDO of API of 37.6 over 6 hours.	
Compartment affected	**Modelling outcome**	**Values and sensitivities exposed**
Seabed	Under this scenario, hydrocarbons are released at the surface. Consequently, exposure to seabed habitats is not expected as hydrocarbons are not expected to be negatively buoyant and will rapidly evaporate prior to reaching the intertidal area.	There are no shallow receptors (<10m depth) within the surface layer (0-10m) exposed to either surface or in-water hydrocarbons.
Water surface	The maximum distance from the release site for surface oil at >1 g/m^2 ranged from 97 km (winter) and 153 km (transitional); at 10g/m^2, maximum distance from the release site ranged from 45 km (summer) to 54 km (transitional).	Threatened and migratory marine mammal, shark and reptile species may occur within the area exposed to surface hydrocarbons; however, any activity is expected to be of a transient nature.
Water Column	Entrained and dissolved hydrocarbons remained in surface layers, typically up to 10 m depth.	Very low probabilities of exposure to the low threshold for entrained hydrocarbons within the 0-10 m depth surface layer were predicted for three AMPs and one State Marine Park. • Mermaid Reef AMP (1% probability of entrained hydrocarbons at 10 ppb) • Montebello AMP (1% probability of entrained hydrocarbons at 10 ppb) • Gascoyne AMP (2% probability of entrained hydrocarbons at 10 ppb) • Ningaloo Marine Park (2% probability of entrained hydrocarbons at 10 ppb).
Air	Threatened and migratory seabird and shorebird species may occur above the area exposed to surface hydrocarbons; however, any activity is expected to be of a transient nature only given the offshore location.	Threatened and migratory marine mammal, and reptile species may occur within the area exposed to surface hydrocarbons; however, any activity is expected to be of a transient nature.
Shorelines	No shoreline contact above the lowest threshold of exposure (>10 g/m^2) was predicted for any of the seasons modelled.	
Socio-economic	• There are a number of Commonwealth and State fisheries with management areas that intersect with the area exposed to surface hydrocarbons. • No restricted defence areas, or ports/harbours are exposed to surface hydrocarbons. • There are no industry, tourism and recreation activities expected to be exposed to surface hydrocarbons.	
Cultural	• There are no heritage or cultural features exposed to surface hydrocarbons	

Table A.2: Modelling outcomes and resulting exposure to values and sensitivities - loss of well control

Spill scenario	A loss of well control event resulting in a release of up to 9.016 MMstb of condensate of API of 51.5 during a period of up to 103 days.	
Compartment affected	**Modelling outcome**	**Values and sensitivities exposed**
Seabed	Under this scenario, hydrocarbons are released at pressure and experience both vertical lift from their buoyancy and initial velocity due to the pressure change. Consequently, exposure to seabed habitats is not expected as once nearfield movement ceases hydrocarbons are not expected to be negatively buoyant thus will only interact with seabed in the intertidal area.	There were typically low, but variable probabilities of entrained hydrocarbon exposure with some islands and reef features: • Imperieuse Reef, 2–37% • Clerke Reef, 2–16% • Mermaid Reef, 1–28% • Scott Reef, 0–12% • Seringapatam Reef, 0–9% • Ashmore Reef, 0–2% • Barrow (and surrounding) Islands, 0–4% • Muiron, Serrurier (and surrounding) Islands, 3–8%.
Water surface	The maximum distance from the release site for surface oil at >1 g/m^2 ranged from 374 km southwest (summer) to 575 km west-southwest (transitional); and at >10 g/m^2 ranged from 174 km west-southwest (transitional) to 180 km north-northeast (winter).	Threatened and migratory marine mammal species may occur within the area exposed to surface hydrocarbons; however, any activity is expected to be of a transient nature. There is a migration Biologically Important Area (BIA) for the Pygmy Blue Whale that intersects with the area exposed to surface hydrocarbons. Threatened and migratory marine reptile species may occur within the area exposed to surface hydrocarbons; however, any activity is expected to be of a transient nature. There is an internesting BIA for the Flatback Turtle that intersects with the area exposed to surface hydrocarbons; however it is noted that it only intersects a small proportion of the northern extent of the BIA. Threatened and migratory shark species may occur within this exposure area; however, any activity is expected to be of a transient nature. There is a foraging BIA for the Whale Shark that partially intersects the area exposed to surface hydrocarbons. One Australian Marine Park (AMP) occur within the area exposed to surface hydrocarbons: • Argo-Rowley Terrace (0–19% probability of contact >10 g/m2). Note: Three AMPs may be within the exposure area at the lower surface threshold (>1 g/m^2): • Argo-Rowley Terrace (15–43% probability) • Montebello (10–19% probability) • Gascoyne (3–16% probability). Surface oil at this level is expected to be visually detectable but not have biological effects.
Water Column	Entrained and dissolved hydrocarbons remained in surface layers, typically up to 30 m depth.	Threatened and migratory shark species may occur within the area exposed to entrained or dissolved hydrocarbons.

		There is a foraging BIA for the Whale Shark that intersects with the area exposed to entrained and dissolved hydrocarbons.
		Threatened and migratory marine reptile species may occur within the area exposed to entrained and dissolved hydrocarbons.
		The following BIAs intersect with the area exposed to entrained and dissolved hydrocarbons:
		• Nesting, internesting, aggregation and foraging BIAs for the Flatback Turtle
		• Nesting, internesting, aggregation, basking and foraging BIAs for the Green Turtle
		• Nesting, internesting and foraging BIAs for the Hawksbill Turtle
		• Nesting and internesting BIAs for the Loggerhead Turtle.
		• Threatened and migratory marine mammal species may occur within the area exposed to entrained and dissolved hydrocarbons.
		• The following BIAs intersect with the area exposed to entrained and dissolved hydrocarbons:
		  • Migration and foraging BIAs for the Pygmy Blue Whale
		  • Migration and resting BIAs for the Humpback Whale

Air	Threatened and migratory seabird and shorebird species may occur above the area exposed to surface hydrocarbons; however, any activity is expected to be of a transient nature only given the offshore location.	There is a breeding BIA for the Wedge-tailed Shearwater that partially intersects with the area exposed to surface hydrocarbons; however, it is noted that it is the edge of the buffer zone around a breeding island (i.e. not the breeding location itself). It is noted that breeding shearwaters may forage up to a maximum of approx. 185 km from their nesting site (Section 6.4.4.3 of EP).
Shorelines	No shoreline contact above the lowest threshold of exposure (>10 g/m^2) was predicted for any of the seasons modelled.	
Socio-economic	• There are a number of Commonwealth and State fisheries with management areas that intersect with the area exposed to surface hydrocarbons. • There are other users (e.g. petroleum industry, commercial shipping) that are known to operate within the area exposed to surface hydrocarbons. • No restricted defence areas, or ports/harbours are exposed to surface hydrocarbons. • There are no tourism and recreation activities expected to be exposed to surface hydrocarbons.	
Cultural	• There are no heritage or cultural features exposed to surface hydrocarbons	

A.1.2 Response Option Feasibility Assessment

Not all response options are appropriate for every oil spill. Different oil types, spill locations, and volumes require different response options and tactics, or a combination of response options and tactics, to form an effective response strategy. In accordance with IPIECA (2017), the potential at-sea response options available to BP:

- On-water containment and recovery;
- Subsea dispersant injection;
- Surface dispersant application;
- Controlled in-situ burning;

- Shoreline booming (used as anchored exclusion, diversion or deflection barriers); and
- Shoreline clean-up

The assessment of feasibility of implementing each of these response options for the spill scenarios covered under this plan was based on the following criteria:

- Suitability/Feasibility – Is the response option suitable for the spill scenario / hydrocarbon type?
- Dependencies – Does the response option rely on other systems to perform its intended function?
- Availability – When is the earliest the response option is available to be implemented?

A.1.2.1 On-water Containment and Recovery

The feasibility assessment of on water containment and recovery is provided in Table A.3.

Table A.3: A.1.2.1 On-water Containment and Recovery Feasibility Assessment

Parameter	Diesel	Gas Condensate
Suitability/Feasibility - Is the response option suitable for the spill scenario / hydrocarbon type?	MDO spreads rapidly to less than 10 µm and so suitable thicknesses for recovery are only present soon after the spill occurs, thus there is insufficient mobilisation time to capture residues and recover significant volumes of oil. Additionally, modelling indicates that a spill would have evaporated/naturally dispersed within 52 hours.	Similar to MDO, the analogue Goodwyn condensate comprises a high portion of volatile constituents. Thus, upon reaching the water's surface, it is subject to rapid evaporation, dispersion, and spreading. Therefore, while this option would not be suitable for use on "fresh" condensate, it may be applicable if weathered condensate patches form.
	IPIECA (2015) indicates that when implemented, efficiency of at-sea containment and recovery operations can vary widely with recovery usually limited to between 5% and 20% of the initial spilled volume. Given the expected high-volatility of the hydrocarbons involved and open-ocean conditions of the Ironbark well location, recovery would be anticipated to be at the lower end of this spectrum. In addition to this, containment and recovery creates significant levels of waste, requires significant manpower and suitable calm weather conditions to be deployed effectively.	
Dependencies - Does the response option rely on other systems to perform its intended function?	This response option relies on the presence of offshore vessels (usually operating in teams of 2 vessels each) utilising towed booms and skimmers to contain and recover the oil. Thus this response option is primarily dependent on the availability of suitable offshore vessels. An additional key, and limiting, dependency is storage for the recovered oil/water volumes.	
Availability – When is the earliest the response option is available to be implemented?	The earliest that on-water containment and recovery could be deployed is within 5 days.	
Selected for further assessment?	No	Yes

A.1.2.2 Subsea Dispersant Injection

The feasibility assessment of subsea dispersant Injection is provided in Table A.4.

Table A.4: A.1.2.2 Subsea Dispersant Injection Feasibility Assessment

Parameter	Diesel	Gas Condensate
Suitability/Feasibility -Is the response option suitable for the spill scenario / hydrocarbon type?	Subsea Dispersant injection is not a suitable / feasible response option for this type of spill event thus has not been discussed further.	The feasibility of implementing subsea dispersant injection on a high-volume gas/dry condensate release, in relatively shallow water, and achieving mixing of the dispersant into the hydrocarbon stream is unknown. Additionally, the

		effectiveness of SSDI in such a release to achieve the desired effect of reducing condensate droplet size and associated hydrocarbons on the water surface, has not been attempted or studied. However, because it may be feasible to physically implement SSDI, it is considered for additional evaluation. (Note - while the application of SSDI may be considered to reduce the Lower Explosive Limit (LEL) and Volatile Organic Compounds (VOCs) above the well originating from the condensate to increase worker safety, the very high volume of natural gas released from the well would be expected to negate any marginal decrease in VOCs from the condensate)
Dependencies - Does the response option rely on other systems to perform its intended function?	N/a	Application of SSDI relies on access to the Subsea First Response Toolkit (SFRT), dispersant stocks and a suitable vessel for deployment. These are accessed via: • Supplementary Agreement with OSRL in respect of the Global Strategic Dispersant Stockpile, • NatPlan, and • AMOSC. SSDI vessel sourced post-incident using proprietary vessel sourcing software available to BP via OSRL subscription.
Availability – When is the earliest the response option is available to be implemented?	N/a	Based upon the capping and containment plan it is expected that the earliest that SSDI could be implemented is within 10 days of the spill occurring which accounts for the mobilisation of the SFRT and dispersant from Perth (Henderson) to the Ironbark-1 well location (via Dampier) and sourcing of dispersants approved for use through the Global Dispersant Stockpile (GDS) through OSRL, as well as BP's internal stockpiles.
Selected for further assessment?	No	Yes

A.1.2.3 Surface Dispersant Application

The feasibility assessment of surface dispersant application is provided in Table A.5.

Table A.5: A.1.2.3 Surface Dispersant Application Feasibility Assessment

Parameter	Diesel	Gas Condensate
Suitability/Feasibility -Is the response option suitable for the spill scenario / hydrocarbon type?	The purpose of surface application of dispersants is to reduce hydrocarbon expression on the water surface. Although MDO has a small persistent fraction, it spreads rapidly and forms thin layers on the	The purpose of surface application of dispersants is to reduce hydrocarbon expression on the surface, thereby reducing potential impacts to receptors on the surface and/or shoreline. Given that no shoreline impacts are anticipated,

	water surface. In addition to there being insufficient time to mobilise dispersant, and associated personnel and equipment to site while suitable surface thicknesses are present, dispersant application can result in punch-through where dispersant passes into the water column without breaking oil layer down if surface layers are too thin. Application can contribute to water quality degradation through chemical application without removing surface oil. Consequently, this option is not considered suitable for this type of spill event and has not been considered further.	the justification for surface dispersant application is limited. Applying dispersants on the surface at or near a high-volume dry gas condensate release would pose significant health and safety risks to responders, given the proximity to the release and the large quantities of gas present. Additionally, the effectiveness of chemical dispersants on dry gas condensate spills has not been studied. However, aerial dispersants could likely be safely applied to patches of weathered condensate that may be present away from the source, if they were to form, as was demonstrated during the Montara response. Consequently, while this option is generally not considered suitable for this type of spill event, it has been included for further evaluation.
Dependencies - Does the response option rely on other systems to perform its intended function?	N/A	Aerial application of dispersants relies on access to aircraft (application and spotter), dispersant stockpiles, and trained crews. These are available through: • OSRL and AMOSC • Global Dispersant Stockpile • BP-owned dispersant stocks
Availability – When is the earliest the response option is available to be implemented?	N/A	Based on service agreements with OSRL and AMOSC, aerial dispersant application could be available to begin operations within 72 hours of an incident.
Selected for further assessment?	No	Yes

A.1.2.4 Controlled In-situ Burning

The feasibility of controlled in-situ burning is provided in Table A.6.

Table A.6: A.1.2.4 Controlled In-situ Burning Feasibility Assessment

Parameter	Diesel	Gas Condensate
Suitability/Feasibility -Is the response option suitable for the spill scenario / hydrocarbon type?	Controlled is-situ burning, is considered a feasible response option for persistent hydrocarbons that have a high surface expression. Given MDO has limited persistence and upon release the surface expression is expected to rapidly evaporate and disperse, this option is not considered suitable for this type of spill event and hasn't been considered further.	Controlled is-situ burning, is considered a feasible response option for persistent hydrocarbons that have a high surface expression. Given gas condensate has limited persistence and upon release the surface expression is expected to rapidly evaporate and disperse, this option is not considered suitable for this type of spill event and has not been considered further.

Dependencies - Does the response option rely on other systems to perform its intended function?	N/A	N/A
Availability – When is the earliest the response option is available to be implemented?	N/A	N/A
Selected for further assessment?	No	No

A.1.2.5 Shoreline Booming (used as anchored exclusion, diversion or deflection barriers)

The feasibility of shoreline booming is provided in Table A.7.

Table A.7: A.1.2.5 Shoreline Booming (used as anchored exclusion, diversion or deflection barriers)Feasibility Assessment

Parameter	Diesel	Gas Condensate
Suitability/Feasibility -Is the response option suitable for the spill scenario / hydrocarbon type?	No shoreline exposure is expected from this spill event given the distance offshore, and the tendency for MDO to evaporate and disperse rapidly via entrainment in the water column. Consequently, this option is not considered suitable for this type of spill event and has not been considered further.	No shoreline exposure above modelled thresholds predicted; consequently, this option is not considered suitable for this type of spill event and has not been considered further.
Dependencies - Does the response option rely on other systems to perform its intended function?	N/A	N/A
Availability – When is the earliest the response option is available to be implemented?	N/A	N/A
Selected for further assessment?	No	No

A.1.2.6 Shoreline Cleanup

The feasibility of shoreline clean-up is provided in Table A.8.

Table A.8: Shoreline Cleanup Feasibility Assessment

Parameter	Diesel	Gas Condensate
Suitability/Feasibility -Is the response option suitable for the spill scenario / hydrocarbon type?	No shoreline exposure is expected from this spill event given the distance offshore, and the tendency for MDO to evaporate and disperse rapidly via entrainment in the water column. Consequently, this option is not considered suitable for this type of spill event and has not been considered further.	No shoreline exposure above modelled thresholds predicted; consequently, this option is not considered suitable for this type of spill event and has not been considered further.
Dependencies - Does the response option rely on other systems to perform its intended function?	N/A	N/A
Availability – When is the earliest the response option is available to be implemented?	N/A	N/A
Selected for further assessment?	No	No

As no response options are deemed feasible to mitigate a spill of MDO resulting from a vessel collision during BP's exploration drilling activities, no further assessment has been conducted for this scenario.

A.2 Outcome Predictions

The environmental risk assessment conducted for the accidental release of condensate from a loss of well control (described in Section 6.4 of the EP) was leveraged to understand the potential consequence or impact to resources at risk using the 'no intervention' case as a baseline level of impact from these events. This information is summarised in Table A.9.

A.3 Balancing Trade-Offs

The next stage of the SIMA assessment process aims to understand if implementing each response option will result in an environmental benefit or cause additional environmental impacts beyond which there is no clear benefit including a response option as part of the planned response strategy.

To complete this, the feasible response options are evaluated, based on the extent to which they mitigate, exacerbate or do not alter the 'no intervention' level of impact. The extent to which each response option mitigates the impact is identified using a qualitative range as described by IPIECA (2018) and shown in Table A.10. The outcomes of the assessment are presented in Section A.4.

Table A.9: Impact modification factors

Impact Modification Factors	Description
+3	Major mitigation of impact
+2	Moderate mitigation of impact
+1	Minor mitigation of impact
0	No or insignificant alteration of impact
-1	Minor additional impact
-2	Moderate additional impact
-3	Major additional impact

Table A.10: Balancing environmental impact trade-offs between 'no intervention' case and spill response options

IRONBARK Spill Impact Mitigation Assessment (SIMA)			No Intervention		Containment & Recovery		In Situ Burning		Surface Dispersant		Subsurface Dispersant		Shoreline Booming	
			Potential relative impact	Numerical relative impact	Impact modification factors	Relative impact mitigation score	Impact modification factors	Relative impact mitigation score	Impact modification factor	Relative impact mitigation score	Impact modification factor	Relative impact mitigation score	Impact modification factor	Relative impact mitigation score
Resource Compartments		Spatial Scale[a]		A	B_1	AxB_1	B_2	AxB_2	B_3	AxB_3	B_4	AxB_4	B_5	AxB_5
Seabed		L	Mod	3	0	0	n/a	--	-1	-3	-1	-3	n/a	--
Water Column		R	Low	2	1	2	n/a	--	-2	-4	-2.5	-5	n/a	--
Water Surface		R	Low	2	1	2	n/a	--	1	2	1.5	3	n/a	--
Shoreline		R	None	1	0	0	n/a	--	0	0	0	0	n/a	--
Air	Response Safety	L	High	4	0	0	n/a	--	0.5	2	1	4	n/a	--
High-Value Resources	Heritage Sites	L	Mod	3	0	0	n/a	--	-1	-3	-1	-3	n/a	--
Socio-economic	Commercial Fisheries, tourism, marine parks	R (econ) L (ecol)	Mod	3	1	3	n/a	--	-2	-6	-2	-6	n/a	--

A.4 Select best response options /develop response strategy

Based on the outcomes of the SIMA presented in Table A.2, SSDI was not considered a viable response option. Additionally, given their potential marginal effectiveness and application, on water containment and recovery, and surface dispersant application are considered only as secondary response options, where they may be used on patches of waxy residue that may form that threaten sensitive receptors.

Therefore, the overall oil spill response strategy for a LOWC event would include the following response options:

Primary Oil Spill Response Options

- Monitoring, evaluation and surveillance
- Oiled wildlife response
- Monitoring Sampling program (as per OSMP)
- Waste management.

Secondary Oil Spill Response Options

- Containment and recovery and application of surface dispersants are carried forward as secondary response options, due to the uncertainty of effectiveness of these response options on spilled condensate (due to the exploratory nature of the drilling activities, some uncertainty associated with properties and behaviour of targeted hydrocarbons remain) at the planning stage of the SIMA. These will be further evaluated during operational SIMAs to be conducted in the event of a spill.

Source Control Options

- In addition to oil spill response options, source control options, including ROV emergency BOP intervention, capping and containment, and drilling of a relief well, would all be initiated concurrently with spill response options.

Appendix E

Operational and Scientific Monitoring Plan

BP IRONBARK
Exploration Drilling

Operational and Scientific Monitoring Plan

AU001-HS-PLN-600-00003

Rev.A03

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Abbreviations and Acronyms

AFMA	Australian Fisheries Management Authority
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
BACI	Before/After and Control/Impact
BP	BP Developments Australia Pty Ltd
BTEX	benzene, toluene, ethylbenzene and xylene
CoC	Chain of Custody
CV	Curriculum Vitae
DAWE	Commonwealth Department of Agriculture, Water and Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DPIRD	Department of Primary Industries and Regional Development
ECD	Ecological character description
EEZ	Economic Exclusion Zone
EMBA	Environment that May Be Affected
EP	Environment Plan
EPOs	Environmental Performance Outcomes
ESC	Western Australian Environment and Science Coordinator
EU	IMT Environmental Unit
EUL	IMT Environmental Unit Leader
HSE	Health, Safety and Environment
IC	Incident Commander
ICS	Incident Command System
IMT	Incident Management Team
JSA	Job Safety Analysis
LEL	Lower explosive limit
LOWC	Loss of Well Control
MAH	Monocyclic Aromatic Hydrocarbons
MDO	Marine Diesel Oil
MGO	Marine Gas Oil
MNES	Matters of National Environmental Significance
NATA	National Association of Testing Authorities, Australia
NatPlan	National Plan for Maritime Environmental Emergencies
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
OMSs	Operational Monitoring Studies
OPEP	Oil Pollution Emergency Plan
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OSMP	Operational and Scientific Monitoring Plan
OSRL	Oil Spill Response Limited
PAH	Polycyclic Aromatic Hydrocarbons
PI	Principal Investigator

PSC	IMT Planning Section Chief
SAPs	Sampling and Analysis Plans
SIP	Study Implementation Plan
SMSs	Scientific Monitoring Studies
SOF	IMT Safety Officer
TPH	Total petroleum hydrocarbon
TRH	Total recoverable hydrocarbon
TS	Technical Specialists
VOCs	Volatile organic compounds
WA DoT	Western Australian Department of Transport
WGS	World Geodetic System

1 Introduction

This Operational and Scientific Monitoring Plan (OSMP) has been prepared to support BP's Ironbark Exploration Drilling Program in WA-359-P and satisfy the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (OPGGS(E)R) requirements for OSMP readiness prior to a hydrocarbon release.

This OSMP is a key component of the environmental management document framework for offshore petroleum activities, which also includes BP's Ironbark Exploration Drilling Environment Plan (EP; AU601-HS-PLN-600-00001) and Oil Pollution Emergency Plan (OPEP; AU601-HS-PLN-600-00002).

This OSMP consolidates BP's monitoring response to all Level 2 and Level 3 hydrocarbon spill events associated with the Ironbark drilling activities, as defined under the Commonwealth National Plan for Maritime Environmental Emergencies (NatPlan) (Section 1.3.1 of the OPEP).

1.1 Objectives

The objectives of this OSMP are:

- Provide a clear, easy to use framework for monitoring following a Level 2 or Level 3 hydrocarbon spill to the marine environment;
- Outline the monitoring required to inform, plan and execute the spill response to reduce environmental harm (operational monitoring);
- Outline the monitoring required to assess any short-term and long-term impacts to the marine and coastal environments (from both the spill and any response activities), their subsequent recovery and inform any remediation activities required (scientific monitoring);
- Provide the strategy for each of the monitoring studies which includes an overview of the monitoring performance objectives, monitoring standards and their measurement criteria; and
- Provide the framework for the BP Incident Management Team (IMT) to develop specific Study Implementation Plans (SIPs) for each of the monitoring studies prior to the drilling activities commencing.

This OSMP demonstrates BP's commitment to achieve monitoring 'readiness' with OSMP arrangements already in place in the event of a Level 2 or Level 3 spill event occurring as a result from the Ironbark drilling activities.

1.2 Response Action Plan Overview

Titleholders must demonstrate that they have adequate capability to conduct the identified monitoring activities and make informed decisions regarding their implementation. This OSMP has been developed to meet the requirements of Regulation 14 of the OPGGS(E)R.

Table 1-1 provides guidance on the OSMP requirements of the OPGGS(E)R, and reference to the relevant section of this document which addresses that requirement.

This OSMP incorporates regulatory guidance from the following documents:

- Guidance Note – Oil pollution risk management (NOPSEMA 2018); specifically, the concepts and considerations from Section 4.6 (Monitoring of impacts to the environment),
- Information Paper – Operational and scientific monitoring programs (NOPSEMA 2016).

Table 1-1: OPGG(E) Regulations Relevant to OSMP

Regulation	Relevant section in this OSMP
OPGGS(E)R	
Part 2, Division 2.3, Regulation 14 (5) The implementation strategy must include measures to ensure that each employee or contractor working on, or in connection with, the activity is aware of his or her responsibilities in relation to the environment plan, including during emergencies or potential emergencies, and has the appropriate competencies and training.	Sections 2.3.1 and 2.3.2
Part 2, Division 2.3, Regulation 14 (8AA) The oil pollution emergency plan must include adequate arrangements for responding to and monitoring oil pollution, including the following: (a) the control measures necessary for timely response to an emergency that results or may result in oil pollution; (b) the arrangements and capability that will be in place, for the duration of the activity, to ensure timely implementation of the control measures, including arrangements for ongoing maintenance of response capability; (c) the arrangements and capability that will be in place for monitoring the effectiveness of the control measures and ensuring that the environmental performance standards for the control measures are met; the arrangements and capability in place for monitoring oil pollution to inform response activities.	Sections 2.3.2, 3.2 and 3.3
Part 2, Division 2.3, Regulation 14 (8D) The implementation strategy must provide for monitoring of impacts to the environment from oil pollution and response activities that: (a) is appropriate to the nature and scale of the risk of environmental impacts for the activity; and (b) is sufficient to inform any remediation activities.	Sections 1.3.3, 2.2.4, 3.2 and 3.3

1.3 Scope

This OSMP is relevant to the activity types, hydrocarbon types and geographical extent applicable to the potential hydrocarbon spills identified for the Ironbark exploration drilling program.

BP's exploration drilling activities in WA-359-P are described in the BP Ironbark Exploration Drilling Program EP. Based on the activities described in the EP, BP has identified accidental release scenarios that could credibly occur during the undertaking of exploration drilling activities in WA-359-P. These are described in Section 6 of the EP. The two worst case scenarios have the potential to result in a spill of hydrocarbons to the marine environment which could require activation of the OSMP:

- A vessel loss of containment resulting from a release of Marine Diesel Oil (MDO) to the surface.
- A total loss of well control (well blowout) resulting in a subsea release of hydrocarbon gas and gas condensate.

Table 1-2 summarises the details of those scenarios which have been modelled[1] and informed the preparation of this OSMP.

Table 1-2: Credible Spill Scenarios for OSMP Implementation

Spill Scenario Parameter	Details
Release location	Ironbark-1 Exploration Well
Coordinates (WGS84)	Long: 116° 04' 35.80 (E); Lat: 19° 09' 34.01" (S)
Scenario 1 – Surface MDO release resulting from vessel loss of containment	
Oil type	MDO
Release depth	Surface
Total volume released	250 m^3
Assumed release duration	6 hours
Applicable Spill Response Levels *	1, 2
Scenario 2 – Subsea gas condensate release resulting from a total loss of well control	
Oil type	Gas condensate (Goodwyn analouge)
Release depth	Subsea (approx. 300 m deep)
Total volume of condensate released[1]	9.016 MMstb
Initial flow rate	91,793 bbl/day (condensate) 11,504 bbl/day (water) 1,541 MMscf/day (gas)
Assumed release duration	103 days
Applicable Spill Response Levels *	2, 3

* refer to OPEP

1.3.1 Activity Types

Activity types relevant to the Ironbark Exploration Drilling activity and regulated under the OPGGS(E)R includes, but is not limited to:

- Exploration drilling activities, and
- Support operations.

1.3.2 Hydrocarbon Types and States

The hydrocarbon type within the Ironbark prospect is anticipated to be gas/condensate. As BP is conducting exploration drilling, Goodwyn 10 PVT has been selected as a suitable analogue given its

[1] BP's Global Wells Central Team have estimated that the initial flow rate for the worst case credible risk of a loss of well control event would be 79,480 bbl/day (condensate rate), 1,236 bbl/day (water rate) and 883 MMscf/day (gas rate). However, BP has modelled the dispersion of a spill based on the higher, highly conservative flow rates of 91,793 bbl/day (condensate rate), 11,504 bbl/day (water rate) and 1,541 MMscf/day (gas rate). Therefore, the predicted exposure areas provide a highly conservative estimate of the potential area that may be exposed to hydrocarbon in the event of loss of well control during the Ironbark exploration drilling program. This highly conservative estimate of area exposed to hydrocarbon has been used to inform this OSMP.

proximity to the Ironbark prospect and proposed well location (refer to Section 2.2.1 of the Ironbark Exploration Drilling EP). Drilling related vessels would typically use MDO or marine gas oil (MGO).

This OSMP is therefore applicable to:

- Condensate, in both its fresh and weathered hydrocarbon state
- MDO/MGO, in both its fresh and weathered hydrocarbon state
- Surface, entrained and dissolved fractions of these two hydrocarbons following release.

1.3.3 Geographical Extent

This OSMP is relevant and applicable to all Commonwealth and State marine and coastal areas that are potentially at risk of exposure to hydrocarbons in the event of a spill resulting from the Ironbark exploration drilling program. The Project location is shown in Figure 1-1, and its environmental context detailed in Section 3 of the EP.

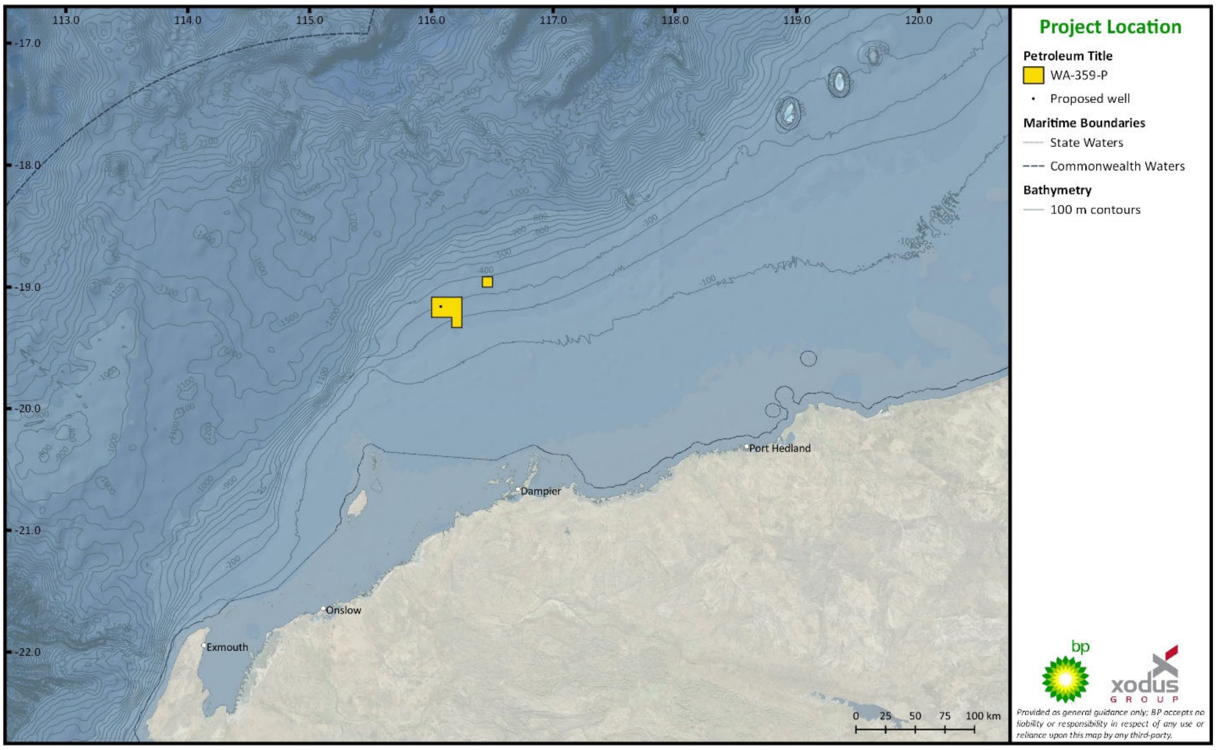

Figure 1-1: Project Location

The spatial boundaries of an individual monitoring study will depend primarily on the actual or potential area affected by the spill. Spatial boundaries of monitoring studies will be sufficient to meet monitoring objectives, usually by determining impacted and non-impacted areas and the level of effects, linking effects to the spill source, and supporting decisions on clean-up strategies. The spatial extent of a monitoring study (either operational or scientific) would only be finalised once a spill event has occurred (see also Section 3.1.3).

The environment that may be affected (EMBA) presented in the EP (Section 3.2) has been determined based upon the outcomes of predictive stochastic modelling, also described in the EP (Sections 6.4.4 and 6.4.5). This provides an indication of all of the potential sensitivities that could be impacted by a potential spill. The results of the stochastic modelling for the MDO and gas/condensate spill, within the EMBA, are shown in Figure 1-2 and Figure 1-3 respectively. The location of the planned well, nature of the hydrocarbons associated with BP's drilling activities, and the outcomes of stochastic modelling have informed the development of this OSMP. In particular, no shoreline exposure is expected, so the OSMP is focused only on monitoring of open water areas of surface, entrained and dissolved exposures.

1.3.3.1 Predicted oil exposure to matters of national environmental significance

Table 1-3 lists matters of national environmental significance (MNES) that are known to occur within the EMBA and if there is predicted oil exposure at or above low thresholds from either of the worst-case spill scenarios. It is noted that these low thresholds are not always relevant to levels associated with potential impacts, however, may represent a change in ambient environmental conditions.

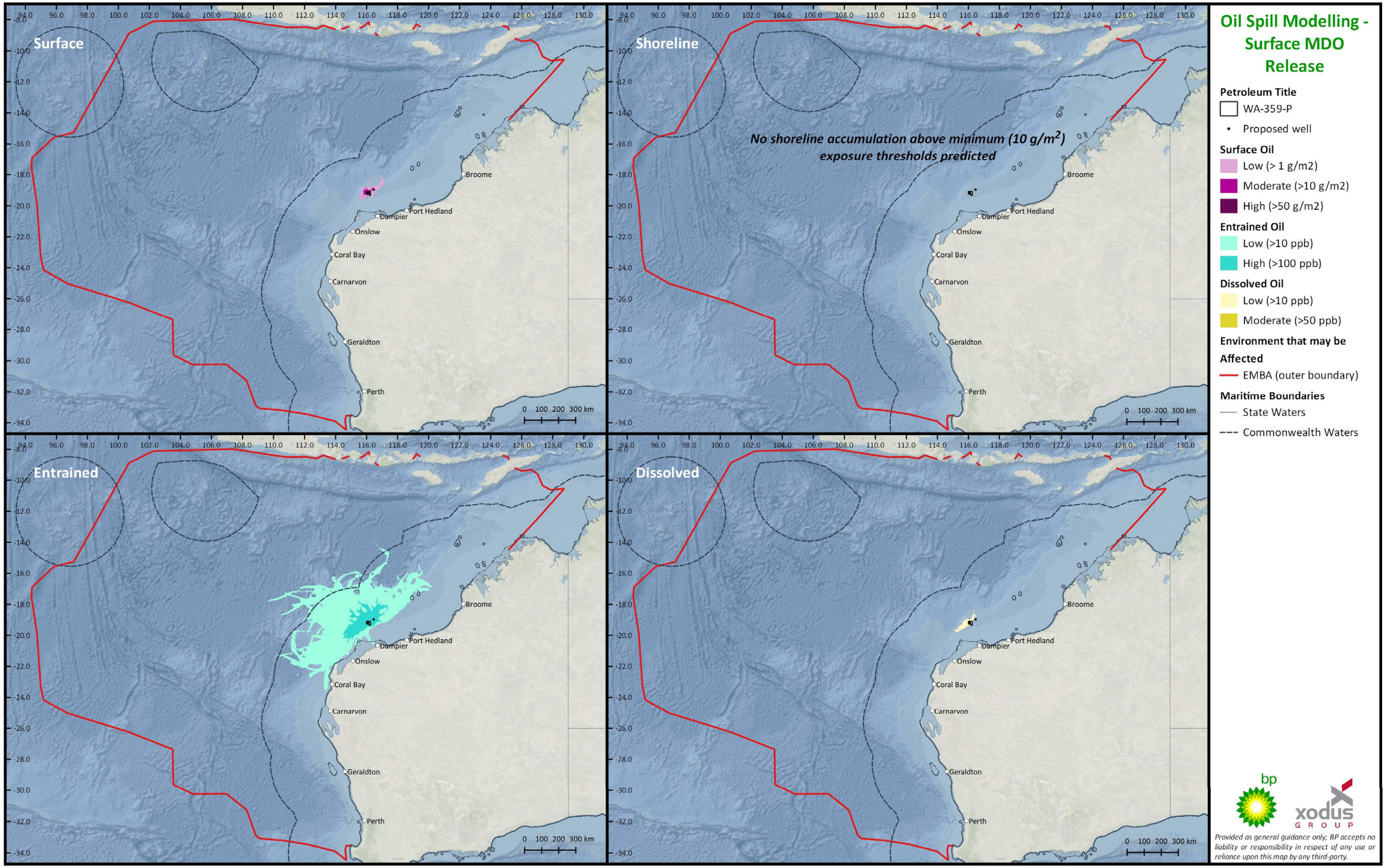

Figure 1-2: Stochastic modelling of predicted oil exposure for a surface release of 250 m^3 of MDO over 6 hours

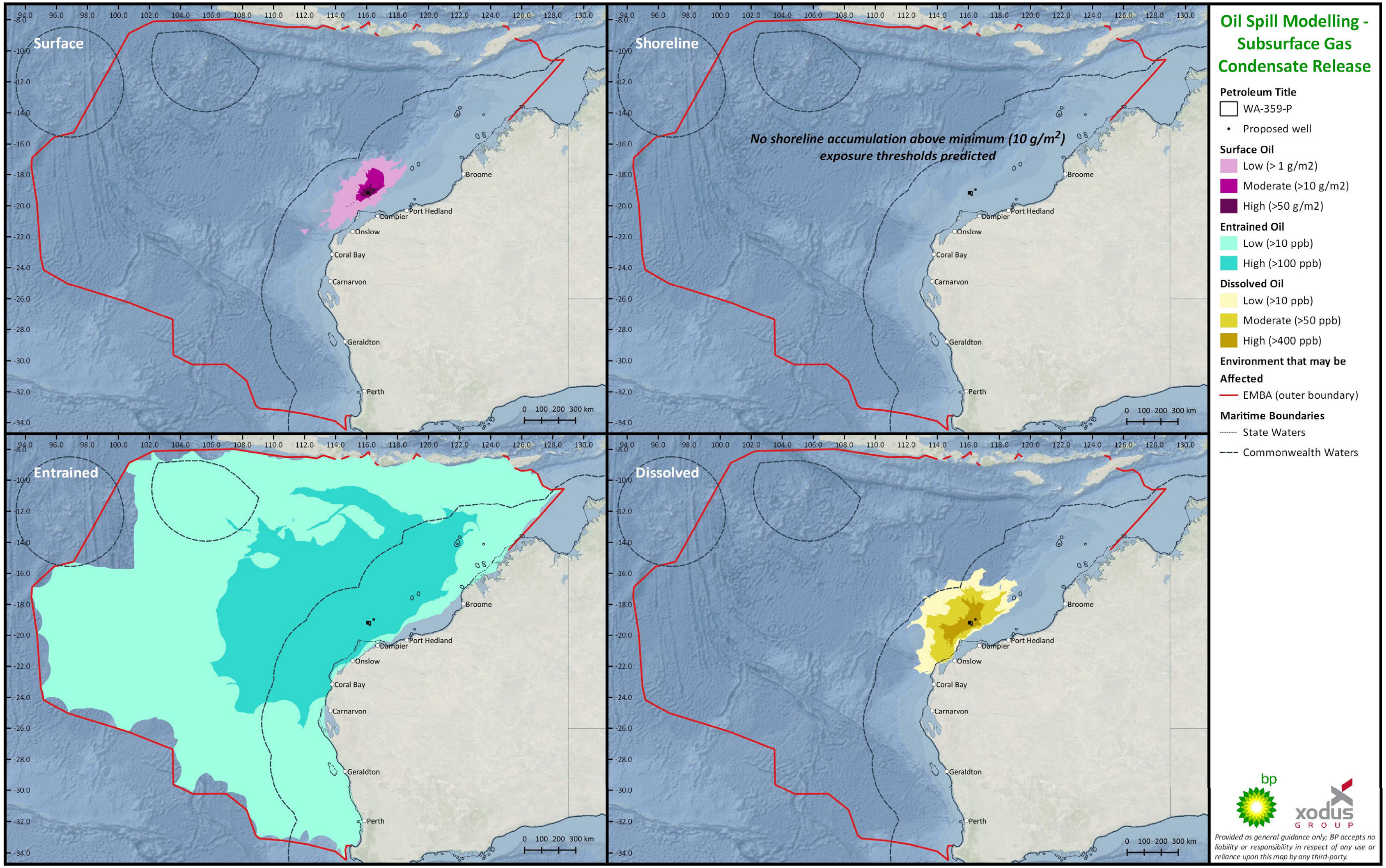

Figure 1-3: Stochastic modelling of predicted oil exposure for a subsurface release of 9.016 MMstb of gas condensate over 103 days

Table 1-3: Predicted exposure of MNES features within the EMBA

MNES Type	Marine and/or coastal MNES features/species within the EMBA	Predicted Oil Exposure above Low Exposure Values (Surface MDO Release)				Predicted Oil Exposure above Low Exposure Values (Subsurface Gas Condensate Release)			
		Shoreline	Surface	Entrained	Dissolved	Shoreline	Surface	Entrained	Dissolved
World Heritage Properties	Komodo National Park (Indonesia)	x	x	x	x	x	x	✓	x
	Shark Bay	x	x	x	x	x	x	✓	x
	The Ningaloo Coast	x	x	✓	x	x	x	✓	✓
National Heritage Places	*Batavia* Shipwreck (Houtman Abrolhos)	x	X	x	x	x	x	✓	x
	HMAS Sydney II and *HSK Kormoran* Shipwreck Sites	x	x	x	x	x	x	✓	x
	Shark Bay	x	x	x	x	x	x	✓	x
	The Ningaloo Coast	x	x	✓	x	x	x	✓	✓
	The West Kimberley	x	x	x	x	x	x	✓	x
Wetlands of International Importance	Ashmore Reef Commonwealth Marine Reserve	x	x	x	x	x	x	✓	x
	Eighty-mile Beach	x	x	x	x	x	x	X	x
	Hosnies Spring (Christmas Island)	x	x	x	x	x	x	✓	x
	Peel-Yalgorup system	x	x	x	x	x	x	✓	x
	Roebuck bay	x	x	x	x	x	x	X	x
	The Dales (Christmas Island)	x	x	x	x	x	x	✓	x
	Vasse-Wonnerup system	x	x	x	x	x	x	X	x
Threatened Ecological Communities	Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	x	x	x	x	x	x	✓	x
	Subtropical and Temperate Coastal Saltmarsh	x	x	x	x	x	x	✓	x
Threatened Species	Various (Seabirds and Shorebirds, Fish and Sharks, Marine Mammals, Marine Reptiles)	x	✓	✓	✓	x	✓	✓	✓
Migratory Species	Various (Seabirds and Shorebirds, Fish and Sharks, Marine Mammals, Marine Reptiles)	x	✓	✓	✓	x	✓	✓	✓

MNES Type	Marine and/or coastal MNES features/species within the EMBA	Predicted Oil Exposure above Low Exposure Values (Surface MDO Release)				Predicted Oil Exposure above Low Exposure Values (Subsurface Gas Condensate Release)			
		Shoreline	Surface	Entrained	Dissolved	Shoreline	Surface	Entrained	Dissolved
Commonwealth Marine Area	Abrolhos Marine Park	x	x	x	x	x	x	✓	x
	Argo-Rowley Terrace Marine Park	x	✓	✓	x	x	✓	✓	✓
	Ashmore Reef Marine Park	x	x	x	x	x	x	✓	x
	Carnarvon Canyon Marine Park	x	x	x	x	x	x	✓	x
	Cartier Island Marine Park	x	x	x	x	x	x	✓	x
	Dampier Marine Park	x	x	x	x	x	x	✓	x
	Eighty Mile Beach Marine Park	x	x	x	x	x	x	x	x
	Gascoyne Marine Park	x	x	✓	x	x	✓	✓	✓
	Geographe Marine Park	x	x	x	x	x	x	✓	x
	Jurien Marine Park	x	x	x	x	x	x	✓	x
	Kimberley Marine Park	x	x	x	x	x	x	✓	x
	Mermaid Reef Marine Park	x	x	✓	x	x	x	✓	x
	Montebello Marine Park	x	x	✓	x	x	✓	✓	✓
	Ningaloo Marine Park	x	x	✓	x	x	x	✓	✓
	Oceanica Shoals Marine Park	x	x	x	x	x	x	✓	x
	Perth Canyon Marine Park	x	x	x	x	x	x	✓	x
	Roebuck Marine Park	x	x	x	x	x	x	x	x
	Shark Bay Marine Park	x	x	x	x	x	x	✓	x
	South-west Corner Marine Park	x	x	x	x	x	x	✓	x
	Two Rocks Marine Park	x	x	x	x	x	x	✓	x

MNES Type	Marine and/or coastal MNES features/species within the EMBA	Predicted Oil Exposure above Low Exposure Values (Surface MDO Release)				Predicted Oil Exposure above Low Exposure Values (Subsurface Gas Condensate Release)			
		Shoreline	Surface	Entrained	Dissolved	Shoreline	Surface	Entrained	Dissolved
Great Barrier Reef Marine Park	None present	—	—	—	—	—	—	—	—
Nuclear Actions	None present	—	—	—	—	—	—	—	—
Water Resource	None present	—	—	—	—	—	—	—	—

✓ = Stochastic spill modelling predicted contact with feature above low (1 g/m^2 surface, 10 ppb entrained and dissolved, 10 g/m^2 shoreline) exposure thresholds; x = Stochastic spill modelling did not predict contact with feature above low exposure thresholds; — = Not relevant.

1.4 Types of Monitoring

Oil spill monitoring has been divided into two types (operational and scientific) which are undertaken for two distinct, but closely related, purposes (NOPSEMA 2016).

- **Operational monitoring studies (OMSs)** during the spill response will support planning and operations through informing the IMT of the spill behaviour (e.g. oil spill trajectory modelling, distribution in the water column, receptors that are impacted or at risk) and to track the effectiveness of the response measures (e.g. deployment of fit-for-purpose instrumentation to document the efficacy of response measures within the IMT);
- **Scientific monitoring studies (SMSs)** will be used to characterise the short- (impact) and long- (recovery) term environmental effects from a spill incident (from both the spill and any response activities). Scientific monitoring will also be used to assess if oil spill response measures have been effective in providing the best Net Environmental Benefit through protection and/or mitigation of the impact of the spill on environmental sensitivities under threat or further impacted these sensitivities.

1.5 Structure of OSMP

This OSMP has been designed to provide:

- Monitoring coordination by the IMT Planning Section Chief and BP's Environment Unit Leader (or delegates);
- Ease of OSMP implementation by team members with details of thoroughness of required information to carry out each study;
- Certainty in the outputs / information / data from the monitoring studies to inform response planning and strategies; and
- A clear and auditable monitoring plan for BP and relevant regulatory agencies.

This OSMP is structured in the following manner:

- Section 1: Introduction;
- Section 2: OSMP Implementation Framework and Strategy;
- Section 3: Monitoring Strategies; and
- Section 4: References.

2 OSMP Implementation Framework and Strategy

2.1 OSMP Framework

In the event of a Level 2 or Level 3 hydrocarbon spill during BP's drilling activities, operational monitoring studies (OMSs) will be implemented to inform spill response and quantify the extent of the spill impact. In addition, scientific monitoring studies (SMSs) will be implemented to evaluate the potential environmental impacts to the marine environment.

OMSs and SMSs are developed based on:

- The values and sensitivities of receptors within the EMBA and hydrocarbon exposure area described in Section 3.3 of the EP;
- The potential impacts and risks of MDO, and gas/condensate spills, which have been assessed in Section 6.4.4 and 6.4.5 of the EP;
- The assessment of spill response options and selection of an overall spill response strategy as described in Section 5 of the OPEP.

This OSMP includes:

- Monitoring strategies for OMSs and SMSs. The strategies provide details on the monitoring performance outcomes, monitoring standards, measurement criteria, initiation triggers, and termination criteria.
- SIPs content list to define the operational document to execute activated OMSs and SMSs in the event of a spill incident.
- Sampling and Analysis Plans (SAPs) to detail the technical aspects of each of the monitoring studies such as field methodology, data analysis and reporting.

The relationship between the OSMP and supporting documents (i.e. SIPs and SAPs), the OPEP, EP and other emergency management documents is shown in Figure 2-1.

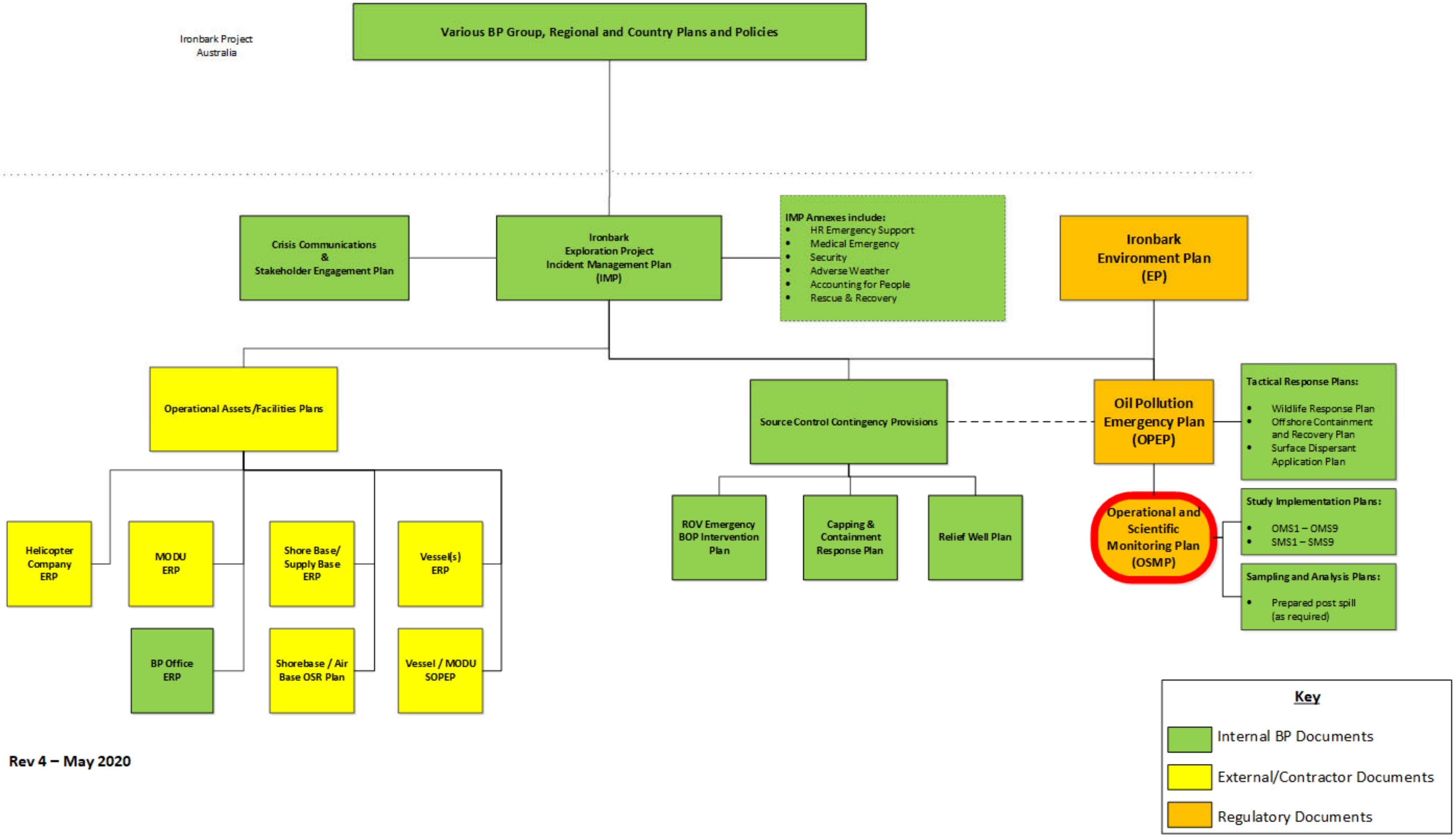

Figure 2-1: A graphical representation of the relationship between all emergency plans and documents

2.2 Monitoring Management and Information Pathways

2.2.1 Overview

The OSMP has primarily been developed to achieve operational monitoring 'readiness' in the event of an unplanned Level 2 or Level 3 spill from the Ironbark Exploration Drilling activity.

In the unlikely event of a Level 2 or Level 3 incident, BP will immediately initiate OMSs and SMSs according to the relevant monitoring strategy initiation criteria and sensitivities affected or with potential to be affected by an actual spill event.

Responsibilities for managing implementation of the OSMP and delivery of the information required within the context of a coordinated spill response required for a Level 2 or Level 3 spill incident will lie within the Environmental Unit (EU) of the IMT (Figure 2-2). All information will be gathered and analysed by the EU and then shared using the Incident Command System (ICS) structure (Figure 2-2).

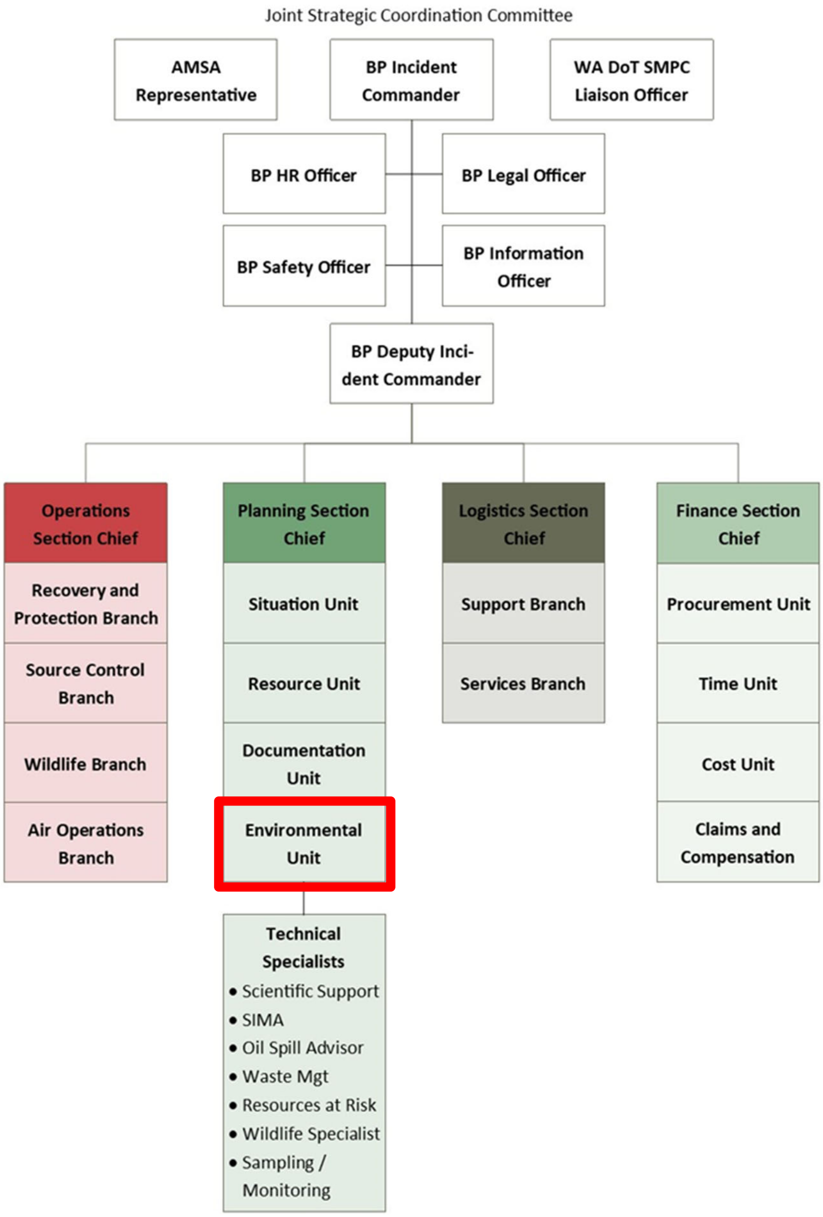

Figure 2-2: Incident Command System Structure

2.2.2 Information Pathways – Operational Monitoring

Operational monitoring information will be used by the BP IMT, where BP is the Control Agency for petroleum activity-related spills in Commonwealth waters, to inform operational response activities.

The Australian Maritime Safety Authority (AMSA), the Control Agency for vessel-based spills in Commonwealth waters, is responsible for operational monitoring to inform response activities, however BP will assist with monitoring wherever possible. All data generated from OMSs will also be directed to the Australian Marine Oil Spill Centre (AMOSC), AMSA and the Western Australian Department of Transport (WA DoT) to assist in operational response planning and effectiveness evaluation (Section 6 of the OPEP).

Information collected from scientific monitoring will be directed to the relevant Commonwealth and State environmental authorities as it becomes available.

2.2.3 Information Pathways – Scientific Monitoring

BP will commence consultation with relevant Commonwealth and Western Australian State authorities prior to the implementation of SMSs to ensure that the approved scientific monitoring program is undertaken in consultation with the appropriate Commonwealth and Western Australian authorities. These authorities will include the Commonwealth Department of Agriculture, Water and Environment (DAWE) for MNES, and for Western Australia, WA DoT who will coordinate the whole of government advice, through the nominated Environmental Science Coordinator. These authorities will be consulted on the focus, scope and duration of the program in Commonwealth and State waters respectively.

BP will notify these authorities on the relevant spill 'level' event and provide operational data to these authorities. BP will consult with these authorities on the content of the scientific studies (e.g. baseline, location of reference and control sites, study method) and obtain feedback which will be incorporated into the scientific study design to ensure scientific monitoring is to the satisfaction of the Commonwealth and State authorities. From this, the SIPs (refer to Section 2.2.8 framework as provided in this OSMP) and draft SAPs may be modified based upon this feedback.

It is noted that monitoring for the SMSs may commence by BP under the draft SAPs, as per the timings defined within each of the strategies (Sections 3.2 and 3.3). Therefore, any modifications from consultation with the respective authorities will be incorporated into amended SAPs on an ongoing and as-needed basis.

2.2.4 List of Monitoring Studies

OMSs and SMSs to be implemented in the event of a Level 2 or Level 3 spill during drilling activities are detailed in Table 2-1.

Table 2-1: OSMP Studies

Study ID	Study Name	OSMP Section	Responsibilities
Operational Monitoring Studies			
OMS1	Operational Forecast Modelling	Section 3.2.1	IMT Planning Section Chief via Environmental Unit
OMS2	Hydrocarbon Spill Surveillance and Tracking	Section 0	IMT Planning Section Chief via Situation Unit
OMS3	Hydrocarbon Weathering Assessment	Section 3.2.3	IMT Planning Section Chief via Environmental Unit
OMS4	Dispersant Efficacy Assessment	Section 3.2.4	IMT Planning Section Chief via Environmental Unit
OMS5	Water Quality Assessment	Section 0	IMT Planning Section Chief via Environmental Unit
OMS6	Sediment Quality Assessment	Section 0	IMT Planning Section Chief via Environmental Unit
OMS7	Marine Fauna Surveillance	Section 0	IMT Planning Section Chief via Environmental Unit
OMS8	Fish Taint Assessment	Section 3.2.8	IMT Planning Section Chief via Environmental Unit
OMS9	Air Quality (Responder Health and Safety) Assessment	Section 0	IMT Safety Officer
Scientific Monitoring Studies			
SMS1	Ecotoxicology Assessment of Hydrocarbons	Section 3.3.1	IMT Environmental Unit Leader via Technical Specialists
SMS2	Water Quality Monitoring	Section 0	IMT Environmental Unit Leader via Technical Specialists
SMS3	Sediment Quality Monitoring	Section 0	IMT Environmental Unit Leader via Technical Specialists
SMS4	Benthic Habitat Monitoring	Section 0	IMT Environmental Unit Leader via Technical Specialists
SMS5	Seabird Population Monitoring	Section 0	IMT Environmental Unit Leader via Technical Specialists
SMS6	Marine Megafauna Surveys	Section 0	IMT Environmental Unit Leader via Technical Specialists
SMS7	Hydrocarbon Monitoring of Representative Commercial and Recreational Fish Species	Section 0	IMT Environmental Unit Leader via Technical Specialists
SMS8	Hindcast Modelling for Impact Assessment	Section 0	IMT Environmental Unit Leader via Technical Specialists
SMS9	Socio-Economic Surveys	Section 0	IMT Environmental Unit Leader via Technical Specialists

2.2.5 Linkages between Environmental Sensitivities, OPEP Response Options and OSMP Studies

The linkage between the environmental sensitivities, the OPEP response options and OSMs and SMSs defined in the OSMP (Section 2.2.4) are summarised in Table 2-2.

To ensure logical and robust linkage between the EP, OPEP and OSMP, the development of monitoring performance outcomes for the OSMP is based on:

- the relevant monitoring Environmental Performance Outcomes (EPOs) of the EP;
- meeting spill response planning and management objectives as detailed in the OPEP; and
- the verification of the impact assessment, in particular severity of the impact and recovery for environmental sensitivities, and effectiveness of mitigation measures identified in the EP and OPEP with regards to spill response options.

Hence, this OSMP monitoring performance outcomes provide explicit linkages as to why the monitoring studies are required for the OPEP (i.e. operational environmental information for response planning and management) and EP (i.e. scientific study to monitor impact to and recovery of environmental sensitivities).

Table 2-2: Environmental Sensitivities which may be monitored as part of the OSMP in the event of a Level 2 or Level 3 Hydrocarbon Spill

Resource Compartment / Receptor Group	Relevant Response Options						Relevant OSMP Study
	Monitoring Evaluation and Surveillance (primary)	Oiled Wildlife Response (primary)	Waste Management (primary)	Containment & Recovery (secondary)	Surface Dispersant Application (secondary)	Source Control	
Seabed							
Benthic Habitats and Communities	✓				✓	✓	OMS3, OMS4, OMS5, OMS6, SMS2, SMS3, SMS4, SMS8
Water Column							
Marine Fauna	✓	✓		✓	✓	✓	OMS1, OMS2, OMS3, OMS4, OMS5, OMS6, OMS7, SMS1, SMS2, SMS3, SMS4, SMS5, SMS6, SMS8
Water Surface							
Marine Fauna	✓	✓	✓	✓	✓	✓	OMS1, OMS2, OMS3, OMS4, OMS5, OMS6, OMS7, SMS1, SMS2, SMS3, SMS4, SMS5, SMS6, SMS8
Shoreline	*No shorelines exposed.*						
High Values Resources (Heritage)					✓		OMS4, SMS8, SMS9
Heritage Places					✓		OMS4, SMS8, SMS9
Socio-economic							
Australian Marine Parks (AMPs)	✓			✓	✓		OMS1, OMS2, OMS3, OMS4, OMS5, OMS6, OMS7, SMS1,

Resource Compartment / Receptor Group	Relevant Response Options						Relevant OSMP Study
	Monitoring Evaluation and Surveillance (primary)	Oiled Wildlife Response (primary)	Waste Management (primary)	Containment & Recovery (secondary)	Surface Dispersant Application (secondary)	Source Control	
							SMS2, SMS3, SMS4, SMS5, SMS6, SMS8
State Protected Areas	✓			✓	✓		OMS1, OMS2, OMS3, OMS4, OMS5, OMS6, OMS7, SMS1, SMS2, SMS3, SMS4, SMS5, SMS6, SMS8
Fisheries	✓			✓	✓	✓	OMS1, OMS2, OMS4, OMS8, SMS7, SMS8, SMS9
Tourism	✓		✓	✓	✓		OMS1, OMS2, OMS4, SMS8, SMS9
Defence	✓			✓	✓		OMS1, OMS2, OMS4, SMS8, SMS9

2.2.6 Monitoring studies relevant to key areas within the EMBA

Table 2-3 provides a summary of the monitoring studies that may be relevant to key areas within the EMBA. Key areas were determined as:

- Australian Marine Parks within the EMBA
- Wetlands of International Importance (Ramsar wetlands) within the EMBA
- Threatened ecological communities within the EMBA
- Threatened or migratory species with a spatially defined biologically important area (BIA) within the EMBA
- World, National and Commonwealth heritage features within the within the EMBA.

Studies will only be implemented if/when the relevant initiation criteria are met (refer to Section 3.2 and 3.3).

The SIPs for each monitoring strategy will ensure that the relevant requirements from the management plans (or similar) associated with each of these areas is incorporated into the study design (refer also to Section 3.1.2).

Table 2-3: Relevant monitoring studies, management plans and actions for key areas within the EMBA

Key Receptor	Operational and Scientific Monitoring Studies	Management Plan / Conservation Advice / Recovery Plan	Relevant Requirements / Management Actions
Australian Marine Parks*			
North Marine Region			
Oceanica Shoals Marine Park	OMS5, OMS6, OMS7, SMS1, SMS2, SMS3, SMS4, SMS5, SMS6	• North Marine Parks Network Management Plan 2018	• Relevant management actions include: Park protection and management—timely and appropriate preventative and restorative actions to protect natural, cultural and heritage values from impacts
North-west Marine Region			
Argo-Rowley Terrace Ashmore Reef Carnarvon Canyon Cartier Island Dampier Eighty Mile Beach Gascoyne Kimberley Mermaid Reef Montebello Ningaloo Roebuck Shark Bay	OMS5, OMS6, OMS7, SMS1, SMS2, SMS3, SMS4, SMS5, SMS6	• North-west Marine Parks Network Management Plan 2018 • North-west Marine Parks Network Management Plan 2018-28, Implementation Plan 1, Foundation Phase 2018-2022	• Relevant management actions include: Park protection and management—timely and appropriate preventative and restorative actions to protect natural, cultural and heritage values from impacts
South-west Marine Region			
Abrolhos Geographe		• South-west Marine Parks Network Management Plan 2018	• Relevant management actions include: Park protection and management—timely and appropriate preventative

Key Receptor	Operational and Scientific Monitoring Studies	Management Plan / Conservation Advice / Recovery Plan	Relevant Requirements / Management Actions
Jurien Perth Canyon South-west Corner Two Rocks	OMS5, OMS6, OMS7, SMS1, SMS2, SMS3, SMS4, SMS5, SMS6	• South-west Marine Parks Network Management Plan 2018-28, Implementation Plan 1, Foundation Phase 2018-2022	and restorative actions to protect natural, cultural and heritage values from impacts
Wetlands of International Importance (Ramsar Wetlands)*			
Ashmore Reef Commonwealth Marine Reserve	OMS5, OMS6, OMS7, SMS1, SMS2, SMS3, SMS4, SMS5, SMS6	• Ashmore Reef Commonwealth Marine Reserve Ramsar Site Ecological Character Description	• Energy production and mining identified as a major driver (threatening activity); specifically, seismic surveys, drilling and oil spills • Limits of acceptable change to elements (component, process, service) of ecological character defined in Table 27 of ECD report
Eighty-mile Beach		• Ecological Character Description of the Eighty-mile Beach Ramsar Site	• Offshore petroleum / gas extraction identified as a minor driver (threatening activity); specifically, oil spills • Limits of acceptable change to elements (component, process, service) of ecological character defined in Table 21 and 22 of ECD report
Hosnies Spring (Christmas Island)		• Ecological Character Description for Hosnies Spring Ramsar Site	• No relevant threat identified • Limits of acceptable change to elements (component, process, service) of ecological character defined in Table 9 of ECD report
Peel-Yalgorup system		• Ecological Character Description of the Peel-Yalgorup Ramsar Site	• No relevant threat identified • Limits of acceptable change to elements (component, process, service) of ecological character defined in Table 40 of ECD report
Roebuck bay		• Ecological Character Description for Roebuck Bay	• No relevant threat identified • Limits of acceptable change to elements (component, process, service) of ecological character defined in Table 22 of ECD report

Key Receptor	Operational and Scientific Monitoring Studies	Management Plan / Conservation Advice / Recovery Plan	Relevant Requirements / Management Actions
The Dales (Christmas Island)		• Ecological Character Description for The Dales Ramsar Site	• No relevant threat identified • Limits of acceptable change to elements (component, process, service) of ecological character defined in Table 13 of ECD report
Vasse-Wonnerup system		• Ecological Character Description for the Vasse-Wonnerup Wetlands Ramsar Site in South-west Western Australia	• No relevant threat identified • Interim limits of acceptable change to elements (component, process, service) of ecological character defined in Table 27 of ECD report
Threatened Ecological Communities*			
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	OMS5, OMS6, SMS2, SMS3, SMS4	Approved Conservation Advice for the Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	• No relevant threat or management action identified
Subtropical and Temperate Coastal Saltmarsh		Conservation Advice for Subtropical and Coastal Saltmarsh	• Pollution from oil spill events are identified as a threat • Actions for this TEC include identifying coastal saltmarsh as important habitat in all oil spill contingency planning and monitor the application of protocols on the management of spills involving saltmarshes
Threatened and/or Migratory Species* with Biologically Important Areas			
Seabirds and Shorebirds			
Common Noddy	OMS7 SMS1 SMS5	N/A	N/A
Australian Lesser Noddy		Conservation Advice *Anous tenuirostris melanops* Australian lesser noddy	• Pollution from oil spill events are identified as a threat • Relevant conservation actions include: Houtman Albrolhos and its surrounds continue to be managed in such a way that human disturbance is minimised
Flesh-footed Shearwater		N/A	N/A
Wedge-tailed Shearwater		N/A	N/A
Lesser Frigatebird		N/A	N/A
White-tailed Tropicbird		N/A	N/A

Key Receptor	Operational and Scientific Monitoring Studies	Management Plan / Conservation Advice / Recovery Plan	Relevant Requirements / Management Actions
Soft-plumaged Petrel		Conservation Advice *Pterodroma Mollis* soft-plumaged petrel	• No relevant threat identified • Relevant conservation actions include: Continue to manage Maatsuyker and Macquarie Island in such a way that human disturbance is minimised
Bridled Tern		N/A	N/A
Caspian Tern		N/A	N/A
Roseate Tern		N/A	N/A
Little Tern		N/A	N/A
Brown Booby		N/A	N/A
Red-footed booby		N/A	N/A
Fish and Sharks			
White Shark	OMS7 SMS1 SMS6	• Recovery Plan for the White Shark (Carcharodon carcharias)	• Relevant identified potential threats: habitat modification. • Relevant management objectives: Continue to identify and protect habitat critical to the survival of the white shark and minimise the impact of threatening processes within these areas (Objective 7).
Whale Shark		• Conservation Advice Rhincodon typus whale shark	• No relevant threat or management actions identified
Dwarf Sawfish		• Approved Conservation Advice for Pristis clavata (Dwarf Sawfish)	• Main potential threats include: habitat degradation due to increasing human development in northern Australia. • No relevant management actions identified.
Freshwater Sawfish		• Approved Conservation Advice for Pristis pristis (largetooth sawfish)	• Main threats include: habitat degradation and modification. • No relevant management actions identified.
Green Sawfish		• Approved Conservation Advice for Green Sawfish	• Main threats include: habitat degradation through coastal development. • No relevant management actions identified.

Key Receptor	Operational and Scientific Monitoring Studies	Management Plan / Conservation Advice / Recovery Plan	Relevant Requirements / Management Actions
Marine Mammals			
Blue Whale, Pygmy Blue Whale	OMS7 SMS1 SMS6	Conservation Management Plan for the Blue Whale - A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999	• Main threats include: habitat modification, vessel disturbance. • Relevant management actions: Minimising vessel collisions (A.4), Measuring and monitoring population recovery (B.1).
Southern Right Whale		Conservation Management Plan for the Southern Right Whale. A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 2011-2021	• Main threats include: habitat modification, vessel disturbance. • Relevant management actions: Addressing vessel collisions (A.5), Measuring and monitoring population recovery (B.1).
Humpback Whale		Conservation Advice *Megaptera novaeangliae* humpback whale	• Main threats include: habitat degradation, vessel disturbance or strike. • Relevant management actions: Minimise vessel collisions.
Sperm Whale		N/A	N/A
Dugong		N/A	N/A
Australian Sea Lion		Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*)	• Other threats include: habitat degradation, pollution and oil spills. • Relevant management objective: Investigate and mitigate other potential threats to Australian sea lion population. • Relevant management actions: Improve the understanding of—and where necessary mitigate—the threat posed to Australian sea lion populations by illegal killings, vessel strike, pollution and oil spills (4.1).
Australian Snubfin Dolphin		N/A	N/A
Indo-Pacific Humpback Dolphin		N/A	N/A
Spotted Bottlenose Dolphin		N/A	N/A

Key Receptor	**Operational and Scientific Monitoring Studies**	**Management Plan / Conservation Advice / Recovery Plan**	**Relevant Requirements / Management Actions**
Marine Reptiles			
Loggerhead Turtle	OMS7 SMS1 SMS6	Recovery Plan for Marine Turtles in Australia	• Main threats include: chemical and terrestrial discharge, vessel disturbance. • Relevant management actions: Minimise chemical and terrestrial discharge (A4).
Green Turtle			
Hawksbill Turtle			
Olive Ridley Turtle			
Flatback Turtle			
World Heritage Properties*			
Komodo National Park (Indonesia)	OMS5, OMS6, OMS7, SMS1, SMS2, SMS3, SMS4, SMS5, SMS6, SMS9	Komodo National Park 25-Year Management Plan 2000-2025	• Main threats include: pollution. • Relevant management options include: treat polluted areas, monitoring and evaluation.
Shark Bay		Shark Bay World Heritage Property Strategic Plan 2008-2020	• Potential pollution sources include: oil spills. • Relevant management objective: Minimise the impact of pollution and waste on World Heritage values and the overall integrity of the World Heritage Property.
The Ningaloo Coast		Ningaloo Coast Strategic Management Framework	• Major potential threats include: resource development. • Management consistent with the objectives and underlying principles of the Ningaloo Coast management system, including Ningaloo Marine Park (Commonwealth), WA Ningaloo Marine Park and Muiron Islands Marine Management Area, Cape Range National Park, unallocated Crown land, freehold owners and leaseholders, Learmonth Air Weapons Range Facility.
National Heritage Places*			
Batavia Shipwreck (Houtman Abrolhos)	SMS9	N/A	N/A
HMAS Sydney II and *HSK Kormoran* Shipwreck Sites		N/A	N/A

Key Receptor	Operational and Scientific Monitoring Studies	Management Plan / Conservation Advice / Recovery Plan	Relevant Requirements / Management Actions
Shark Bay	OMS5, OMS6, OMS7, SMS1, SMS2, SMS3, SMS4, SMS5, SMS6, SMS9	N/A	N/A
The Ningaloo Coast		N/A	N/A
The West Kimberley		N/A	N/A
Commonwealth Heritage Places			
Ashmore Reef National Nature Reserve	OMS5, OMS6, OMS7, SMS1, SMS2, SMS3, SMS4, SMS5, SMS6, SMS9	N/A	N/A
Christmas Island Natural Areas		N/A	N/A
Garden Island		N/A	N/A
Mermaid Reef – Rowley Shoals		N/A	N/A
Ningaloo Marine Area (Commonwealth waters)		N/A	N/A
Scott Reef and Surrounds (Commonwealth area)		N/A	N/A
HMAS Sydney II and *HSK Kormoran* Shipwreck Sites	SMS9	N/A	N/A

2.2.7 Monitoring Strategy Template

This section describes the generic format and content of a monitoring (field) study strategy.

Each monitoring strategy outlines the process for implementation of a field study and specifically addresses the following key questions:

- Why? – through the selection of monitoring performance outcome(s).
- What? – through the identification of monitoring performance standard(s).
- Who? When? How? Where? – through the identification of measurement criteria and other components of the strategy. The technical details of the when (e.g. monitoring frequency), the how (e.g. sampling and analysis methodology and logistics) and the where (e.g. locations of sites) are provided in the implementation plans for each monitoring study.

Each monitoring study's strategy has been structured in a consistent manner to facilitate familiarity and ease of reference using table format as described in Table 2-4.

Table 2-4: Structure of Operational and Scientific Monitoring Strategies

Strategy Component	Description
Monitoring Performance Outcome	'Monitoring' goal(s) from the implementation of the monitoring program.
Monitoring Performance Standard	Performance(s) required of the monitoring study elements (systems, equipment, personnel and/or procedures) that are used as the basis to manage achievement of the monitoring performance outcome.
Measurement Criteria	Criteria to assess whether the monitoring performance standards for the monitoring study have been achieved. Criteria are auditable.
Initiation Trigger	Criteria to initiate the monitoring study.
Termination Trigger	Criteria to terminate the monitoring study.
Timing	Timeline for implementation of the monitoring study
Study Implementation Plan	Reference to OSMP implementation plan for a particular study
Monitoring Design	Potential types of monitoring designs that may be appropriate for use for the monitoring study
Sampling Techniques	Potential types of sampling techniques that may be appropriate for use for the monitoring study
Sampling Frequency	Potential sampling frequencies that may be appropriate for use for the monitoring study
Parameters	Potential parameters that may be sampled and analysed as part of the monitoring study
Competencies	Competency criteria for roles on the monitoring study team.
Reporting	Outputs (e.g. reports) of the findings of study for dissemination to relevant and approved parties.
Review and Auditing	Internal (reviews) and external (audit) overview.
Responsibilities	Responsibilities for different elements of each monitoring study.
Relevant References and Guidelines	Guidelines and high-level references to implement the strategy.

2.2.8 Study Implementation Plan Template

SIPs will be developed by BP prior to commencement of the drilling activity for each study in accordance with the measurement criteria of the strategy. SIPs will include, at a minimum, the following elements:

- Introduction;
- Project Management;
- Review and update (if required) of available baseline information for the North West Shelf (studies SMS2-SMS7; SMS9);
- Sampling and Analysis Methodology (or Modelling Methodology)
    - Activation triggers and termination criteria of OSMP studies;
    - Implementation:
        - Roles and responsibilities,
        - Lines of communication,
        - Summary of studies,
        - Implementation phases,
        - Health, Safety and Environment (HSE) requirements,
        - Survey logistics,
        - Data management,
        - Technical reporting,
        - Internal review, external audit and testing,
        - Maintenance and review;
    - Resources:
        - Field logistics, mobilisation and demobilisation details,
        - Organisations and competent personnel,
        - Plant
        - Analytical laboratory,
        - Monitoring equipment;
    - Scientific monitoring considerations:
        - Sites during reactive baseline surveys,
        - Additional sites,
        - Impact assessment approach;
- Reporting and Communications;
- Quality Assurance/Control procedures;
- Internal Reviews and External Audits: Compliance Schedule and Reporting;

- HSE management details.

The SIPs will be finalised and agreed with BP and relevant stakeholders prior to the drilling activity.

2.3 OSMP Implementation

2.3.1 Roles and Responsibilities

In the event of a spill incident resulting from a vessel collision, AMSA, as the Control Agency, will be responsible for the implementation of operational monitoring.

In the event of a Level 2 or Level 3 spill incident from a loss of well control, BP is responsible for the implementation and adherence to this OSMP. Table 2-5 identifies primary responsibilities associated with OSMP key roles. Each strategy in Section 3 provides more specificity of responsibilities for a particular monitoring program. Figure 2-3 shows these key roles and the flow of data and information during the implementation of the OSMP.

Table 2-5: Generic Roles and Responsibilities for this OSMP

Position	Responsibilities
Incident Commander (IC) (or delegate)	• Overall responsibility for implementation of this OSMP.
IMT Planning Section Chief (PSC)	• Interface between IC and IMT Environmental Unit Leader. • Responsibility for provision of spill characteristics and response measures needed for the implementation of this OSMP. • Ensures field response is informed by operational monitoring via IMT Operations Section Chief (OSC). • Initiate operational and scientific monitoring strategies as required. • Termination of operational and scientific monitoring strategies as required.
IMT Environmental Unit Leader (EUL)	• Approval of reports and plans for operational and scientific monitoring. • Day-to-day coordination and review of scientific monitoring programs. • Provide advice to IMT PSC on initiation / termination criteria. • Provide activity and response status updates to the OSMP Implementation Director • Termination of scientific monitoring modules as required (where IMT PSC is no longer in place). • Oversee external audits. • Compliance interface with regulator(s)
OSMP Implementation Director	• Overall management of the OSMP strategies for the external service provider/s. • Work in collaboration with the IMT EUL to implement the OSMP. • Interface between the PIs and IMT EUL. • Provide BP with a monthly log of the PI and TS personnel available to implement the OSMP. • Following activation, provide BP with the confirmed PIs for relevant scopes and confirm the availability of initial personnel, equipment and resources
Technical Specialist (TS) / Principal Investigator (PI)	• Development and/or review of SIPs and SAPs. • Responsible for implementation of a particular OSMP study. • Review and/or carry out study's monitoring reporting requirements. • Provides advice with respect to environmental issues as required. • Implement this OSMP. • Compliance with the requirements of this OSMP.

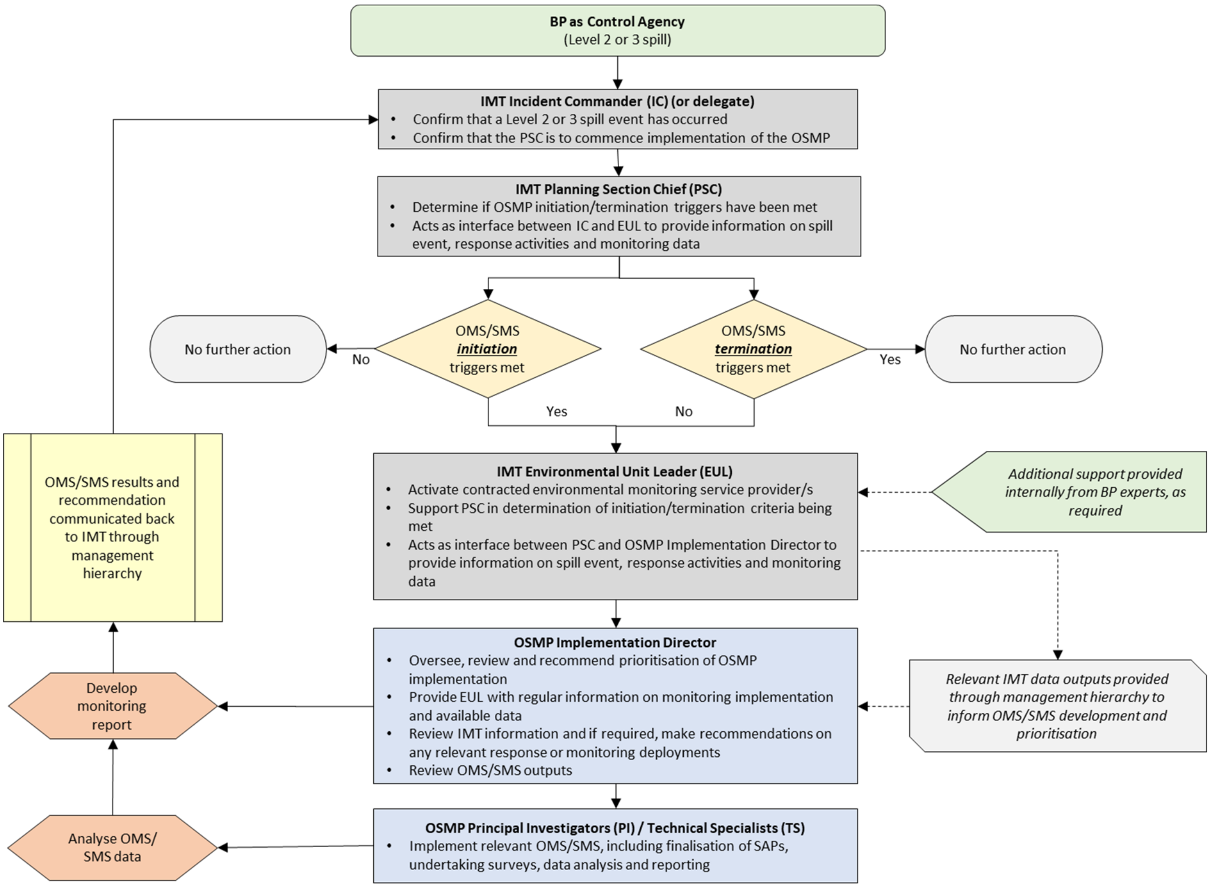

Figure 2-3: OSMP Activation, Implementation and Communication

2.3.2 Capability, Training and Competency

Resources for monitoring (i.e. Technical Specialists and Principal Investigators) may include both internal BP resources and external service provider/s.

BP has internal predictive modelling capability and also contracts in place with external modelling providers (OSRL, AMOSC). Prior to activities associated with the EP commencing, BP will have in place a contract with at least one external consultancy that is able to confirm the availability of appropriately qualified and competent personnel to implement the monitoring requirements of this OSMP (i.e. they will meet the minimum competency requirements as specified in Table 2-6). In the event that additional resources are required, other consultancy capacity will be utilised (on an as needed basis) and may extend to specialist contractors such as research agencies or universities. The BP procurement and selection process for OSMP service providers is based on the ability to meet the following minimum criteria:

- experience preparing and implementing OSMPs for oil and gas operators in Western Australia;
- sufficient numbers of personnel that mean the minimum qualifications and experience requirements for the PI and TS roles;
- sufficient locally available personnel to meet immediate implementation requirements in the event of a spill.

Prior to, and each month during activities, BP will maintain an up-to-date register of the internal and external service provider/s resource capabilities (that meet the minimum competency requirements) for each operational and scientific monitoring study. To support this register, the OSMP Implementation Director is responsible for providing a monthly report on personnel availability (Table 2-5). This monthly report from the service provider will also nominate an appropriate PI (with a back-up resource) for each of the operational and scientific monitoring studies, noting it is acceptable that a single resource may function across multiple scopes.

Prior to the activity commencing, all nominated OSMP service provider personnel will complete the OPEP/OSMP roll-out induction (as detailed in Table 7-4 of the EP). In addition, the OSMP Implementation Director will be involved in a Training Exercise for a spill scenario, as per Table 8.3 in the OPEP.

Table 2-6 details the capability assessment for the implementation of the OSMP studies. It identifies the minimum number of personnel to manage and implement the OSMP studies and platforms (vessel, aircraft or vehicles) required to perform the studies. The studies have been grouped where appropriate to ensure effective use of resources.

The minimum number of resources identified is based on:

- in the event of a spill, the full EMBA not being impacted, as it represents multiple spill simulations;
- no shoreline contact (in line with predictions);
- higher concentrations of hydrocarbon being spatially limited to the vicinity of the release location, however it is noted that lower concentrations that require monitoring do extend beyond these distances;
- low likelihood that high numbers of wildlife would be oiled within the offshore environment given the volatility of the oil types and the predicted (stochastic) spatial extent of surface oil at >10 g/m^2.

The minimum training and competencies for the personnel are also captured within Table 2-6; noting that additional detail is also provided under specific monitoring strategies in Section 3. Training and competencies for members of the IMT (including the EUL) are detailed in the OPEP.

2.3.2.1 Activation

In the unlikely event of a Level 2 or Level 3 offshore spill event, operational and scientific monitoring studies will be initiated once the relevant criteria have been met (refer to criteria within each monitoring strategy in Section 3.2 and 3.3). The IMT EUL (or delegate) will contact the service provider/s OSMP Implementation Director to initiate their response.

Once notified, the OSMP Implementation Director will confirm the PIs (as needed), and SAPs will be prepared based on the requirements of the individual spill event. Based on initiated studies and SAPs, personnel, equipment and mobilisation will commence as per the timings defined in each monitoring strategy (Sections 3.2 and 3.3).

Table 2-6: Capability Needs Assessment (with minimum competency requirements) for Ironbark-1 Exploration Drilling OSMP

Scope Description	Operational and/or Scientific Monitoring Studies	OSMP Implementation Director	Principal Investigator*	Technical Specialists	Platform
Overall management of the OSMP strategies	All	1 x OSMP Implementation Director: • Bachelor degree in environmental science/engineering (or equivalent) • >20 years' experience in environmental practice • Ironbark OPEP/OSMP roll-out induction	N/A	N/A	N/A
Oil spill modelling	OMS1 SMS8	N/A	1 x Principal Investigator: • Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Ironbark OPEP/OSMP roll-out induction	1 x Technical Specialist: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice, specifically environmental modelling	N/A
Aerial surveillance and tracking, marine fauna observations	OMS2 OMS4 OMS7	N/A	1 x Principal Investigator: • Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Ironbark OPEP/OSMP roll-out induction	2 x Technical Specialists: • Bachelor degree in environmental science/engineering or equivalent • Completed marine mammal observation / marine fauna observation training • Familiar with oil visual observation techniques • 1 x Lead Specialist to have >5 years' experience in environmental practice	1 x Aircraft
Oil sampling, ecotoxicology,	OMS3	N/A	1 x Principal Investigator:	2 x Technical Specialists:	1 x Vessel

Scope Description	Operational and/or Scientific Monitoring Studies	OSMP Implementation Director	Principal Investigator*	Technical Specialists	Platform
water and sediment impact and recovery	OMS5 OMS6 SMS1 SMS2 SMS3		• Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Ironbark OPEP/OSMP roll-out induction	• Bachelor degree in environmental science/engineering or equivalent • Familiar with oil, water and sediment sampling and recording techniques including in-situ profiling). • Familiar with water and sediment quality data analysis • 1 x Lead Specialist to have >5 years' experience in environmental practice	
Dispersant efficacy	OMS4 *Notes:* *Aerial surveillance requirements are included separately above*	N/A	1 x Principal Investigator: • Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Ironbark OPEP/OSMP roll-out induction	2 x Technical Specialists: • Bachelor degree in environmental science/engineering or equivalent • Familiar with oil visual observation techniques • Familiar with relevant sampling techniques (e.g. use of fluorometer, water sample collection) • 1 x Lead Specialist to have >5 years' experience in environmental practice • 1 x Technical Specialist with experience in underwater video surveillance 1 x Safety Officer: • Experience with air quality monitoring	1 x Vessel
Marine fauna surveillance	OMS7 *Notes:*	N/A	1 x Principal Investigator:	2 x Technical Specialists:	1 x Vessel

Scope Description	Operational and/or Scientific Monitoring Studies	OSMP Implementation Director	Principal Investigator*	Technical Specialists	Platform
	Aerial surveillance requirements are included separately above		• Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Ironbark OPEP/OSMP roll-out induction	• Bachelor degree in environmental science/engineering or equivalent • Completed marine mammal observation / marine fauna observation training • 1 x Lead Specialist to have >5 years' experience in environmental practice	
Marine fauna impact and recovery	SMS5 SMS6 *Notes:* *Aerial surveillance requirements are included within OMS2* *Oiled, injured, and diseased fauna handling to be undertaken by trained personnel resources are detailed in Oiled Wildlife Response within the OPEP*	N/A	1 x Principal Investigator: • Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Ironbark OPEP/OSMP roll-out induction	4 x Technical Specialists (per vessel): • Bachelor degree in environmental science/engineering or equivalent • Familiar with fauna observation and recording techniques • Familiar with analysis and interpretation of biota data • 1 x Lead Specialist to have >5 years' experience in environmental practice • 2 x Technical Specialists to have completed marine mammal observation / marine fauna observation training • 1 x Technical Specialist to be familiar with tissue sampling, storage and preservation • 1 x Technical Specialist with experience in underwater video surveillance	2 x Vessel
Fish tainting, impact and recovery	OMS8 SMS7	N/A	1 x Principal Investigator:	2 x Technical Specialists: • Bachelor degree in environmental science/engineering or equivalent	1 x Vessel

Scope Description	Operational and/or Scientific Monitoring Studies	OSMP Implementation Director	Principal Investigator*	Technical Specialists	Platform
			• Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Ironbark OPEP/OSMP roll-out induction	• Familiar with fish/biological tissue sampling • Familiar with analysis and interpretation of biota data • 1 x Lead Specialist to have >5 years' experience in environmental practice • 1 x Technical Specialist with experience in sensory assessment / olfactory analysis	
Air quality	OMS9	N/A	1 x Principal Investigator: • Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Ironbark OPEP/OSMP roll-out induction	1 x Safety Officer: • Experience with air quality monitoring	1 x Vessel
Benthic habitat impact and recovery	SMS4	N/A	1 x Principal Investigator: • Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Ironbark OPEP/OSMP roll-out induction	4 x Technical Specialists: • Bachelor degree in environmental science/engineering or equivalent • Familiar with benthic habitat observation and recording techniques • Familiar with identification, analysis and interpretation of benthic habitat data • Commercial dive qualifications (if diving required)	1 x Vessel

Scope Description	Operational and/or Scientific Monitoring Studies	OSMP Implementation Director	Principal Investigator*	Technical Specialists	Platform
				• 1 x Lead Specialist to have >5 years' experience in environmental practice • 1 x Technical Specialist with experience in underwater video surveillance and/or operation of ROV	
Heritage and socioeconomic	SMS9 *Notes:* *Any aerial or vessel surveillance (if required) would be included with one of the other monitoring platforms*	N/A	1 x Principal Investigator: • Bachelor degree in environmental science/engineering (or equivalent) • >10 years' experience in environmental practice • Ironbark OPEP/OSMP roll-out induction	1 x Technical Specialist: • Bachelor degree in environmental science/engineering or equivalent • >5 years' experience in environmental practice, specifically with social, cultural and heritage values • Familiar with the interpretation and management of heritage, social and economic data	N/A

* = One person may fulfil multiple Principal Investigators roles, depending on the nature and scale of the spill event.

2.3.3 OSMP Phased Approach

Development and implementation of the OSMP is as detailed in Table 2-7; with decision-trees shown in Figure 2-4 and Figure 2-5 for operational and scientific monitoring .

Table 2-7: Development and implementation for this OSMP

Time Period	Activity	Purpose	Output
Approval			
Upon regulatory acceptance of the Environment Plan and prior to activity commencement.	Implementation plans prepared and available to support OSMP.	Operational and Scientific Monitoring Studies defined.	OSMP and SIPs.
	Ensure availability of human resources, logistics and scientific equipment to implement OSMP if required.	'Readiness' for initiation of OSMP field activities if required.	Resources under existing agreements (people, equipment, plant), and confirmation that competent persons (PIs) are available for OSMP responsibilities.
Readiness			
Capacity available and enhanced if and where required.	Pool of resources for monitoring team identified and provided with a contract call-off.	'Readiness' for a timely response upon notification of OSMP mobilisation.	Timely mobilisation of environmental monitoring teams in event of a Level 2 or Level 3 hydrocarbon release.
Monitoring			
Post-spill, pre-exposure (OMS and SMS– as triggered)	Mobilisation of monitoring team and implementation of OSMP (OMS and SMS – as triggered).	Operational monitoring studies (OMSs) to inform response planning and management of a hydrocarbon spill.	Data, notifications, and reports to inform response team to inform response planning and management (OMS).
		Collection of reactive baseline data in scientific monitoring studies (SMS – as triggered).	Condition of environmental values established at start of hydrocarbon spill prior to hydrocarbon exposure (SMS – as triggered).
Post-exposure (OMS and SMS– as triggered)	Continued implementation of OSMP (OMS and SMS – as triggered).	OMSs to inform response planning and management of hydrocarbon spill and scientific monitoring studies to monitor impact to environmental sensitivities.	Data, notifications, and reports to inform response planning and management (OMS) and to monitor impact to environmental sensitivities (SMS – as triggered).
	Acquisition of existing (non-public) baseline data for environmental sensitivities (SMS – as triggered).	Acquisition of existing (non-public) data from relevant custodians for use in scientific monitoring studies data analysis (SMS – as triggered).	Database, spreadsheets, reports etc of available baseline data (SMS – as triggered).
	Cease operational (OMS) monitoring when termination criteria met.	Cessation of response planning and management because environmental sensitivities no longer at risk from additional hydrocarbon impacts.	Data/information collated to date for both OMS and SMS to inform SMS Hind-cast modelling.

Time Period	Activity	Purpose	Output
Long-Term Monitoring (SMS)	Continued implementation of OSMP SMS only.	Scientific monitoring studies to monitor impact/recovery to environmental sensitivities.	Data and reports to monitor impact / recovery to environmental sensitivities (SMS).
	Cease scientific (SMS) monitoring when termination criteria are met.	Cessation of monitoring because environmental sensitivities completely / sufficiently recovered from hydrocarbon impacts.	Final Reports.

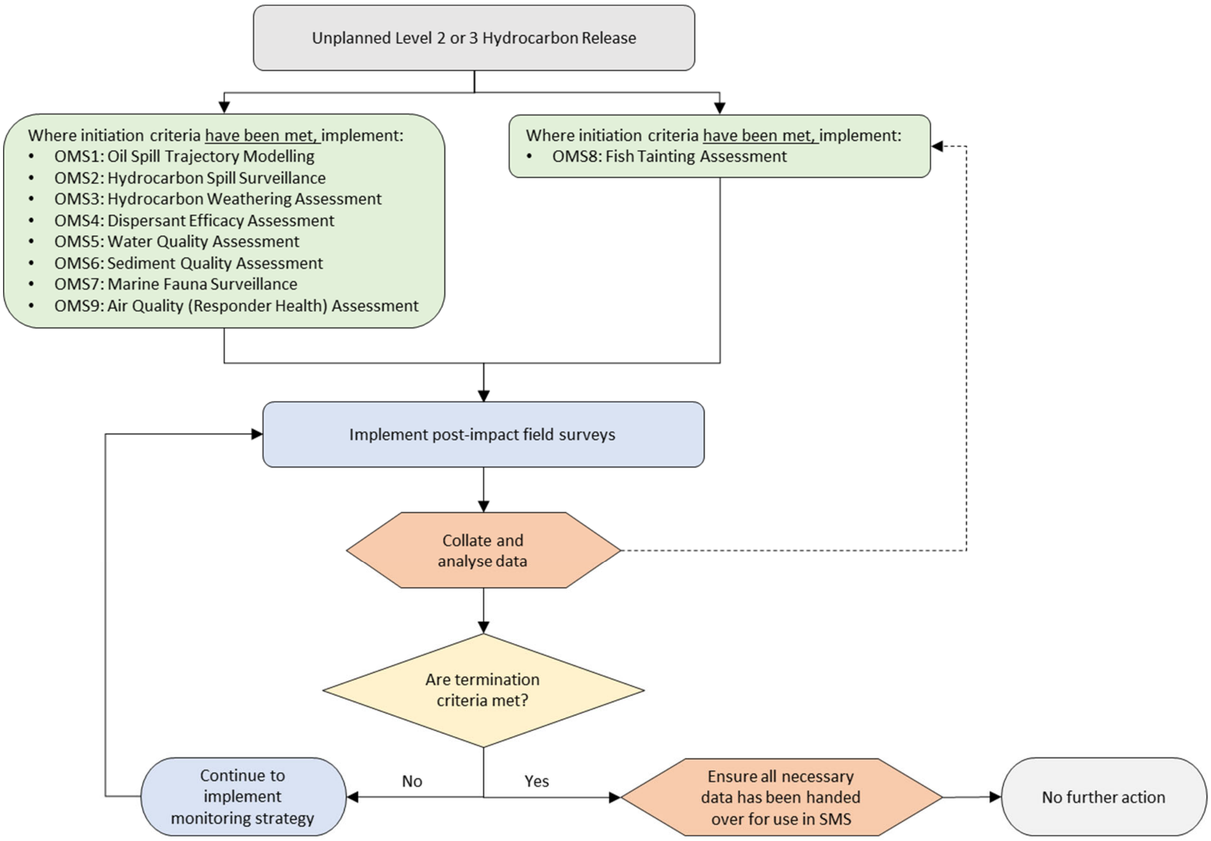

Figure 2-4: Decision Tree for the Overall Implementation of the Operational Monitoring Program

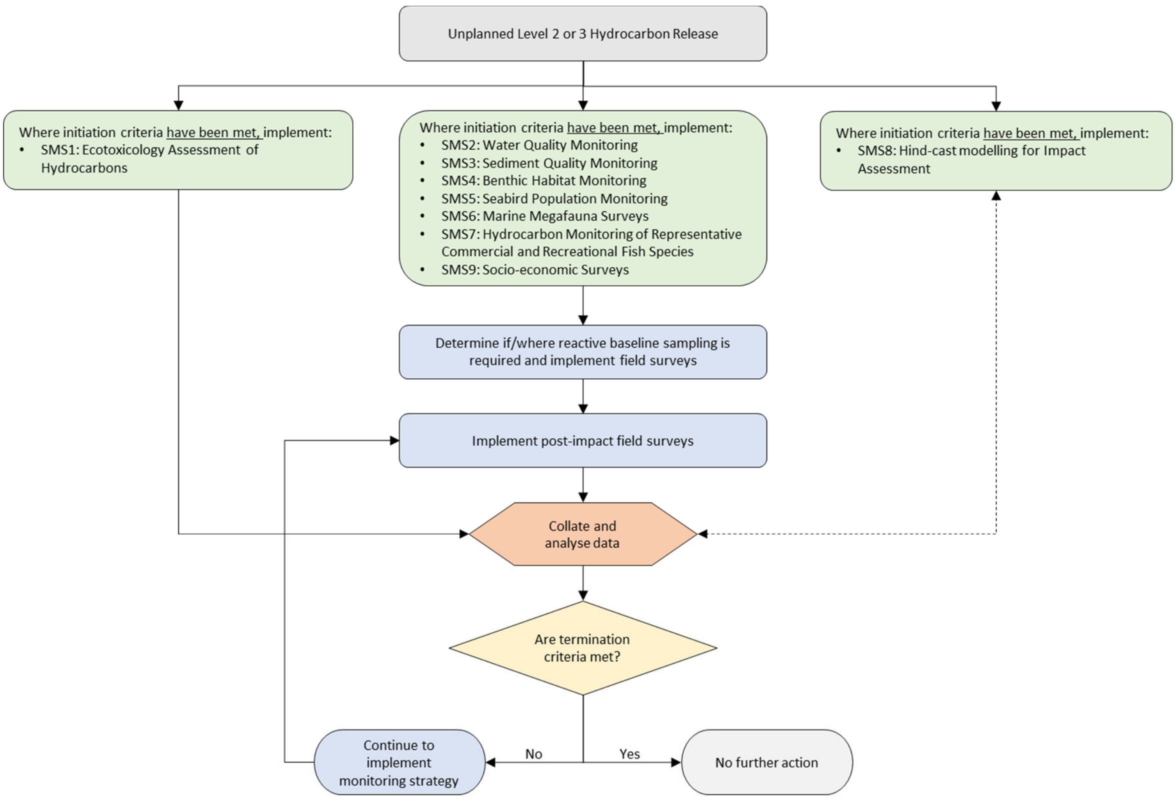

Figure 2-5: Decision Tree for the Overall Implementation of Scientific Monitoring Program

2.3.4 Implementation Checklists

2.3.4.1 Activation Process

BP's IMT is responsible for activating the OSMP. Table 2-8 outlines BP's OSMP activation process, and the initial implementation steps including testing initiation criteria and development and approval of the initial SAPs for field surveys.

Table 2-8: BP OSMP Activation Process Checklist

Responsibility	Action	Timeframe	Complete
IMT Planning Section Chief (BP)	Confirm with the IMT EUL to activate the OSMP	<1 hour of spill notification	☐
	Provide confirmation on initiation (and termination) criteria being met for OMSs and SMSs, as needed	<1 hour of advice from IMT EUL regarding initiation criteria	☐
	Initiate OMS/SMS strategies, as triggered based on their initiation criteria	<4 hours of OSMP initiation	☐
IMT Environment Unit Leader (BP)	Contact the nominated OSMP Implementation Director of the relevant environmental monitoring service providers to activate their services	<4 hours of spill notification	☐
	Confirm a reliable communications line is established between IMT and OSMP Implementation Director to facilitate data transfer between BP IMT and environmental monitoring service provider/s, as needed	<4 hours of spill notification	☐
	Provide OPEP Monitoring, Evaluation and Surveillance (MES) and OMS1-OMS3 data (e.g. spill trajectory modelling, visual	<1 hour of data being received by IMT	☐

	observations, fate and weathering modelling, remote sensing etc.) to environmental monitoring service provider/s, as relevant		
	Liaise directly with OSMP Implementation Director to determine which OMSs and SMSs are to be implemented, and provide this advice to the IMT PSC	< 4 hours of MES/OMS data being received from IMT	☐
	Facilitate BP approval of SAPs developed by environmental monitoring service provider/s (noting monitoring for the OMSs/SMSs may commence by BP under the draft SAPs, as per the timings defined Sections 3.2and 3.3)	Prior to SAP implementation as per timeframes provided in Section 3.2 (OSMs) and Section 3.3 (SMSs)	☐
OSMP Implementation Director (Environmental Monitoring Service Provider/s)	Provide advice to the IMT EUL regarding the initiation (and termination) criteria for OMSs and SMSs	<4 hours of MES/OMS data being received from IMT	☐
	Confirm the PIs/TSs associated with each of the initiated OMSs and SMSs	<1 hour from confirmation from IMT PSC of initiation criteria being met	☐
	Confirm availability of initial personnel and equipment resources, facilitate development of initial SAPs, as required	<12 hours of spill notification	☐
	Seek BP approval of SAPs via IMT EUL prior to implementation (noting monitoring for the OMSs/SMSs may commence by BP under the draft SAPs, as per the timings defined Sections 3.2and 3.3)	Prior to SAP implementation as per timeframes provided in Section 3.2 (OSMs) and Section 3.3 (SMSs)	☐
Principal Investigator (Environmental Monitoring Service Provider/s)	Provide advice to the OSMP Implementation Director regarding the initiation (and termination) criteria for OMSs and SMSs	<4 hours of MES/OMS data being received from IMT	☐
	Review and approve SAPs, as required	Prior to SAP implementation as per timeframes provided in Section 3.2 (OSMs) and Section 3.3 (SMSs)	☐
Technical Specialist (TS) (Environmental Monitoring Service Provider/s)	Develop initial SAPs for initiated OMSs/SMSs, as needed	Prior to SAP implementation as per timeframes provided in Section 3.2 (OSMs) and Section 3.3 (SMSs)	☐

2.3.4.2 Monitoring Priorities

An initial priority planning assessment was undertaken (as described in Section 2.4.6) based on the stochastic spill trajectory modelling. In the event of a spill, a prioritisation process will also be completed based on actual spill event trajectory and surveillance information. Table 2-9 provides a checklist to assist in the confirmation of monitoring priorities in the event of a spill.

Table 2-9: Checklist for determining monitoring priorities

Responsibility	Action	Timeframe	Complete
IMT Environment Unit Leader (BP)	Liaise directly with OSMP Implementation Director to determine monitoring priorities, including reactive baseline where appropriate, and provide this advice to the IMT PSC	Initially, within 12 hours of MES/OMS data being received from IMT, then ongoing	☐

OSMP Implementation Director (Environmental Monitoring Service Provider/s)	Continually re-evaluate monitoring priorities in consultation with IMT EUL throughout spill response	Initially, within 12 hours of MES/OMS data being received from IMT, then ongoing	☐
Principal Investigator (PI)/ Technical Specialist (TS) (Environmental Monitoring Service Provider/s)	Complete desktop risk assessment to identify values and sensitivities at risk	Initially, within 12 hours of MES/OMS data being received from IMT, then ongoing	☐
	Determine monitoring priorities (e.g. what strategies, areas, sites (including control sites), reactive or post-impact etc) for OMSs/SMSs, as needed	Initially, within 4 hours of completion of OMS1 desktop risk assessment, then ongoing	☐

2.3.4.3 Finalising Monitoring Design

The initial SAPs for each of the OMSs/SMSs (where required) will be prepared post-spill event. BP's checklist for finalising the initial SAPs is provided in Table 2-10. The Environment Monitoring Service Provider/s OSMP Implementation Director will be responsible for seeking approval from BP of the finalised SAP used in the OMSs and SMSs (refer to Section 2.3.4.1 for approval steps and timings).

Table 2-10: Checklist for finalising monitoring designs

Responsibility	Action	Timeframe	Complete
Principal Investigator (PI)/ (Environmental Monitoring Service Provider/s)	Confirm, based on SIP, and any additional available data (e.g. reactive baseline), the optimal sampling and analytical technique/s	Prior to SAP implementation as per timeframes provided in Section 3.2 (OSMs) and Section 3.3 (SMSs)	☐
	Confirm, based on SIP, most appropriate sampling technique/s		☐
	Confirm, based on SIP, most appropriate sampling frequency		☐
	For SMSs, where relevant, review SIPs to: • Confirm benchmarks and guidelines to be used • Confirm indicator species • Confirm parameters and metrics		☐
	Review and approve SAPs		☐
Technical Specialist (TS) (Environmental Monitoring Service Provider/s)	Develop initial SAPs for OMSs/SMSs, as needed	Prior to SAP implementation as per timeframes provided in Section 3.2 (OSMs) and Section 3.3 (SMSs)	☐
	Review and revise SAPs for OMSs/SMSs, as needed	Ongoing	☐

2.3.4.4 Mobilisation

Environmental Monitoring Service Providers will be required to coordinate the availability of personnel, equipment and survey platforms (vessels, aircraft, vehicles etc.) for all monitoring programs they are responsible for. BP will be responsible for flights and accommodation, as required. BP's checklist for mobilising monitoring teams is provided in Table 2-11.

Table 2-11: Checklist for mobilisation of monitoring teams

Responsibility	Category	Action	Complete
Environmental Monitoring Service Provider(s)	Resourcing	Confirm availability of all monitoring personnel (noting required competencies in OMSs/SMSs as per Section 2.2.3 and relevant as relevant Section 3.2 (OSMs) and Section 3.3	☐
		Allocate number of teams, personnel, equipment and supporting resource requirements	☐
	HSE	Undertake HAZIDs as required and consolidate/review field documentation including safety plans, emergency response plans, and daily field reports	☐
		Develop site-specific health and safety plans which is compliant with BP health safety and environment systems (including call in timing and procedures)	☐
		Conduct pre-mobilisation meeting with monitoring team/s on survey objectives, logistics, safety issues, reporting requirements and data management	☐
	Logistics	Confirm flights and accommodation are in place	☐
		Develop field survey schedules, detailing staff rotation	☐
	Equipment	Arrange survey platform (vessel, aircraft, vehicles) as required to meet survey specifications (e.g. equipped with appropriate fridge and freezer space for transportation of samples (and carcasses for opportunistic collection)).	☐
		Confirm consumables (including personal protective equipment) have been purchased and will be delivered to required location	☐
		Liaise with NATA-accredited laboratories to confirm: • availability, • limits of detection, • sampling holding times, • transportation, • obtain sample analysis quotes And arrange provision of: • appropriate sample containers, • Chain of Custody (CoC) forms, • suitable storage options for all samples, • arrangements for couriers (if necessary)	☐
		Confirm specialist equipment requirements and availability (including redundancy)	☐
		Check GPS units and cameras are working and that sufficient spare batteries and memory cards are available	☐
		Confirm sufficient equipment to allow integration of survey software and navigational systems (e.g. GPS, additional equipment and adaptors), and additional GPS units prepared	☐

		Confirm GPS survey positions (where available) have been QA/QC checked and pre-loaded into navigation software/positioning system	☐
		Check field laptops, ensuring they have batteries, power cable, and are functional	☐
		Check if a first aid kit or specialist PPE is required	☐
		Confirm arrangements for freight to mobilisation port is in place	☐

2.3.5 Reporting

The reporting requirements for the OSMP are detailed in each monitoring study's strategy (Section 3).

For the scientific monitoring studies, the appropriate regulator will be provided with:

- Annual reports that summarise all of the on-going (or recently terminated) monitoring studies; and
- Final reports for each monitoring study.

Where required and agreed, the appropriate regulator can request other reports from the IMT EUL (or delegate) and can also confirm adherence to the reporting schedule and contents (defined in the strategies and implementation plans) through the auditing mechanism which is described in Section 2.3.6 below.

2.3.6 Internal Review and External Auditing

Across the suite of OSMP studies, the adopted internal review and auditing approach during an incident response comprises the following framework:

- Each study's implementation plan will define a monitoring compliance audit schedule on the basis of the commitments, including termination criteria, in the study's strategy (refer Section 3) and more detailed commitments defined in each study's implementation plan.
- Internal review by the IMT Environmental Unit Leader regarding the conformance to the OSMP's audit schedule elements will be carried out routinely (one month for OMSs, three months for SMSs). Any non-conformances will need to be rectified by the PI within two weeks of the internal review. All internal reviews will be recorded and archived on compliance pro-forma reports in each study's implementation plan.
- External audits by the relevant regulator(s) of completed compliance reports and other OSMP commitments may be carried out at any time.

2.3.7 OSMP Review and Revisions

Regulation 19 of the OPGGS(E)R provides for the revision of this OSMP framework at least 14 days before the end of the period of five years from the most recent approval of any associated EP.

The OSMP (and supporting SIPs) are also subject to review, and revised if necessary, on an annual basis to incorporate the following:

- Significant change in the hydrocarbon spills risks associated with Ironbark Exploration Drilling activities;

- Significant environmentally relevant changes (e.g. changes to relevant legislation, stakeholder information, MNES, State/Commonwealth management plans, scientific measurement methods; or availability of new literature or data);
- Findings from internal or external audits or exercises;
- Lessons learned following any actual spill event.

Review records will be captured in BP's document management system. Subsequent revisions to the OSMP or implementation plans will be actioned and closed-out as soon as practicable following the review.

2.4 Scientific Monitoring Elements

2.4.1 Establishment of Baseline Dataset

BP has prepared a Description of the Environment (Section 3 of the EP), identifying and describing ecological and social receptors that may be present in the environment that may be affected (EMBA). This section is the primary source of publicly available information used to describe the environment within BP's Ironbark Exploration Drilling EP.

Specifically, modelling indicates that hydrocarbon exposures above impact thresholds (hydrocarbon exposure area) from a loss of well control (LOWC) hydrocarbon spill event have the potential to occur within the North-west Marine Region, South-west Marine Region (DEWHA 2008), outside the Australian EEZ and the south-east edge of the EEZ surrounding Christmas Island Territory (Figure 2-6).

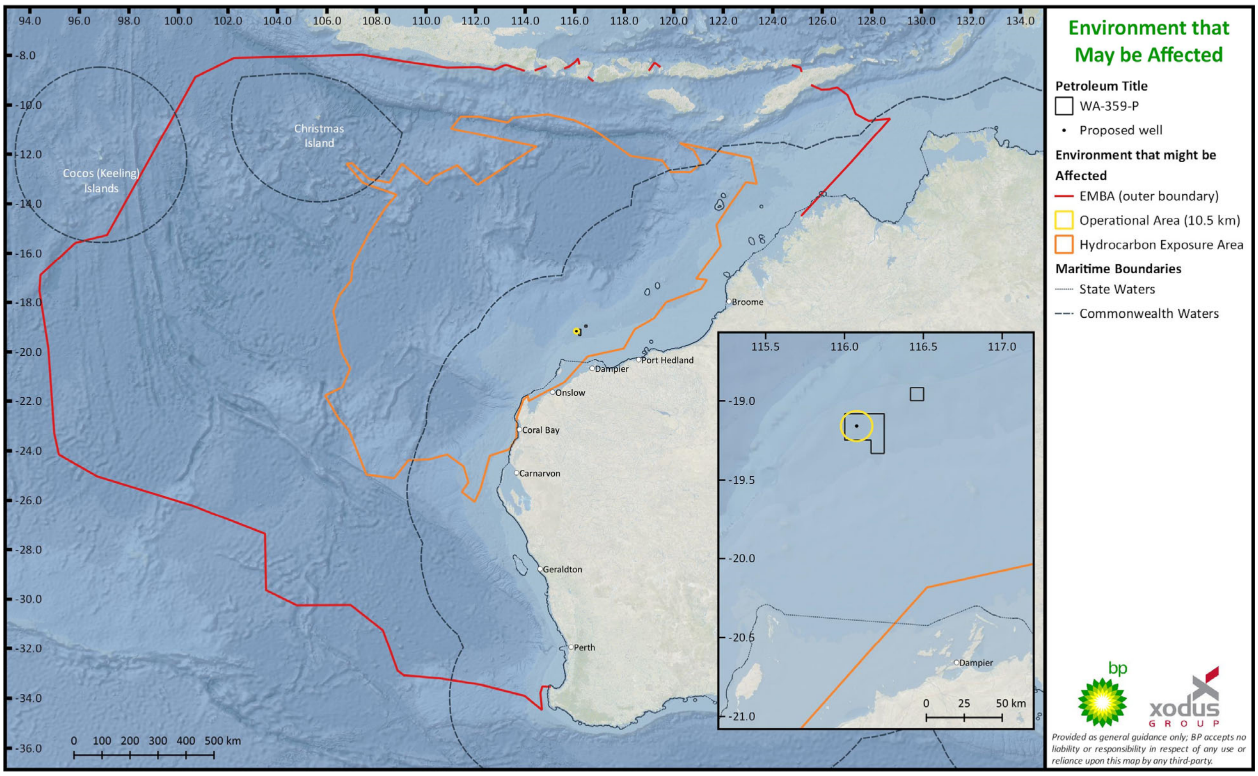

Figure 2-6: Extents of EMBA and Hydrocarbon Exposure Area

Baseline data provides information on the condition of ecological receptors prior to, or spatially independent (e.g. if used in control chart analyses) of, a spill event. While the description of the environment within the EP provides useful information on the environmental values in the region, it is insufficient to serve as a robust baseline dataset for a scientifically-based impact and recovery assessment in the event of a hydrocarbon spill. Establishment of a robust baseline dataset is primarily required for assessment of impacts and recovery (i.e. to allow the detection of changes between pre-impact and post-impact when using a BACI style analytical approach; see Section 2.4.3) to environmental sensitivities at sensitive locations.

Given the large aerial extents of predicted oil exposure (or EMBA) from worst-case spill scenarios, and the inherent spatial and temporal variability in the environment, an ongoing or pre-impact baseline monitoring program is not planned. However, in recognition of the importance of having knowledge of the relevant environmental data or information sources that is available to support analyses during the implementation of the OSMP in the event of a spill, BP has prepared an initial database of known literature and studies (Appendix A). As per Section 2.2.8, this database will also be reviewed and updated (as required) during preparation of the SIPs; and the data itself will be acquired (where necessary) if a spill event occurs (Table 2-7).

It is acknowledged that the use of pre-existing scientific monitoring studies may have limitations for spill impact and recovery analysis, due to factors such as:

- Methodology differences between various monitoring studies (e.g. field methods and data analysis techniques).
- Spatial and temporal coverage of data (e.g. sensitive locations not monitored, temporal gaps at sensitive locations).
- Natural changes over time.

These differences will affect the type of analysis that could be undertaken (e.g. BACI, IvC etc). The final sampling and analysis design will be selected in conjunction with the OSMP Implementation Director and PIs (Section 2.4.3). Any identified data gaps within the existing baseline (for example any differences in methods, spatial and temporal variations in environmental condition, different monitoring locations etc) will be taken into account by the PI of a particular study such that the design of each scientific monitoring study is optimised for the detection of environmental change. This assessment is completed as part of the SIP development. Where practicable, reactive baseline studies may also be triggered by a Level 2 or 3 hydrocarbon release, to gather additional data on the current state of the environment. Where these reactive programs are initiated, this information will be incorporated into analytical design by the PI.

2.4.2 Impact and Reference Sites

In the event of a spill incident, monitoring sites will be established within and beyond the area of exposure, including around identified priority/sensitive locations where relevant.

Not all identified priority/sensitive locations may be impacted by a hydrocarbon release, so several priority/sensitive locations may be able to serve as a suitable reference location (i.e., control or 'non-impact' location) in the event of a spill incident. However, as a contingency, additional reference locations will be established for those monitoring studies where all environmental receptors are present at all sensitive locations and are predicted to be well outside the predicted hydrocarbon exposure area.

Monitoring sites at reference locations will be selected that are:

- As similar as possible to impacted sites.

- Representative of the wider area.
- Free from obvious anthropogenic impacts.

They should also be similar in key physical parameters (e.g., tidal currents, habitat type, substrata, temperature, and salinity) and not differ significantly between sites. Selection of multiple reference sites will assist in accounting for natural variability between impact and reference sites.

2.4.3 Impact Assessment Approach

Collection of post-impact data for comparison with baseline data (where it exists) is required to determine whether any differences between the impact and reference locations is attributable to the hydrocarbon release. To enable detection of environmental impact from a spill incident requires careful consideration of the sampling/survey strategy since spatial and temporal variability will also account for differences between locations despite whether there has been a disturbance or not. Multiple reference locations will be necessary to prevent falsely attributing any differences in the spatial data to the impact and to allow robust statistical analyses of the resultant data.

Where limited or no baseline data is available as identified in the final implementation plan, post-impact monitoring will, where practicable, be designed by the PI with 'beyond- BACI' principles resulting in data that are amenable to statistical techniques such as asymmetrical analyses of variance following procedures described by Underwood (1994). However, in situations where a BACI design is not practicable or not appropriate, other impact assessment approaches may be adopted, including (but not limited to):

- Impact versus Control;
- Gradient of Impacts;
- Control Charts; or
- Lines of Evidence.

2.4.4 Duration of the Two Phases of Monitoring for a Level 2 and Level 3 Incident

This OSMP will be implemented after a Level 2 or Level 3 spill incident on the following basis:

- The duration of any spill incident is likely to vary from an instantaneous release (0-24 hours) for a MDO spill and up to 103 days for a wellhead failure.
- Both MDO and condensate typically evaporate and weather very rapidly, having little persistence in the water column and no predicted exposure of shorelines.
- Subsequent monitoring after the cessation of the spill incident will be as per the relevant implementation plans to allow:
    - 6 months to complete study SMS8 (Hind-cast Modelling Impact Assessment) and thereby inform the long-term monitoring phase adjustment to the SIPs for studies SMS2-SMS7.
    - 1 month for the PI of studies SMS2-SMS7 & SMS9 to revise the SIPs for long-term modelling revisions to these plans.
    - 2 months for the IMT Environmental Unit Leader to consult with relevant regulatory authorities and key stakeholders regarding any proposed modifications to the SIPs.
- Any revisions to the SIPs and OSMP will not occur prior to completion of the above.

Once SIPs and the OSMP have revised (as required), the implementation plans for any long-term monitoring phase of studies SMS2-SMS7 and SMS9 will be followed until the relevant termination criteria are met.

2.4.5 Permits and Licences

The worst-case spill scenarios for the BP Ironbark exploration drilling program may extend through both Commonwealth and State waters. The permits generally required by the governments are listed in Table 2-12.

Permit applications require details on the samples to be collected (including timing, species, numbers, methods to be used etc.), and can take up to approximately six weeks for approval. However, in the event of an oil spill, this process is likely to expediated and/or given exemptions.

The PI/TS will confirm the need for any permits during the development of a draft SAP once a spill event has occurred.

In addition to any permits/licences required for sampling, it may be necessary to request and/or notify relevant agencies or stakeholders regarding access to an area. This may include (but is not limited to):

- Director of National Parks: Australian Marine Parks;
- DBCA: State marine protected areas;
- Other Operators: Operational zones or petroleum safety zones; and
- Traditional Owners / Representative Councils: culturally significant indigenous sites.

Table 2-12: Permits that may be required to support scientific monitoring

Permit	Relevance	Legislation	Government Agency
General Permit Application for: • threatened species and ecological communities • migratory species • whales and dolphins • listed marine species	Required for matters for scientific sampling for matters listed under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	EPBC Act	DAWE
Access to Biological Resources in a Commonwealth Area for Non-Commercial Purposes	An applicant must obtain written permission from each Access Provider. The Access Provider must state permission for the applicant to: • enter the Commonwealth area • take samples from the biological resources of the area • remove samples from the area	EPBC Act	DAWE
Application for a licence to take (i.e. capture, collect, disturb, study) fauna for scientific purposes in State Waters out to three nautical miles (nm).	Conducting scientific research (including filming and photography) in a State MPA in State Waters out to three nm	*Biodiversity Conservation Act 2016* and *Biodiversity Conservation Regulations 2018*	DBCA
Application for exemption	Collecting virtually all marine biota (flora and fauna), whether alive or dead, anywhere in marine waters out to 200 nm. Excludes aquatic mammals, aquatic reptiles, aquatic birds, amphibians, or (except in relation to Part 3 and Division 1 of Part 11) pearl oysters. Exemption for any non-standard equipment	Section 7 and Regulation 6 of the Fish Resources Management Act 1994 (WA) and Regulations	DPIRD

2.4.6 Priority Planning for Scientific Monitoring

Priority planning for scientific monitoring has been developed based on two elements: (i) sensitive areas that may be exposed within a short-period of time, and (ii) study scopes that have a short lead time on preparing the draft SAP for implementation.

Priority planning areas for potential scientific monitoring have been identified where the following criteria are met:

- Predicted time to exposure is ≤48 hours or distance from Ironbark-1 well location is ≤100 km and
- Any of the following sensitive environmental receptors are present:
  - Australian Marine Parks
  - State marine protected areas
  - Internationally important wetlands (Ramsar wetlands) or nationally important wetlands

  - Mangrove or saltmarsh habitat
  - Known breeding/calving/nesting aggregation areas for protected (threatened or migratory) fauna
  - Known breeding/haul-out areas for pinnipeds
  - Threatened ecological communities, and
- Time given for preparation of a draft SAP for a particular scientific monitoring study is ≤48 hours.

Note, the predicted time to exposure requirement is based upon the shortest time provided (i.e. 48 hours) for the TS to prepare the draft SAP for a scientific monitoring study (see strategy tables in Section 3.3). However, for the Ironbark-1 spill modelling (Appendix C of the EP), minimum time to exposure was only reported for surface oil. Therefore, as a conservative estimate, a distance of 100 km from the Ironbark-1 well has been included as a spatial criterion. This distance was based off a relatively high ambient current of approx. 0.6 m/s and assumes no weathering/evaporation of the oil during transit. This distance is used as an analogue for the areas that may be exposed to oil during the initial 48-hour period.

While there is defined aggregation areas (BIAs, critical habitat etc) for some protected fauna within the 100 km buffer from the Ironbark-1 well location, there is no priority scientific studies requiring draft SAPs to be pre-prepared (Table 2-13).

Table 2-13: Priority Planning Areas and Scientific Studies for Ironbark-1 Exploration Drilling

Sensitive Environmental Receptor	Priority Planning Area	Priority Scientific Studies
Australian Marine Parks	None	N/A
State Marine Protected Areas	None	N/A
Internationally Important Wetlands	None	N/A
Nationally Important Wetlands	None	N/A
Mangrove Habitat	None	N/A
Saltmarsh Habitat	None	N/A
Known breeding/calving/nesting aggregation areas for protected fauna	Marine waters south of Ironbark-1 (breeding BIA for the Wedge-tailed Shearwater)	None*
	Marine waters south of Ironbark-1 (foraging BIA for the Whale Shark)	None^
	Marine waters offshore of Ironbark-1 (migratory BIA for the Pygmy Blue Whale)	None^
	Marine waters south of Ironbark-1 (migratory BIA for the Humpback Whale)	None^
	Marine waters south of Ironbark-1 (internesting BIA and critical habitat for the Flatback Turtle)	None^
Known breeding/haul-out areas for pinnipeds	None	N/A
Threatened Ecological Communities	None	N/A

* Draft SAP for SMS5 (Seabird Population Monitoring) is required within 72 hours.

^ Draft SAP for SMS6 (Marine Megafauna Surveys) is required within 72 hours.

3 Monitoring Strategies

3.1 Preliminary Activities for Monitoring Strategies

3.1.1 Impacts from Response Activities

Implementation of oil spill response actions may have impacts upon environmental sensitivities located at each of the response locations. This OSMP considers these 'secondary' impacts in addition to the primary objective of monitoring impacts from the oil spill itself.

BP has assessed possible secondary impacts to sensitivities in areas associated with response activities. These impacts are identified in Table 3-1 and have been incorporated into the respective monitoring strategies.

This listing may be reviewed, expanded or modified during a response in order to respond to site specific conditions and circumstances.

Table 3-1: Secondary Impacts Response and/or Monitoring Activities

Response or Monitoring Activity	Secondary Impact	Monitoring Strategy	Monitoring Parameters
Response: • Monitoring Evaluation and Surveillance* • Oiled Wildlife Response* • Containment & Recovery^ • Surface Dispersant Application^ • Source Control Monitoring: • OMS3, OMS4, OMS5, OMS6, OMS7, OMS8, OMS9 • SMS2, SMS3, SMS4, SMS5, SMS6, SMS7	• Vessel impacts to marine fauna	• SMS6: Marine Megafauna Surveys	• Megafauna 'damage incidents'
Response: • Monitoring Evaluation and Surveillance* Monitoring: • OMS2, OMS7 • SMS5, SMS6	• Aviation impacts to marine fauna	• SMS5: Seabird Population Monitoring • SMS6: Marine Megafauna Survey	• Incidents of altered fauna behaviour (e.g. direction alteration, altered behaviour) • Fauna 'damage incidents'
Response: • Surface Dispersant Application^	• Change in water quality • Change in sediment quality • Toxicity impacts to marine fauna and flora	• SMS2: Water Quality Monitoring • SMS3: Sediment Quality Monitoring • SMS4: Benthic Habitat Monitoring • SMS5: Seabird Population Monitoring • SMS6: Marine Megafauna Surveys	• Dispersant chemicals in water/sediment • Observations of state (condition) of habitat/fauna • Chemical analysis of tissue samples

* = Primary oil spill response strategy; ^ = Secondary oil spill response strategy (refer to OPEP).

3.1.2 Monitoring Strategies – Protected Matters Constraints

3.1.2.1 Species Protection

Prior to the deployment of monitoring teams to a spill location, a Job Safety Assessment (JSA) will be undertaken to ensure all activities are performed safely, with minimal impacts to the environment and to verify equipment. This assessment will consider the following with respect to the protected matters which may be present at monitoring locations:

- Likelihood of encounter with protected species at monitoring locations and the seasonal activity of the protected species (i.e. feeding, calving, etc.);
- Review of latest threatened species recovery plans or conservation advices with respect to species 'threats' and management controls and restrictions to prevent impacts during monitoring activities; and
- Confirmation of regulatory restrictions (e.g. marine mammal buffer distances) which must be observed when undertaking activities.

These requirements will be documented within the JSA and technical specialists will participate in the JSA to confirm their awareness of these constraints.

3.1.2.2 Monitoring Parameter Selection and Management Plan Requirements

Monitoring parameters and methodologies selected observe the necessary requirements of existing conservation management. Where available, management plans provide details of relevant 'umbrella species' which are monitored over time (e.g. long-term indicators for Ramsar sites) to monitor the long-term health of the area and meet objectives of the management plan (e.g. water quality indicators, offshore intertidal reef indicators). Relevant management plans have been consulted in the preparation of the SIPs to identify these indicators (e.g. for bird species such as the Streaked Shearwater parameters such as population size and breeding success).

Protection requirements have been considered in the selection of methodologies and monitoring parameters in the respective monitoring strategies.

Refer also to Section 0 regarding the inclusion of relevant management actions and objectives for protected areas and/or species.

3.1.3 Prioritisation within Monitoring Strategies for Species / Populations / Habitats

In the event of a Level 2/3 spill, operational forecast modelling (OMS1) will be undertaken to establish the predicted trajectory and location of oil spill residues. In conjunction with this information, the Western Australian Oil Spill Response Atlas (OSRA) provided by the Western Australian DoT provides a valuable tool to identify the distribution of biologically sensitive species present in the spill trajectory pathway.

The scale of the spill and likelihood/consequence of oil impact on sensitive habitats, protected species or areas of conservation value (Marine National Park, AMPs, etc.) at threat will define the level of effort required and the particular parameters (e.g. species/habitat) monitored in each scientific monitoring strategy. Factors affecting the selection and prioritisation of species and/or habitats to be monitored during a spill incident include:

- The species/habitat sensitivity to oiling and the likelihood of oiling, in particular presence and potential exposure to MNES protected under the EPBC Act;

- Ability to access the monitoring location;
- Identified species which are monitored within conservation management plans;
- Social factors which may affect selection due to their iconic nature (e.g. Humpback Whale) or may have commercial impacts (e.g. iconic species [Humpback Whale], fishing interest);
- Available baseline data for individual species or habitat;
- Time for oil to impact the habitat/species and the ability to access the monitoring locations; and
- Feedback from the Western Australian Environment and Science Coordinator (ESC) on the required species selection during the spill event.

The IMT Environmental Unit Leader will observe these parameters when determining, selecting and prioritising species/populations/habitats to the monitored.

Species currently targeted for monitoring on the basis of available information (baseline and conservation management plans) are contained within the respective monitoring strategies within this OSMP.

3.2 Operational Monitoring Strategies

As noted in Section 1.4, the aim of operational monitoring is to provide timely information to be used in planning and executing hydrocarbon spill responses. Upon notification of an uncontrolled hydrocarbon release, the BP Incident Commander (or delegate) will initiate the Operational Monitoring Program. The strategy for each operational monitoring study is provided in this section together with a reference to the corresponding implementation plan for each study. The OMSs outlined in this section include:

- OMS1 – Operational Forecast Modelling,
- OMS2 – Hydrocarbon Spill Surveillance and Tracking,
- OMS3 – Hydrocarbon Weathering Assessment,
- OMS4 – Dispersant Efficacy Assessment,
- OMS5 – Water Quality Assessment,
- OMS6 –Sediments Quality Assessment,
- OMS7 – Marine Fauna Surveillance,
- OMS8 – Fish Taint Assessment, and
- OMS9 – Air Quality (Responder Health and Safety) Assessment.

Note: due to the rapid weathering characteristics of MDO, operational monitoring studies are not considered relevant for a vessel collision event where hydrocarbon release only occurs over a short period of time. The time that would elapse between a spill occurring and monitoring personnel being on site would render the data collected unnecessary in informing response strategies. Operational monitoring studies are therefore only actioned (once initiation criteria are met) as a result of a loss of well control incident.

3.2.1 OMS1 Strategy: Operational Forecast Modelling

Strategy Component	Description
Monitoring Performance Outcomes	Carry out daily real-time predictions (forecasts) of the temporal / spatial distribution and concentrations of hydrocarbons on the surface and within the water column via numerical modelling to meet the following OPEP requirements: • In the event of a hydrocarbon release, provide operational data / information to predict the weathering of hydrocarbons released. • Implement operational monitoring in accordance with the OPEP to identify sensitivities potentially at risk of hydrocarbon exposure, inform the SIMA and identify which sensitivities may require operational monitoring. • OPEP Section 5.3.1 (Monitoring Evaluation and Surveillance).
Performance Standards	**Measurement Criteria**
1: Readiness to implement OMS1 prior to survey	1a: BP has internal predictive modelling capability and contracts in place with external service providers (OSRL, AMOSC).
2: Provision of daily quasi-real-time predictions (forecasts) to inform operational responses (and scientific monitoring of sensitive locations)	2a: For Level 2 or Level 3 Spill: Amount and duration of spill provided to modellers by IMT PSC (or delegate) for incorporation into the forecast modelling inputs within 1 day of incident. 2b: Daily information from OMS2 (surveillance validation) provided to modellers to refine and improve short-term model forecasts. 2c: At least daily simulation(s) provided by modellers with hydrocarbon spatial and temporal distribution predictions of 3-4 days into the future, which are available via a secured web site to all authorised response personnel. 2d: Availability of modelling personnel for advice and explanation of model results at any time (24 hours a day 7 days a week). 2e: Undertake a desktop assessment - to obtain all relevant information in relation to the values and sensitivities that may be affected from the moving oil slick. Note: Values and sensitivities are defined as those described in Section 3 of the EP, including islands, reefs, shoals and banks, and areas of conservation significance, and BIAs associated with MNES.
3: Close-out reporting to inform ongoing SMSs	3a: PI to submit Report on OMS1 (Forecast Modelling) within 1 month of modelling termination to IMT EUL. 3b: EUL (or delegate) to distribute to PIs of SMS to inform post-spill scientific monitoring within 1 week of submission.
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	Modelling Termination: • Any related scientific monitoring studies have been initiated by the IC (or delegate) **and** • The IC (or delegate) considers that continuation of monitoring under OMS1 will not result in a change to the scale or location of active response options **or** • The IC (or delegate) has advised that agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the response **or** • The IC (or delegate) has advised that continuation of monitoring under OMS1 may increase overall environmental impact Study Termination: Approval of OMS1 Close-Out Report by the PSC (or delegate).
Timing	• Where required, external service providers have been activated within 4 hours of the initiation criteria being met.

	• Forecast modelling to commence within 24 hours of initiation criteria being met.
Study Implementation Plan	OMS1 (Operational Forecast Modelling)
Monitoring Design	N/A
Sampling Techniques	Monitoring techniques will vary depending on the individual event and final monitoring design. The following types of monitoring may be implemented under OMS1: • Vessel-based • Aerial-based (aircraft, satellite etc) • Visual observations of behaviour and weathering.
Sampling Frequency	Continual
Parameters	Monitoring parameters will vary depending on the individual event and final monitoring design. The following types of parameters may be analysed under OMS1: • Visual records of extent and state (e.g. colour/optical effect on surface, form (slick, emulsion, mousse etc.), presence of waxy residue).
Competencies	RPS Response via AMOSC is the recognised industry leader in predictive modelling of hydrocarbon incidents and no competency test and training is warranted. BP modelling personnel are qualified with over 10 years' experience in performing oil spill trajectory modelling for BP's upstream and downstream businesses to inform contingency planning as well as supporting oil spill exercises and incidents. In addition they have provided training in the use of SINTEF's OSCAR model to regional staff.
Reporting	• RPS Response via AMOSC to develop OMS1 implementation plan. • Provision of location, start time, volume and duration of spill memorandum to RPS. • Forecast modelling daily report including forecast modelling inputs, outputs, validation and uncertainties and modelling results uploaded daily to a secure website by RPS Response for PSC, EUL and OMS2 PI.
Review and Auditing	• Review of operational forecast modelling by EUL and AMOSC. • Annual internal review of OMS1 Strategy and Study implementation plan (methodology, procedures, processes) by EUL with period between reviews no longer than 12 months. • Non-conformances recorded with follow-up by EUL within 2 weeks.
Responsibilities	<u>IC:</u> • Overall responsibility for implementation of the Strategy and implementation plan. <u>PSC (or delegate):</u> • Interface between IC and EUL. • Provides necessary spill input parameters to PI. • Communicate forecast modelling results to response personnel via OSC. • Communications with RPS Response, AMSA and AMOSC as required regarding forecasting modelling. <u>EUL (or delegate):</u> • Ongoing review and approval of the OMS1 Implementation plan. • Day-today coordination of the study results. • Carry out periodic internal reviews of implementation plan. • Oversee external audits.

	• Ensure information from OMS2 (Hydrocarbon Spill Surveillance and Tracking) provided to RPS. • Ensure information from Study OMS1 is provided to the PI of Study OMS2. • Provide advice as required to IC and PSC. • Communications with NOPSEMA's Environment Division. PI: • Review / update Study OMS1 implementation plan • Daily implementation of this implementation plan. • Provision by RPS of quasi-real-time modelling and daily updates to a secure website. • Provision by RPS of advice with respect to modelling forecasts to EUL and PSC. • Ensure availability of RPS staff 24 hours a day for 7 days a week for consultation of modelling results with response personnel.
Relevant References and Guidelines	• RPS Response guidelines • Oil Spill Monitoring Handbook (Hook et al 2016)

3.2.2 OMS2 Strategy: Hydrocarbon Spill Surveillance and Tracking

Strategy Component	Description
Monitoring Performance Outcomes	Conduct surveillance and tracking of surface hydrocarbon spill distribution to meet the following OPEP requirements: • Provide operational data / information to support and inform response planning and operations and monitor the spill response; and • Implement operational monitoring in accordance with the OSMP to identify sensitivities at risk of hydrocarbon exposure, inform the SIMA and identify sensitivities which require scientific monitoring. • OPEP Section 5.3.1 (Monitoring Evaluation and Surveillance).
Performance Standards	**Measurement Criteria**
1: Readiness to implement OMS2 prior to survey	1a: PI, TS and field equipment (e.g. satellite tracking buoys) sourced from pool of internal and external resources (e.g. AMOSC, OSRL) under existing contracts. 1b: BP to maintain a database of appropriate satellite imagery providers (e.g. through AMOSC and OSRL). 1c: Satellite tracking buoys will be on vessels and MODU.
2: Acquisition of at least daily surface slick distributions and slick trajectory	2a: IMT PSC (or delegate) to initiate mobilisation of vessel, aircraft, PI, TS and equipment to site after notification. 2b: PI in consultation with PSC (or delegate) plans daily surveillance activities on basis of OMS1 (Forecast Modelling) and other surveillance information (e.g. satellite imagery, satellite tracking buoys, latest surveillance), and any planned response measures. Survey objectives and plan recorded.
3: Daily informing for response planning and management	3a: PI responsible for amalgamating daily surveillance reports from variety of sources (e.g. vessel observations, satellite imagery, tracking buoys). Key topics to include in report are size and trajectory of slick, predicted slick behaviour, effectiveness of response measures and observed impacts or threats to environmental sensitivities. 3b: Daily reports are provided to PSC (or delegate) to inform response planning, management and effectiveness, and to all OSMP PIs to inform planning, execution and optimisation of studies.
4: Provision of Close-Out Report and Data	4a: PI responsible for collation of relevant data (e.g. vessel-based surveillance, and satellite imagery) into a Close-out Report and Database to inform planning for post-spill response scientific monitoring within 1 month of the OMS2 field study termination.

	4b: PSC (or delegate) to distribute to PIs of the SMS to inform post-spill scientific monitoring within 1 week of submission.
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	Field Observation Termination: • Any related scientific monitoring studies have been initiated by the IC (or delegate) **and** • The IC (or delegate) considers that continuation of monitoring under OMS2 will not result in a change to the scale or location of active response options **or** • The IC (or delegate) has advised that agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the response **or** • The IC (or delegate) has advised that continuation of monitoring under OMS2 may increase overall environmental impact Study Termination: Approval of OMS2 Close-Out Report and Database by the PSC (or delegate).
Timing	• Where required, external service providers have been activated within 4 hours of the initiation criteria being met. • Field surveillance to commence within 24 hours of initiation criteria being met. Note: timing of mobilisation and field surveys is dependent on safe operating conditions (e.g. weather, sea state, etc.) and operational access to sites.
Study Implementation Plan	OMS2 (Hydrocarbon Spill Surveillance and Tracking)
Monitoring Design	N/A
Sampling Techniques	Monitoring techniques will vary depending on the individual event and final monitoring design. The following types of monitoring may be implemented under OMS2: • Aerial-based (aircraft, satellite etc), • Visual observations of behaviour and weathering.
Sampling Frequency	Continual
Parameters	Monitoring parameters will vary depending on the individual event and final monitoring design. The following types of parameters may be analysed under OMS2: • Visual records of extent and state (e.g. colour/optical effect on surface, form (slick, emulsion, mousse etc), presence of waxy residue).
Competencies	• PI with experience in managing and leading hydrocarbon spill or similar monitoring. • Aerial-based observers trained in aerial observation of hydrocarbon spills. • CVs to be kept on file.
Reporting	• Daily Study OMS2 reports on hydrocarbon spill surveillance and tracking observations. • Final Study OMS2 Report within 4 weeks after cessation of monitoring activities.
Review and Auditing	• Validation of hydrocarbon mapping confidence using aerial-based surveillance and tracking buoys; • Annual internal review of OMS2 Strategy and implementation plan methodology, procedures, processes and records by EUL (or delegate).

	• Non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	IC: • Overall responsibility for implementation of the strategy and implementation plan. PSC (or delegate): • Interface between IC and EUL. • Facilitate daily surveillance activities. • Disseminate OMS2 information to response team. • Communications with AMOSC, AMSA, as required regarding surveillance and tracking of spill. EUL (or delegate): • Ongoing review and approval of OMS2 implementation plan. • Compliance with OMS2 implementation plan requirements. • Day-today coordination of the study results. • Carry out periodic internal reviews of implementation plan. • Oversee external audits. • Ensure information from OMS1 is provided to OMS2 PI. • Provide advice as required to IC and PSC. • Communications with NOPSEMA's Environment Division. PI: • Daily implementation of this implementation plan. • Plan, coordinate and implement daily surveillance and tracking field activities. • Review, approve and disseminate daily surveillance information and final report. • Daily communication with the TS. • Advise EUL (or delegate) and IC. • Review the Hydrocarbon Spill Surveillance and Tracking Final Report. TS: • Undertake and record field observations. • Contribute to reports. • Contribute to the Hydrocarbon Spill Surveillance and Tracking Final Report where required.
Relevant References and Guidelines	• Hook et al 2016 Oil Spill Monitoring Handbook. • AMSA 2003 Post-Spill Monitoring: Background Paper. • Oil Spill Monitoring Handbook (Hook et al, 2016).

3.2.3 OMS3 Strategy: Hydrocarbon Weathering Assessment

Strategy Component	Description
Monitoring Performance Outcomes	To determine the physical and chemical properties of hydrocarbon as it weathers to characterize temporal decrease in toxicity to meet the following OPEP requirements: • Provide operational data / information to support and inform response planning and operations and monitor the spill response; and • Implement operational monitoring in accordance with the OSMP to identify sensitivities at risk of hydrocarbon exposure, inform the SIMA and identify sensitivities which require scientific monitoring. • OPEP Section 5.3.1 (Monitoring Evaluation and Surveillance).
Performance Standards	**Measurement Criteria**
1: Readiness to implement OMS3 Hydrocarbon Weathering Assessment.	1a: PI and TS to be sourced from pool of resources under existing contracts. 1b: EUL maintains a database of appropriate vessel providers and NATA accredited analytical laboratory (e.g. ALS for weathering testing) 1c: OMS3 (Hydrocarbon Weathering Assessment) implementation plan in place and approved by EUL.
2: Acquisition of data on hydrocarbon chemical properties.	2a: PI plans monitoring survey on basis of information from OMS1 (Operational Forecast Modelling), OMS2 (Hydrocarbon Spill Surveillance and Tracking), coordination with other studies, and planned response activities. Vessel-based monitoring objective and plan recorded on the daily report. 2b: Experienced TS carry out vessel-based sampling at nominated locations along a longitudinal transect through the slick and water depths. Fluorescence and turbidity (in addition to temperature and salinity) profiles carried out initially to verify proxy indicators of dissolved aromatics and entrained hydrocarbons, respectively, and to select depths for sample collection. Water samples then collected and stored appropriately, and organised for immediate couriering under holding time to analysis laboratory. Chain of Custody (CoC), Laboratory Receipt Notification and field records stored / archived by TS. 2c: NATA-accredited laboratory carries out analysis of analytes (e.g., BTEX, MAH, PAH) and physical properties (e.g., wax content) as appropriate to the hydrocarbon spill. CoC and Analysis Report provided and data archived by TS. 2d: 2a-2c carried out on at least 3 surveys that are as soon as possible after the spill event, and at frequencies thereafter determined by the hydrocarbon type as defined by the PIs.
3: Characterise fate / weathering properties of hydrocarbon.	3a: After each survey, the PI / TS carries out analyses of hydrocarbon data to characterise weathering characteristics with discussion on likely decrease in toxicity with weathering time on the basis of chemical composition of different 'ages' of hydrocarbon in terms of release into the marine environment. 3b: PI / TS provides summary of fate / weathering properties of hydrocarbon in OMS3 Final Report within 3 weeks of receipt of last Laboratory Analysis Report.
4: Informing spill response and technical specialist.	4a: Interim reports provided by PI after each survey, within 1 week of receipt of laboratory analysis provided to PSC, EUL (or delegate) and all PIs. 4b: OMS3 Final Report summarising hydrocarbon weathering assessment (for informing SIMA of hydrocarbon persistence) provided by PI / TS within 4 weeks of final laboratory results to PSC, EUL (or delegate) and all PIs.
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	<u>Field activity termination:</u> The PSC will terminate the operational module when the following criteria has been met:

	• For hydrocarbon weathering assessments, the PSC (or delegate) and PI in consultation with NOPSEMA, WA DoT and/or AMSA deem that weathering characteristics of hydrocarbon are sufficiently characterised so further assessment no longer required. Study Termination: Submission and approval of Hydrocarbon Weathering Assessment Final Report (OMS3).
Timing	• Where required, external service providers have been activated within 4 hours of the initiation criteria being met. • Field surveillance to commence within 24 hours of initiation criteria being met. Note: timing of mobilisation and field surveys is dependent on safe operating conditions (e.g. weather, sea state, etc.) and operational access to sites.
Study Implementation Plan	OMS3 (Hydrocarbon Weathering Assessment)
Monitoring Design	N/A

Sampling Techniques	Sampling techniques will vary depending on the individual event and final monitoring design. The following types of monitoring may be implemented under OMS3:
	• Vessel-based
	• Collection of an oil sample:
	  ○ Surface skimming (sampling pole with container),
	  ○ Oleophilic absorbent pads.
	• Behaviour and weathering:
	  ○ Visual observations.

Sampling Frequency	As determined by the PI in consultation with the IMT EUL (or delegate)
Parameters	Sampling parameters will vary depending on the individual event and final monitoring design. The following types of parameters may be analysed under OMS3: • Physical properties (e.g. viscosity, pour point, density, wax content) • Chemical properties (e.g. hydrocarbon characterisation, volatile content) • Oil component concentrations (e.g. TRH, BTEX, PAH, MAH) • Visual records of extent and state (e.g. colour/optical effect on surface, form (slick, emulsion, mousse etc), presence of waxy residue).
Competencies	• PI is an experienced and qualified water quality scientist with experience in using fluorometry (or similar) and with field experience in monitoring campaigns. • TS (field) with appropriate training and/or experienced as marine scientist or technicians with appropriate training and field experience in vessel-based water quality monitoring. Trained in vessel-based hydrocarbon spill sampling and interpreting data from fluorometer. • TS (office) to be experienced water quality analysts for OMS3 office-based analyses. • BP to maintain a database of appropriate vessel providers. • Laboratory with NATA accreditation. • CVs to be kept on file.
Reporting	• Daily reporting on pro forma during field surveys including daily monitoring objectives, plan, analytical progress and emerging results. • Laboratory analysis reports. • Interim reports with assessment of the hydrocarbon weathering properties for each survey. • Final OMS3 Report summarizing hydrocarbon weathering assessment.

Review and Auditing	• Field and data QA/QC procedures. • Laboratory QA/QC sample analyses; • Annual internal review of OMS3 Strategy and study implementation plan methodology, procedures, processes and records by EUL (or delegate). • Non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	<u>IC:</u> • Overall responsibility for implementation of the strategy and implementation plan. <u>PSC (or delegate):</u> • Interface between IC and EUL. • Facilitates field monitoring. • Disseminate OMS3 information to response team. • Communicate with AMOSC, AMSA, DoT. <u>EUL (or delegate):</u> • Ongoing review and approval of the OMS3 implementation plan. • Day-today coordination and review of the study results. • Compliance with OMS3 implementation plan requirements. • Carry out periodic internal reviews of implementation plan. • Oversee external audits. • Communications with NOPSEMA's Environment Division. • Provide advice to the IC and PSC. <u>PI:</u> • Plan, coordinate and implement daily hydrocarbon weathering assessment survey. • Daily communications with EUL (or delegate) and TS. • Advise EUL (or delegate). • Review daily pro-forma, Interim Survey Reports and Hydrocarbon Weathering Assessment Final Report. <u>TS:</u> • Undertake hydrocarbon weathering monitoring activities. • Coordinate laboratories and transport of samples to laboratories. • Carry out hydrocarbon weathering analyses and reporting. • Contribute to vessel-based surveillance sections of Interim Survey Reports and Final Report. • Store and archive data.
Relevant References and Guidelines	• Hook et al 2016 Oil Spill Monitoring Handbook. • AMSA 2003 Post-Spill Monitoring: Background Paper.

3.2.4 OMS4 Strategy: Dispersant Efficacy Assessment

Strategy Component	Description
Monitoring Performance Outcomes	To provide information on the efficacy of a chemical dispersant applied to the spilled hydrocarbon, and to meet the following OPEP requirements: • Provide operational data / information to support and inform response planning and operations and monitor the spill response. • Monitor the effectiveness of dispersant application to reduce surface oiling.
Performance Standards	**Measurement Criteria**
1: Readiness to implement OMS4 on Dispersant Efficacy Assessment.	1a: PI and TS to be sourced from pool of resources under existing contracts or agreements with service providers such as AMOSC, , AMSA, OSRL. 1b: BP to maintain a database of appropriate service providers, including vessels, ROVs etc. 1c: OMS4 (Dispersant Efficacy Assessment) implementation plan in place and approved by EUL.
2: Acquisition of data on hydrocarbon dispersion and surface VOCs.	2a: PI plans monitoring survey on basis of information supplied by PSC (or delegate) regarding planned response activities and use of dispersant. Vessel-based monitoring objective and plan recorded on the daily report. 2b: For surface dispersant application: Experienced TS carry out vessel or aerial-based sampling for dispersant efficacy. Sampling aligned with industry standard SMART protocol. 2c: For any dispersant application: Experienced TS carry our vessel-based air quality monitoring for VOCs and %LELs as per the industry recommended API method.
3: Quasi-real-time informing of spill response	3a: Provide sub-daily assessment of efficacy observations and/or measurements. 3b: Provide sub-daily assessment of VOCs, %LELs, and relevance to human health.
Additional Information	
Initiation Trigger	The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred and Surface Dispersant Application has been selected as a response option in accordance with the OPEP.
Termination Criteria	<u>Field activity termination:</u> • Any related scientific monitoring studies have been initiated by the IC (or delegate) **and** • The IC (or delegate) considers that continuation of monitoring under OMS4 will not result in a change to the scale or location of active response options **or** • The IC (or delegate) has advised that agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the response **or** • The IC (or delegate) has advised that continuation of monitoring under OMS4 may increase overall environmental impact <u>Study Termination:</u> Submission and approval by EUL (or delegate) of Dispersant Efficacy Assessment Final Report.
Timing	OMS4 is to be undertaken at the same time as the Surface Dispersant Application response strategy.
Monitoring Design	N/A
Sampling Techniques	Sampling techniques will vary depending on the individual event and final monitoring design. The following types of sampling and surveillance may be implemented under OMS4: • Visual observations: o Aerial or vessel based. • Oil and water sampling:

	◦ Water sampling techniques as per OMS4 (e.g. niskin bottle, hose with peristaltic pump, etc.), ◦ Fluorometer, ◦ Underwater video surveillance. • Air quality monitoring: ◦ In-situ detectors.
Sampling Frequency	As determined by the PI in consultation with the IMT EUL (or delegate)
Parameters	Sampling parameters will vary depending on the individual event and final monitoring design. The following types of parameters may be analysed under OMS4: • Oil concentrations (e.g. TPH, TRH, BTEX, PAH, MAH), • Fluorescence, • VOCs and %LELs.
Competencies	• PI with experience in managing and leading hydrocarbon spill or similar monitoring. • TS with trained in vessel-based and/or aerial-based hydrocarbon spill monitoring. • TS familiar with relevant sampling techniques (e.g. sub-surface video surveillance, use of fluorometer, water sample collection etc.). • TS familiar with air quality monitoring. • Prequalified vessels and aircraft. • CVs to be kept on file by PI.
Reporting	• Sub-daily reports of dispersant efficacy and air quality. • Final OMS4 Report summarising Dispersant Efficacy Assessment monitoring within 1 months of survey completion.
Review and Auditing	• Field and data QA/QC procedures. • Annual internal review of OMS4 Strategy and implementation plan methodology, procedures, processes and records by EUL (or delegate). • Non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	<u>IC:</u> • Overall responsibility for implementation of the strategy and implementation plan. <u>PSC (or delegate):</u> • Interface between IC and EUL. • Facilitate dispersant efficacy monitoring. • Inform the PI of planned / ongoing response measures. • Disseminate OMS4 Dispersant Efficacy Assessment information for response planning and management. • Communication and coordination with AMOSC, AMSA, WA DoT. <u>EUL (or delegate):</u> • Compliance with OMS4 implementation plan requirements. • Day-to-day coordination and review of OMS4 results • Carry out internal periodic reviews of implementation plan. • Oversee external audits. • Complete compliance reporting requirements. • Provide advice as required to IC. • Communications with NOPSEMA's Environment Division and WA DoT, Commonwealth DAWE.

	PI: • Daily implementation of the implementation plan. • Plan, coordinate and implement surveys. • Coordinate field monitoring, communications and daily reporting. • Advise EUL (or delegate). • Review Final Report. TS: • Implement field monitoring. • Carry out associated reporting.
Relevant References and Guidelines	• Hook et al 2016 Oil Spill Monitoring Handbook. • Dispersant Application Monitoring Field Guide Tier I Visual Observation (Oil Spill Response Limited, 2011). • Special Monitoring of Applied Response Technologies (NOAA 2006).

3.2.5 OMS5 Strategy: Water Quality Assessment

Strategy Component	Description
Monitoring Performance Outcomes	Conduct intertidal and subtidal water quality monitoring to: • Provide a rapid assessment of the presence, type and concentrations of oil (and dispersant chemicals where relevant) in offshore and intertidal waters • Inform response planning and operations • Provide data to validate forecast / hindcast modelling • Inform the implementation of scientific monitoring in accordance with this OSMP.
Performance Standards	**Measurement Criteria**
1: Readiness to implement SMS5 program.	1a: PI and TS to be sourced from pool of resources under existing contracts (1b: PI to maintain a database of appropriate service providers, including vessels.
2: Appropriate collection, transport and analysis of water samples.	2a: TS to collect and store water samples, and keep field records (e.g. field book, checklists) as per the OMS5 SIP. CoC to confirm sample collection. Where required, transport to appropriate laboratories, and sample receipt notification from the NATA-accredited laboratory (e.g. ALS) to confirm arrival of water samples within holding times. Documents stored / archived by TS. 2b: Laboratory Analysis Report issued by NATA-accredited laboratory with analyte list defined in the SIP (within 3 weeks of sample collection) and stored by TS.
3: Acquisition and dissemination of water quality data for hydrocarbons in water.	3a: TS collects water quality data as soon as possible at sensitive priority areas, commercial fishery areas, pelagic sites and reference sites as per the SIP. TS store / archive field records. 3b: PI to provide data (within 1 day of receipt of in-situ data, and 1 week of receipt of Laboratory Analysis Report for analytical data) to EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC and other PIs.
4: Acquisition of hydrocarbon data from marine waters during the hydrocarbon release.	4a: Collection and analysis of hydrocarbon concentrations in marine waters as prescribed in the OMS5 SIP by TS during the hydrocarbon release.
5: Provision of hydrocarbon monitoring of marine waters dataset to OMS1 and SMS8 for modelling.	5a: PI responsible for provision of OMS5 dataset to PI of OMS1 (Operational Forecast Modelling) as data is available. 5b: PI responsible for provision of OMS5 dataset to PI of SMS8 (Hind-cast Modelling Impact Assessment) to serve as a validation data of hydrocarbon concentrations in marine waters within 1 week of cessation of unplanned hydrocarbon releases.

Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	Field Study Termination: • Any related scientific monitoring studies have been initiated by the IC (or delegate) **and** • The IC (or delegate) considers that continuation of monitoring under OMS5 will not result in a change to the scale or location of active response options **or** • The IC (or delegate) has advised that agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the response **or** • The IC (or delegate) has advised that continuation of monitoring under OMS2 may increase overall environmental impact Study Termination: Approval of OMS5 Close-Out Report and Database by the PSC (or delegate).
Timing	• Where required, external service providers have been activated within 4 hours of the initiation criteria being met. • Where required, an initial SAP to be available within 12 hours of initiation criteria being met • Field surveys to commence within 24 hours of initiation criteria being met. Note: the initial SAP may be revised as required due to the nature of an ongoing spill event, changing operational requirements and/or results from data collected to date Note: timing of mobilisation and field surveys is dependent on safe operating conditions (e.g. weather, sea state, etc.) and operational access to sites
Study Implementation Plan	OMS5 (Hydrocarbon in Marine Waters Assessment)
Monitoring Design	The following are monitoring designs recommended: • Gradient approach • Grid approach Where practicable, samples should also be collected at the leading edge of a surface slick, as this is typically the thickest part. Final design will be confirmed during preparation of the SAP by the TS.

Sampling Techniques	Sampling techniques will vary depending on the individual event and final monitoring design. The following types of sampling may be implemented under SMS2:
	• Surface water sample collection:
	  ○ Sampling pole with container,
	  ○ Hose with peristaltic pump.
	• Sub-surface water sample collection:
	  ○ Niskin bottle (or similar),
	  ○ Hose with peristaltic pump.
	• In-situ profiles:
	  ○ Physio-chemical profiles,
	  ○ Fluorometer.

Sampling Frequency	As determined by the PI in consultation with the IMT EUL (or delegate)
Parameters	Sampling parameters will vary depending on the individual event and final monitoring design. The following types of parameters may be analysed under SMS2: • Oil concentrations (e.g. TRH, BTEX, PAH, MAH),

	• Physical parameters (e.g. temperature, salinity, DO, pH), • Fluorescence, • Dispersant chemicals (if applied).
Competencies	• PI to be an experienced and qualified water quality scientist with field experience in vessel-based water quality monitoring (or equivalent). • TS (field) to be experienced marine scientists or technicians with appropriate training and experienced in water quality sampling. • TS (office) to be experienced water quality analysts for SMS3 office-based analyses. • Laboratory services with NATA accreditation. • CVs to be kept on file. • Commercial certified / surveyed plant (vessels).
Reporting	• Daily Study OMS5 reports on water quality sampling and observations. • Final Study OMS5 Report within 4 weeks after cessation of monitoring activities.
Review and Auditing	• Field and data QA/QC procedures. • Chain of Custody Documentation for Samples. • Laboratory QA/QC sample analysis. • Annual internal review of Strategy OMS5 SIP (methodology, procedures, processes, records, reporting and QA/QC) by EUL (or delegate); • Any non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	<u>IC:</u> • Overall responsibility for implementation of the OMS5 Strategy and implementation plan. <u>PSC (or delegate):</u> • Interface between IC and EUL. • Facilitates field monitoring. • Disseminate OMS5 information to response team. <u>EUL (or delegate):</u> • Day-to-day coordination and review of the study results. • Compliance with OMS5 SIP requirements. • Carry out periodic internal reviews of SIP. • Oversee external audits. • Communications with NOPSEMA’s Environment Division. • Provide advice to the IC and PSC. <u>PI:</u> • Plan, coordinate and implement OMS5 survey. • Review, approve and disseminate water quality monitoring information. • Daily communications with EUL (or delegate) and TS. • Advise EUL (or delegate). • Review daily pro-forma, interim and final reports. <u>TS:</u> • Undertake monitoring activities. • Coordinate laboratories and transport of samples to laboratories. • Carry out data analyses. • Prepare reports, including water quality survey reports and final report. • Store and archive data.

Relevant References and Guidelines	Hook et al 2016 Oil Spill Monitoring Handbook. Australian and New Zealand Water Quality Guidelines for Fresh and Marine Waters Quality, ANZECC & ARMCANZ (2000).

3.2.6 OMS6 Strategy: Sediment Quality Assessment

Strategy Component	Description
Monitoring Performance Outcomes	Conduct intertidal and subtidal sediment quality monitoring to: • Provide a rapid assessment of the presence, type and concentrations of oil (and dispersant chemicals where relevant) in subtidal and intertidal sediments • Inform response planning and operations • Inform the implementation scientific monitoring in accordance with this OSMP.
Performance Standards	**Measurement Criteria**
1: Readiness to implement OMS6 Hydrocarbon Monitoring in Marine Sediments Assessment.	1a: PI and TS to be sourced from pool of resources under existing contracts (). 1b: PI to maintain a database of appropriate service providers, including vessels.
2: Appropriate collection, transport and analysis of sediment samples.	2a: TS to collect and store sediment samples, and keep field records (e.g. field book, checklists) as per the OMS6 SIP. CoC to confirm sample collection. Where requried, transport to appropriate laboratories, and sample receipt notification from the NATA-accredited laboratory (e.g. ALS) to confirm arrival of sediment samples within holding times. Documents stored / archived by TS. 2b: Laboratory Analysis Report issued by NATA-accredited laboratory with analyte list defined in the SIP (within 3 weeks of sample collection) and stored / archived by TS.
3: Acquisition and dissemination of data for hydrocarbons in sediments.	3a: TS to collect sediment quality data from the seabed at subtidal and intertidal locations, pelagic sites, commercial fishery areas and reference sites as per the SIP. TS store/archive field records and CoC. 3b: PI to provide data (within 1 day for in-situ data, and 1 week of receipt of Laboratory Analysis Report for analytical data) to EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC and other PIs
4: Acquisition of routine hydrocarbon data in marine sediments during the hydrocarbon release.	4a: Collection and analysis of hydrocarbon concentrations in marine sediments as prescribed in OMS6 SIP by TS during the hydrocarbon release.
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	<u>Field Study Termination</u>: • Any related scientific monitoring studies have been initiated by the IC (or delegate) **and** • The IC (or delegate) considers that continuation of monitoring under OMS6 will not result in a change to the scale or location of active response options **or** • The IC (or delegate) has advised that agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the response **or** • The IC (or delegate) has advised that continuation of monitoring under OMS6 may increase overall environmental impact

	Study Termination: Approval of OMS6 Close-Out Report and Database by the PSC (or delegate).
Timing	• Where required, external service providers have been activated within 4 hours of the initiation criteria being met. • Where required, an initial SAP to be available within 12 hours of initiation criteria being met • Field surveys to commence within 24 hours of initiation criteria being met. Note: the initial SAP may be revised as required due to the nature of an ongoing spill event, changing operational requirements and/or results from data collected to date. Note: timing of mobilisation and field surveys is dependent on safe operating conditions (e.g. weather, sea state, etc.) and operational access to sites.
Study Implementation Plan	OMS6 (Hydrocarbon in Marine Sediments Assessment)
Monitoring Design	The following are monitoring designs recommended: • Gradient approach • Grid approach Final design will be confirmed during preparation of the SAP by the TS.

Sampling Techniques	Sampling techniques will vary depending on the individual event and final monitoring design. The following types of sampling may be implemented under SMS3:
	• Subtidal sample collection:
	  ○ Grab or core sampler.
	  ○ Sediment box.
	• Intertidal sample collection:
	  ○ Cores or auger
	  ○ Sediment box

Sampling Frequency	As determined by the PI in consultation with the IMT EUL (or delegate)
Parameters	Sampling parameters will vary depending on the individual event and final monitoring design. The following types of parameters may be analysed under SMS3: • Oil concentrations (e.g. TRH, BTEX, PAH, MAH), • Physical parameters (if applied), • Total organic carbon, • Physical parameters (e.g. PSD).
Competencies	• PI with an experienced marine scientist with at least 5 years' experience in collecting marine sediment samples (or equivalent). • TS (field) will include experienced and qualified marine scientists with field experience in vessel-based sediment and water quality monitoring. • TS (office) to be experienced sediment quality analysts for OMS5 office-based analysis. • Laboratory services will be NATA certified. • CVs to be kept on file. • Commercial certified / surveyed plant (vessels).
Reporting	• Daily Study OMS6 reports on water quality sampling and observations. • Final Study OMS6 Report within 4 weeks after cessation of monitoring activities.
Review and Auditing	• Field and data QA/QC procedures. • Chain of Custody Documentation for Samples. • Laboratory QA/QC sample analysis.

	• Annual internal review of Strategy OMS5 SIP (methodology, procedures, processes, records, reporting and QA/QC) by EUL (or delegate); • Any non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	IC: • Overall responsibility for implementation of the strategy and implementation plan. PSC (or delegate): • Interface between IC and EUL. • Facilitates field monitoring. • Disseminate OMS6 information to response team EUL (or delegate): • Day-to-day coordination and review of the study results. • Compliance with OMS5 SIP requirements. • Carry out periodic internal reviews of SIP. • Oversee external audits. • Communications with NOPSEMA's Environment Division. • Provide advice to the IC and PSC. PI: • Plan, coordinate and implement OMS5 survey. • Review, approve and disseminate water quality monitoring information. • Daily communications with EUL (or delegate) and TS. • Advise EUL (or delegate). • Review daily pro-forma, interim and final reports. TS: • Undertake monitoring activities. • Coordinate laboratories and transport of samples to laboratories. • Carry out data analyses. • Prepare reports, including water quality survey reports and final report. • Store and archive data.
Relevant References and Guidelines	• Hook et al 2016 Oil Spill Monitoring Handbook. • ANZECC & ARMCANZ (2000) Fresh and Marine Water Guidelines (including ISQC sediments).

3.2.7 OMS7 Strategy: Marine Fauna Surveillance

Strategy Component	Description
Monitoring Performance Outcomes	Conduct fauna surveillance to: • Provide a rapid assessment of the presence, type and location of oiled marine fauna • Inform response planning and operations, including oiled wildlife response strategies • Inform the implementation scientific monitoring in accordance with this OSMP.
Performance Standards	**Measurement Criteria**
1: Readiness to implement OMS7 Marine Fauna Surveillance program.	1a: PI and TS to be sourced from pool of resources under existing contracts (1b: PI to maintain a database of vessel and aircraft service providers

2: Acquisition of marine fauna survey data during the hydrocarbon release.	2a: Collection and analysis of marine fauna data from priority sensitive locations and predicted impact and reference sites, as per the SIP by the TS. TS to store / archive field records. 2b: PI to provide data (within 1 day for in-situ data) to EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC and other PIs. The monitoring data could be used for consideration of hazing activities to prevent the oiling of marine megafauna. A license would be required before any hazing activities could be undertaken.
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	Field Termination: • Any related scientific monitoring studies have been initiated by the IC (or delegate) **and** • The IC (or delegate) considers that continuation of monitoring under OMS7 will not result in a change to the scale or location of active response options **or** • The IC (or delegate) has advised that agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the response **or** • The IC (or delegate) has advised that continuation of monitoring under OMS7 may increase overall environmental impact Study Termination: Approval of OMS7 Close-Out Report and Database by the PSC (or delegate).
Timing	• Where required, external service providers have been activated within 4 hours of the initiation criteria being met. • Where required, an initial SAP to be available within 12 hours of initiation criteria being met • Field surveys to commence within 24 hours of initiation criteria being met. Note: the initial SAP may be revised as required due to the nature of an ongoing spill event, changing operational requirements and/or results from data collected to date. Note: timing of mobilisation and field surveys is dependent on safe operating conditions (e.g. weather, sea state, etc.) and operational access to sites.
Study Implementation Plan	OMS7 (Marine Fauna Surveillance)
Monitoring Design	The following are monitoring designs recommended: • Gradient approach • Grid approach Final design will be confirmed during preparation of the SAP by the TS.
Sampling Technique	The following types of sampling may be implemented under OMS7: • Manned surveillance: o Aerial observations from fixed-wing or helicopter, o Vessel-based observations, o Opportunistic / incidental observations. • Unmanned surveillance: o UAV and/or satellite.
Sampling Frequency	As determined by the PI in consultation with the IMT EUL (or delegate)
Parameters	The following types of parameters may be analysed under OMS7: • Abundance (adults, juveniles, fledging/hatchling etc)

	• Density • Distribution • State (e.g. evidence of stress, oil cover, injured etc.)
Competencies	• PI with significant experience in marine fauna management (or equivalent). Field experience in managing marine fauna surveys (aerial, boat-based, telemetry, acoustic). Experience in leading marine mega-fauna technical studies and reporting. • TS (vessel and aerial-based) will include experienced and qualified marine zoologists with at least five years' experience in surveys of marine mega-fauna. • TS (office) to be experienced marine mega-fauna analysts for SMS6 office-based analyses. • Commercial certified / surveyed plant (vessels and aircraft). • CVs to be kept on file.
Reporting	• Daily Study OMS7 reports on fauna surveillance and observations. • Final Study OMS7 Report within 4 weeks after cessation of monitoring activities.
Review and Auditing	• Field and data QA/QC procedures. • Annual internal review of Strategy OMS5 SIP (methodology, procedures, processes, records, reporting and QA/QC) by EUL (or delegate); • Any non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	<u>IC:</u> • Overall responsibility for implementation of the Strategy and implementation plan. <u>PSC:</u> • Interface between IC and EUL. • Facilitates field monitoring. • Disseminate OMS7 information to response team <u>EUL (or delegate):</u> • Day-to-day coordination and review of the study results. • Compliance with OMS5 SIP requirements. • Carry out periodic internal reviews of SIP. • Oversee external audits. • Communications with NOPSEMA's Environment Division. • Provide advice to the IC and PSC. <u>PI:</u> • Plan, coordinate and implement OMS5 survey. • Review, approve and disseminate water quality monitoring information. • Daily communications with EUL (or delegate) and TS. • Advise EUL (or delegate). • Review daily pro-forma, interim and final reports. <u>TS:</u> • Undertake monitoring activities. • Carry out data analyses. • Prepare reports, including water quality survey reports and final report. • Store and archive data.
Relevant References and Guidelines	• Oil Spill Monitoring Handbook (Hook et al, 2016).

	• DoEE (2017). Australian National Guidelines for Whale and Dolphin Watching. • Recovery Plan for Marine Turtles in Australia, 2017-2027.

3.2.8 OMS8 Strategy: Fish Tainting Assessment

Strategy Component	Description
Monitoring Performance Outcomes	Conduct surveillance and sampling to: • Provide an assessment of the potential of fish tainting in areas of recreational and/or commercial fisheries • Inform response planning and operations • Inform the implementation of scientific monitoring in accordance with this OSMP.
Performance Standards	**Measurement Criteria**
1: Readiness to implement OMS8 program.	1a: PI and TS to be sourced from pool of resources under existing contracts (. 1b: PI to maintain a database of vessel service provider. 1c: PI to maintain a database of accredited laboratories (e.g. CSIRO) for analysis of fish tissue samples, and of suitably experienced olfactory analysts.
2: Acquisition and dissemination of fish tainting data during the hydrocarbon release.	2a: Collection and analysis of representative commercial and recreational fish species to determine the presence of tainting. Where possible, samples will be obtained from commercial catches at point of landing. BP will liaise with the DAFWA and / or AFMA regarding sampling and analysis of commercial fish stock. TS to store/archive field records. 2b: Olfactory analysis of fish samples by suitably quailed analysts. CoC to confirm sample collection. Documents stored / archived by TS. 2c: Laboratory analysis of fish samples at accredited laboratory (e.g. CSIRO). CoC to confirm sample collection, transport to appropriate laboratories, and sample receipt notification from the accredited laboratory to confirm arrival of fish samples within holding times. Documents stored / archived by TS. 2c: Laboratory Analysis Report issued by accredited laboratory with analysis techniques as defined in SIP (within 3 weeks of sample collection) and stored / archived by TS. 2d: PI to provide data (within 1 day for in-situ data, and 1 week of receipt of Laboratory Analysis Report for analytical data) to EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC and other PIs.
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 offshore oil spill has occurred and data from OMS1 and OMS2 indicates potential and/or actual exposure to known fishing grounds, **or** • Allegations of damage are received from commercial fisheries or government agencies, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	<u>Field Termination</u>: • Any related scientific monitoring studies have been initiated by the IC (or delegate) **and** • The IC (or delegate) considers that continuation of monitoring under OMS8 will not result in a change to the scale or location of active response options **or** • The IC (or delegate) has advised that agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the response **or**

	• The IC (or delegate) has advised that continuation of monitoring under OMS8 may increase overall environmental impact Study Termination: Approval of OMS8 Close-Out Report and Database by the PSC (or delegate).
Timing	• Where required, external service providers have been activated within 4 hours of the initiation criteria being met. • Where required, an initial SAP to be available within 12 hours of initiation criteria being met • Field surveys to commence within 24 hours of initiation criteria being met. Note: the initial SAP may be revised as required due to the nature of an ongoing spill event, changing operational requirements and/or results from data collected to date Note: timing of mobilisation and field surveys is dependent on safe operating conditions (e.g. weather, sea state, etc.) and operational access to sites.
Study Implementation Plan	OMS8 (Fish Tainting Assessment)
Monitoring Design	The following are monitoring designs recommended: • Gradient approach • Grid approach Final design will be confirmed during preparation of the SAP by the TS.

Sampling Technique	The following types of sampling may be implemented under OMS8:
	• Systematic fish sample collection:
	  ○ Olfactory evaluation,
	  ○ Tissue collection.
	• Opportunistic carcass collection and tissue sampling.

Sampling Frequency	As determined by the PI in consultation with the IMT EUL (or delegate)
Parameters	The following types of parameters may be analysed under OMS8: • Odour and appearance, • Chemical analysis of tissue samples (e.g. TRH, BTEX, PAH, MAH).
Competencies	• PI will be a fisheries scientist with at least 5 years professional experience in epidemiological studies of marine fish and aquaculture species (or equivalent). • TS (field) sampling teams include experienced and qualified marine scientists with experience in the collection of fish samples. • Olfactory analysis must be led by a scientist experienced in the use of the duo-trio method. • TS (office) to be experienced fish analysts for SMS7 office-based analyses. • CVs to be kept on file. • Laboratory services will be NATA accredited.
Reporting	• Daily Study OMS8 reports on sampling and observations. • Final Study OMS8 Report within 4 weeks after cessation of monitoring activities.
Review and Auditing	• Field and data QA/QC procedures. • CoC documentation for samples. • Laboratory QA/QC sample analysis. • Annual internal review of Strategy OMS8 SIP (methodology, procedures, processes, records, reporting and QA/QC) by EUL (or delegate); • Any non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.

Responsibilities	IC: • Overall responsibility for implementation of the OMS8 Strategy and implementation plan. PSC: • Interface between IC and EUL. • Facilitates field monitoring. • Disseminate OMS8 information to response team EUL (or delegate): • Day-to-day coordination and review of the study results. • Compliance with OMS5 SIP requirements. • Carry out periodic internal reviews of SIP. • Oversee external audits. • Communications with NOPSEMA's Environment Division and DPIRD. • Provide advice to the IC and PSC. PI: • Plan, coordinate and implement OMS8 survey. • Review, approve and disseminate fish taint monitoring information. • Daily communications with EUL (or delegate) and TS. • Advise EUL (or delegate). • Review daily pro-forma, interim and final reports TS: • Coordinate fish sampling at home ports where appropriate. • Undertake fish sampling activities. • Coordination of laboratories and transport of samples to laboratories. • Perform data analyses. • Prepare reports including interim survey and final report. • Store and archive data.
Relevant References and Guidelines	• Hook et al 2016 Oil Spill Monitoring Handbook. • ANZECC & ARMCANZ (2000) Fresh and Marine Water Guidelines • Yender et al. (2002). Managing Seafood Safety after an Oil Spill. • Reilly & York. (2001). Guidance on Sensory Testing and Monitoring of Seafood for Presence of Petroleum Taint Following an Oil Spill. • Gagnon et al. (1999). Biochemical and Chemical Parameters for Aquatic Ecosystem Health Assessments Adapted to the Australian Oil and Gas Industry.

3.2.9 OMS9 Strategy: Air Quality (Responder Health and Safety) Assessment

Strategy Component	Description
Monitoring Performance Outcomes	Conduct fauna surveillance to: • Provide a rapid assessment of the presence, type and concentration of hazardous volatile organic compounds (VOCs) • Inform response planning and operations.
Performance Standards	**Measurement Criteria**
1: Readiness to implement OMS9 air quality program.	1a: PI and TS to be sourced from pool of internal and external resources under existing contracts. 1b: PI to maintain a database of appropriate equipment providers.

2: Acquisition and dissemination of air quality data during the hydrocarbon release.	2a: Collection of air quality data from locations immediately within the vicinity of the spill source and reference sites, as per the SIP by the TS. TS to store / archive field records. 2b: PI to provide data (within 2 hours of receipt of in-situ data) to IMT Safety Officer (SOF) (or delegate). SOF (or delegate) to approve within 2 hours of submission and distribute to PSC and other PIs.
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	<u>Field Termination</u>: • The IC (or delegate) considers that continuation of monitoring under OMS9 will not result in a change to the scale or location of active response options **or** • The IC (or delegate) has advised that agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the response **or** • The IC (or delegate) has advised that continuation of monitoring under OMS9 may increase overall environmental impact <u>Study Termination</u>: Approval of OMS9 Close-Out Report and Database by the PSC (or delegate).
Timing	OMS9 is to be undertaken at the same time as any active response strategy within immediate vicinity of the spill source.
Study Implementation Plan	OMS9 (Air Quality [Responder Health and Safety] Assessment)
Monitoring Design	N/A
Sampling Technique	The following types of sampling may be implemented under OMS7: • In-situ detectors.
Sampling Frequency	Continual
Parameters	The following types of parameters may be analysed under OMS9: • VOCs and %LELs
Competencies	• PI with significant experience in air quality management and/or health and safety management (or equivalent). • TS will include experienced and qualified personnel with at least five years' experience in air quality monitoring. • Commercial certified / surveyed plant (vessels and aircraft). • CVs to be kept on file.
Reporting	• Daily Study OMS9 reports on air quality data. • Final Study OMS9 Report within 4 weeks after cessation of monitoring activities.
Review and Auditing	• Field and data QA/QC procedures. • Annual internal review of Strategy OMS9 SIP (methodology, procedures, processes, records, reporting and QA/QC) by SOF (or delegate); • Any non-conformances recorded with follow-up by SOF (or delegate) within 2 weeks.
Responsibilities	<u>IC:</u> • Overall responsibility for implementation of the Strategy and implementation plan. <u>PSC:</u> • Interface between IC and SOF.

	• Facilitates field monitoring. • Disseminate OMS9 information to response team EUL (or delegate): • Day-to-day coordination and review of the study results. • Compliance with OMS9 SIP requirements. • Carry out periodic internal reviews of SIP. • Oversee external audits. • Communications with NOPSEMA's Environment Division. • Provide advice to the IC and PSC. PI: • Plan, coordinate and implement OMS9 survey. • Review, approve and disseminate water quality monitoring information. • Daily communications with SOF (or delegate) and TS. • Advise SOF (or delegate). • Review daily pro-forma, interim and final reports. TS: • Undertake monitoring activities. • Carry out data analyses. • Prepare reports, including water quality survey reports and final report. • Store and archive data.
Relevant References and Guidelines	• Oil Spill Monitoring Handbook (Hook et al, 2016). • Workplace Exposure Standards for Airborne Contaminants (Safe Work Australia 2018)

3.3 Scientific Monitoring Strategies

As noted in Section 1.4, the aim of the SMSs is to quantify the nature of extent, severity and persistence of environmental impacts from a significant spill event (from both the spill and any response activities) and inform appropriate remediation activities. Upon notification of a Level 2 or Level 3 spill incident, the BP Incident Commander (or delegate) will initiate the Scientific Monitoring Program where outcomes of the Monitoring and Evaluation Strategy (MES) and/or data from the Operational Monitoring Strategies indicate that the SMS strategies are warranted. The strategy for each SMS is provided in this section together with a reference to their respective implementation plans.

The SMS strategies outlined in this section include:

- SMS1 – Ecotoxicology Assessment of Hydrocarbons.
- SMS2 – Water Quality Monitoring.
- SMS3 – Sediment Quality Monitoring.
- SMS4 – Benthic Habitat Monitoring.
- SMS5 – Seabird Population Monitoring.
- SMS6 – Marine Megafauna Surveys.
- SMS7 – Hydrocarbon Monitoring of Representative Commercial and Recreational Fish Species.
- SMS8 – Hind-cast Modelling for Impact Assessment.
- SMS9 – Socio-Economic Surveys.

3.3.1 SMS1 Strategy: Ecotoxicology Assessment of Hydrocarbons

Strategy Component	Description
Monitoring Performance Outcomes	Undertake eco-toxicological studies to establish hydrocarbon exposure thresholds for sensitive biotic receptors to assist with the assessment of impacts to environmental sensitivities affected by the spill. This is used to: • Define hydrocarbon eco-toxicities and subsequent contribution to changes in the marine environment from unplanned hydrocarbon releases; • Reduce the range of uncertainty of impacts to fauna and initiation and termination criteria of other scientific monitoring strategies; • Contribute to publicly available hydrocarbon exposure thresholds so information can be utilized by the oil and gas industry for future environmental assessments of hydrocarbon spills.
Performance Standards	**Measurement Criteria**
1: Readiness to implement SMS1 monitoring program.	1a: PI and TS to be sourced from pool of resources under existing contracts. 1b: PI to maintain a database of appropriate services providers, including vessels. 1c: PI has arrangement in place with experienced ecotoxicology laboratory (e.g. SINTEF and NATA accredited ALS).
2: Acquisition of hydrocarbon samples.	2a: When safe to do so (taking into consideration the volatility of hydrocarbon), TS to collect hydrocarbon samples from the surface in proximity of the release. Field records stored / archived. Note: sampling may occur coincidentally with OMS3 sampling. 2b: CoC to confirm samples transported and received by laboratories, and Sample Receipt Notifications to confirm arrival at laboratories.

3: Determination of hydrocarbon exposure threshold.	3a: Report issued by ecotoxicology laboratory providing industry standard exposure thresholds for a number of relevant indicator organisms for hydrocarbon.
4. Characterisation of composition of released hydrocarbon.	4a: Report issued by NATA-accredited laboratory detailing hydrocarbon composition of samples used in ecotoxicology assessment.
5. Exposure threshold values made available to industry.	5a: PI to provide EUL (or delegate) with SMS1 Scientific Monitoring Final Report within 4 weeks of Ecotoxicology Laboratory Report. EUL (or delegate) after consultation with Commonwealth DAWE, NOPSEMA and WA DoT to approve SMS1 Scientific Monitoring Final Report within 4 weeks of submission by PI.
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred **and** data from the OMS1 and/or OMS5 has confirmed exposure to offshore or intertidal waters, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	The EUL (or delegate) will terminate the study when, in consultation with NOPSEMA, AMOSC, AMSA and WA DoT: • Laboratory toxicity testing has established the risk of environmental damage caused by the hydrocarbon release; and • Independent scientific specialists have reached agreement that the result of the testing provides a satisfactory exposure threshold for hydrocarbon.
Timing	• External service providers have been activated within 24 hours of the initiation criteria being met, • A draft SAP, prepared by the TS, to be available within 48 hours of the initiation criteria being met, • Consultation with relevant agencies to commence as soon as practicable after initiation criteria being met, • Field surveys to commence within 72 hours of initiation criteria being met. Note: the draft SAP may be revised as required due to the nature of an ongoing spill event, changing operational requirements and/or results from data collected to date. Note: timing of mobilisation and field surveys is dependent on safe operating conditions (e.g. weather, sea state, etc.) and operational access to sites.

Sampling Techniques	Sampling techniques will vary depending on the individual event and final monitoring design. The following types of sampling may be implemented under SMS1:
	• Surface water sample collection:
	  ○ Sampling pole with container,
	  ○ Hose with peristaltic pump.
	• Sub-surface water sample collection:
	  ○ Niskin bottle (or similar),
	  ○ Hose with peristaltic pump.

Parameters	Sampling parameters will vary depending on the individual event and final monitoring design. The following types of parameters may be analysed under SMS1: • Oil concentrations (e.g. TRH, BTEX, PAH, MAH), • Dispersant chemicals (if applied). • Ecotoxicity values (e.g. LC50, PNEC)
Competencies	• PI will be an experienced and qualified eco-toxicologist with at least 10 years' experience in eco-toxicological assessment including hydrocarbons (or equivalent).

	• TS (field) to be experienced marine scientist or technicians with appropriate training and field experience in vessel-based water quality monitoring. Trained in vessel-based water quality monitoring. • CVs to be kept on file. • Laboratory services with NATA certification. • Nationally recognized ecotoxicology laboratory for exposure value determination of hydrocarbon (e.g. SINTEF and NATA accredited ALS). • Commercial certified / surveyed plant (vessels and aircraft).
Reporting	• Laboratory Analysis Report of hydrocarbon chemical composition within 7 weeks of spill. • Ecotoxicology Laboratory Report of exposure hydrocarbon threshold within 10 weeks of spill. • SMS1 Final Report within 2 weeks of receiving eco-toxicological laboratory report.
Review and Auditing	• Chain of Custody Documentation for Samples. • QA/QC sample analysis. • Validation and checking of laboratory results. • Annual internal review of SMS1 strategy implementation plan (methodology, procedures, processes, records, reporting and QA/QC) by EUL (or delegate). • Any non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	IC: • Overall responsibility for implementation of SMS1. PSC: • Facilitate in the collection of hydrocarbon samples. EUL: • Compliance with SMS1 implementation plan requirements. • Carry out periodic internal reviews of implementation plan. • Day-to-day coordination and review of study results. • Oversee external audits. • Approve and provide compliance reporting requirements. • Approve the SMS1 Final Report. • Provide advice with respect to environmental issues as required to the IC and PSC. • Communications with NOPSEMA's Environment Division, AMSA, and WA DoT. PI: • Daily implementation of this implementation plan. • Plan, coordinate and implement ecotoxicology assessment of hydrocarbon. • Review, approve and disseminate hydrocarbon monitoring information and SMS1 final report. • Communications between TS and EUL (or delegate). • Provide advice as required to the EUL (or delegate). TS: • Undertake hydrocarbon monitoring activities. • Coordinate laboratories, storage and transport of samples. • Carry out data analysis and reporting. • Store and archive data.
Relevant References and Guidelines	Hook et al 2016 Oil Spill Monitoring Handbook.

	Australian and New Zealand Water Quality Guidelines for Fresh and Marine Waters Quality, ANZECC & ARMCANZ (2000).

3.3.2 SMS2 Strategy: Water Quality Monitoring

Strategy Component	Description
Monitoring Performance Outcomes	Monitor hydrocarbons in marine waters at subtidal and offshore intertidal impact sites (which may include where relevant: priority/sensitive locations, State or Commonwealth marine protected areas, pelagic sites, commercial fishery areas) and reference sites to support the assessment of environmental impacts and recovery. This will be used for: • Determining the impact and recovery of water quality from the oil spill and/or any response activities, • Determining if any remediation actions may be required, • Provide data to validate hind-cast modelling confidence of the fate and transport of hydrocarbons.
Performance Standards	**Measurement Criteria**
1: Readiness to implement SMS2 program.	1a: PI and TS to be sourced from pool of resources under existing contracts. 1b: PI to maintain a database of appropriate service providers, including vessels.
2: Reactive baseline monitoring and establishment of monitoring sites	2a: PI to consider outputs from OMS1 and OMS2 to prioritise sensitive priority areas for the establishment of monitoring sites and gathering reactive monitoring data. 2b: PI and TS to establish locations for monitoring sites within sensitive priority areas as well as at least one independent reference area 2c: TS to undertake surveys, and appropriately store/archive field records, photos, video and other data. 2d: PI to provide Reactive Baseline Survey chapter of the Baseline Report (within 6 weeks of reactive baseline survey completion) to the EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC.
3: Appropriate collection, transport and analysis of water samples.	3a: TS to collect and store water samples, and keep field records (e.g. field book, checklists) as per the SMS2 implementation plan. CoC to confirm sample collection, transport to appropriate laboratories, and sample receipt notification from the NATA-accredited laboratory (e.g. ALS) to confirm arrival of water samples within holding times. Documents stored / archived by TS. 3b: Laboratory Analysis Report issued by NATA-accredited laboratory with analyte list defined in the implementation plan (within 3 weeks of sample collection) and stored by TS.
4: Acquisition and dissemination of existing water quality baseline data for hydrocarbons in water.	4a: TS collects water quality data as soon as possible at sensitive priority areas, commercial fishery areas, pelagic sites and reference sites as per the implementation plan. TS store / archive field records. 4b: PI to provide Baseline Data chapter of Baseline Report within 8 weeks of hydrocarbon release) to EUL (or delegate). EUL (or delegate) to approve within 2 weeks of submission and distribute to PSC and other PIs.
5: Acquisition of hydrocarbon data from marine waters during the hydrocarbon release and for 3 months after the cessation of the release.	5a: Collection and analysis of hydrocarbon concentrations in marine waters as prescribed in the SMS2 implementation plan by TS during the hydrocarbon release and for 3 months after the cessation of the hydrocarbon release. 5b: PI to provide a short report for each survey (within 1 week of receipt of Laboratory Analysis Report) to EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC and other PIs.
6: Provision of hydrocarbon monitoring of marine waters dataset to SMS8 for Hind-cast Modelling.	6a: PI responsible for provision of SMS2 dataset to PI of SMS8 (Hind-cast Modelling Impact Assessment) to serve as a validation data of hydrocarbon concentrations in marine waters at monitored sites within 4 weeks of cessation of unplanned hydrocarbon releases.

7: Revise implementation plan for long-term monitoring phase of hydrocarbons in water after the cessation of the hydrocarbon release and carry out long-term monitoring phase.	7a: PI to consider final information / results from SMS8 (Hind-cast Modelling for Impact Assessment) in the revision of the implementation plan for the long-term monitoring phase of hydrocarbons in marine waters after the cessation of the hydrocarbon release. Recommendation provided as a brief memorandum to participants for the SMS8 Hind-cast Modelling workshop within 3 months after cessation of hydrocarbon release. 7b: PI revises SMS2 SIP for long-term monitoring phase of hydrocarbons in water within 3 months after cessation of hydrocarbon releases and provides to EUL (or delegate). EUL (or delegate) to approve revision to SMS2 implementation plan for long-term monitoring phase of hydrocarbons in marine waters within 8 weeks of submission after consultation with DAWE, NOPSEMA and WA DoT; and disseminates to TS. 7c: PI responsible for implementation of Long-Term Monitoring Phase of the SMS2 SIP.
8: Assess impact of hydrocarbons in marine waters	8a: PI responsible to assess the impact of hydrocarbons in marine waters within survey (single survey), annual (data to date, EP reporting commitment) and final (all data) reports relative to the established baseline condition and the reference sites as prescribed in the SMS2 SIP. 8b: PI to prepare and to provide EUL (or delegate) with a SMS2 Chapter for Annual Scientific Monitoring Reports as specified by the EUL (or delegate) each year and the SMS2 Hydrocarbons in Marine Sediments Scientific Monitoring Final Report within 8 weeks of field termination. EUL (or delegate) after consultation with DAWE, NOPSEMA and WA DoT to approve Final Hydrocarbons in Marine Sediments Report within 3 months of field termination for dissemination.
9: Regulatory compliance reporting.	9a: EUL (or delegate) to provide regulators (NOPSEMA, WA DoT and DAWE) with Annual Scientific Monitoring Reports that includes a SMS2 Chapter and SMS2 Water Quality Scientific Monitoring Final Report within 4 weeks of approval by the EUL (or delegate).
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred **and** data from the OMS1 and/or OMS5 has confirmed exposure to offshore or intertidal waters, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	<u>Field Study Termination:</u> The PSC or EUL (or delegate) will terminate the study when, in consultation with NOPSEMA, WA DoT and DAWE: • Hydrocarbon concentrations and/or relevant water quality parameters (e.g. chemicals from dispersant) in offshore waters have returned to within the natural dynamics of baseline state and/or control sites, **or** • Hydrocarbon concentrations and/or relevant water quality parameters (e.g. chemicals from dispersant) in offshore waters are below relevant ANZG (2018) 99% species protection levels or other applicable benchmark values, **or** • The IC (or delegate) has advised that agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the monitoring, **and** • The PSC or EUL (or delegate) in conjunction with relevant government agency, considers that water quality values within protected areas (i.e. Australian Marine Parks, Ramsar wetlands or State marine protected areas) have not been impacted or have returned to within the natural dynamics of baseline state. <u>Study Termination:</u> Submission and approval of SMS2 Final Report.
Timing	• External service providers have been activated within 24 hours of the initiation criteria being met, • A draft SAP, prepared by the TS, to be available within 48 hours of the initiation criteria being met,

<table>
<tr><td></td><td colspan="2">

Consultation with relevant agencies to commence as soon as practicable after initiation criteria being met,
Field surveys to commence within 72 hours of initiation criteria being met.

Note: the draft SAP may be revised as required due to the nature of an ongoing spill event, changing operational requirements and/or results from data collected to date.
Note: timing of mobilisation and field surveys is dependent on safe operating conditions (e.g. weather, sea state, etc.) and operational access to sites.
</td></tr>
<tr><td rowspan="6">Monitoring Design</td><td colspan="2">The following are monitoring designs recommended for different spill extents/behaviour; final design will be confirmed during preparation of the SAP by the Technical Specialist/s.</td></tr>
<tr><td>Spill Extent / Behaviour</td><td>Monitoring Design</td></tr>
<tr><td>Spill plume concentrated around source, dissipating with distance</td><td>Gradient approach</td></tr>
<tr><td>Spill plume has dissipated away from source</td><td>Gradient approach
Lines of Evidence</td></tr>
<tr><td>Nearshore spill or spill reaches shoreline</td><td>BACI (if appropriate baseline data available)
IvC
Gradient approach</td></tr>
<tr><td>Spill interacts with area of biological importance (e.g. bay/shoal/island)</td><td>BACI (if appropriate baseline data available)
IvC</td></tr>
<tr><td>Sampling Techniques</td><td colspan="2">Sampling techniques will vary depending on the individual event and final monitoring design. The following types of sampling may be implemented under SMS2:

Surface water sample collection:
Sampling pole with container,
Hose with peristaltic pump.
Sub-surface water sample collection:
Niskin bottle (or similar),
Hose with peristaltic pump.
In-situ profiles:
Physio-chemical profiles,
Fluorometer.
</td></tr>
<tr><td>Sampling Frequency</td><td colspan="2">
Initial sampling frequency will be determined by during preparation of the SAP by the Technical Specialist/s.
Ongoing sampling frequency will be determined by the Technical Specialist/s in consultation with the EUL following each monitoring and reporting event.
</td></tr>
<tr><td>Parameters</td><td colspan="2">Sampling parameters will vary depending on the individual event and final monitoring design. The following types of parameters may be analysed under SMS2:

Oil concentrations (e.g. TRH, BTEX, PAH, MAH),
Physical parameters (e.g. temperature, salinity, DO, pH),
Fluorescence,
Dispersant chemicals (if applied).
</td></tr>
<tr><td>Competencies</td><td colspan="2">PI to be an experienced and qualified water quality scientist with field experience in vessel-based water quality monitoring (or equivalent).</td></tr>
</table>

	• TS (field) to be experienced marine scientists or technicians with appropriate training and experienced in water quality sampling. • TS (office) to be experienced water quality analysts for SMS3 office-based analyses. • Laboratory services with NATA accreditation. • CVs to be kept on file. • Commercial certified / surveyed plant (vessels).
Reporting	PI and TS responsible for the preparation, and EUL (or delegate) responsible for the approval and dissemination of the following: • SMS2 implementation plan. • SMS2 Reactive Baseline Survey and Baseline Data Report. • SMS2 Survey Reports. • Long-Term Monitoring Phase Study revision of SMS2 implementation plan. • SMS2 Final Report.
Review and Auditing	• Chain of Custody Documentation for Samples. • Laboratory QA/QC sample analysis. • Annual internal review of Strategy SMS2 implementation plan (methodology, procedures, processes, records, reporting and QA/QC) by EUL (or delegate); • Any non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	IC: • Overall responsibility for implementation of the SMS2 Strategy and implementation plan. PSC: • Facilitate of water quality sampling in areas contacted by the hydrocarbon. EUL (or delegate): • Ongoing review and approval of the SMS2 implementation plan long-term monitoring phase revision of the implementation plan. • Compliance with SMS2 implementation plan requirements. • Day-to day coordination and review of monitoring results. • Carry out periodic internal reviews of implementation plan. • Oversee external audits • Communications with NOPSEMA's Environment Division, DAWE, Department of Water and Environmental Regulation and Department of Transport. • Approve and provide compliance reporting requirements. • Approve Hydrocarbon Monitoring of Marine Waters Final Report. • Provide advice to IC and PSC as required. PI: • Daily implementation of this implementation plan. • Plan, coordinate and implement daily water quality survey. • Review, approve and disseminate water quality monitoring information. • Daily communications between TS and EUL (or delegate). • Review Water Survey Reports, Baseline Report, and Hydrocarbon Monitoring of Marine Waters Final Report. • Provide advice as required to EUL (or delegate). TS: • Undertake water quality monitoring activities. • Coordinate laboratories. • Carry out data analyses.

	• Prepare reports, including water quality survey reports and final report. • Store and archive data.
Relevant References and Guidelines	Hook et al 2016 Oil Spill Monitoring Handbook. Australian and New Zealand Water Quality Guidelines for Fresh and Marine Waters Quality, ANZECC & ARMCANZ (2000).

3.3.3 SMS3 Strategy: Sediment Quality Monitoring

Strategy Component	Description
Monitoring Performance Outcomes	Monitor hydrocarbons in marine sediments at subtidal (rocky reef), pelagic sites, commercial fishery areas and reference sites to support assessment of environmental impacts and recovery. This will be used for: • Determining the impact and recovery of sediment quality from the oil spill and/or any response activities, • Determining if any remediation actions may be required, • To provide data to validate hind-cast modelling confidence of the sedimentation of hydrocarbons onto the seabed.
Performance Standards	**Measurement Criteria**
1: Readiness to implement Sc4 Hydrocarbon Monitoring in Marine Waters program.	1a: PI and TS to be sourced from pool of resources under existing contracts (). 1b: PI to maintain a database of appropriate service providers, including vessels.
2: Reactive baseline monitoring and establishment of monitoring sites	2a: PI to consider outputs from OMS1 and OMS2 to prioritise sensitive priority areas for the establishment of monitoring sites and gathering reactive monitoring data. 2b: PI and TS to establish locations for monitoring sites within sensitive priority areas as well as at least one independent reference area 2c: TS to undertake surveys, and appropriately store/archive field records, photos, video and other data. 2d: PI to provide Reactive Baseline Survey chapter of the Baseline Report (within 6 weeks of reactive baseline survey completion) to the EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC.
3: Appropriate collection, transport and analysis of sediment samples.	3a: Technical specialist to collect and store sediment samples, and keep field records (e.g., field book, checklists) as per the SMS3 implementation plan. CoC to confirm sample collection, transport to appropriate laboratories, and sample receipt notification from the NATA-accredited laboratory (e.g., ALS) to confirm arrival of sediment samples within holding times. Documents stored / archived by TS. 3b: Laboratory Analysis Report issued by NATA-accredited laboratory with analyte list defined in the implementation plan (within 3 weeks of sample collection) and stored / archived by TS.
4: Acquisition and dissemination of existing baseline data for hydrocarbons in sediments.	4a: Technical specialist to collect sediment quality data from the seabed at subtidal (rocky reef) and intertidal (sandy beaches) locations, pelagic sites, commercial fishery areas and reference sites within 1 week of hydrocarbon release. Technical specialist store/archive field records and CoC. 4b: PI to provide Baseline Data chapter of Baseline Report (within 8 weeks of hydrocarbon release) to EUL (or delegate). EUL (or delegate) to approve within 2 weeks of submission and distribute to PSC and other PIs.
5: Acquisition of routine hydrocarbon data in marine sediments during the hydrocarbon release and for 3 months after the cessation of hydrocarbon release.	5a: Collection and analysis of hydrocarbon concentrations in sediments as prescribed in the SMS3 implementation plan by Technical specialist during the hydrocarbon release and for 9 months after the cessation of hydrocarbon releases.

	5b: PI to provide a short data report summarising each field survey (within 4 weeks of completion of each survey) to EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC and other PIs.
6. Provision of hydrocarbon monitoring of marine sediments dataset to Study Sc8 for Hind-cast Modelling Impact Assessment.	6a: PI responsible for provision of SMS3 dataset to PI of SMS8 Hind-cast Modelling Impact Assessment to serve as a validation data set for sedimentation of hydrocarbons onto the sea bottom at priority sensitive locations, pelagic sites and reference sites within 4 weeks of termination of unplanned hydrocarbon release.
7: Revise implementation plan for long-term monitoring phase of hydrocarbons in sediments after the hydrocarbon release and carry out long-term monitoring phase.	7a: PI to consider final information/results from SMS8 (Hind-cast Modelling for Impact Assessment) in the revision of the implementation plan for the long-term monitoring phase of hydrocarbons in sediments after cessation of the hydrocarbon release. 7b: PI revises SMS3 implementation plan for long-term monitoring phase of hydrocarbons in sediments (within 4 weeks after SMS8 Final Report approval). EUL (or delegate) to approve revision to SMS4 implementation plan for long-term monitoring phase of hydrocarbons in sediments within 8 weeks of submission after consultation with DAWE, NOPSEMA and WA DoT; and disseminates to TS. 7c: PI responsible for implementation of Long-Term Monitoring Phase of SMS4 implementation plan.
8: Assess impact of hydrocarbons in marine sediments.	8a: PI responsible to report survey results and to assess the effect of hydrocarbons on marine sediment quality in the Survey (single survey), Annual (data to date, EP reporting commitment) and Final (all data) reports relative to the established baseline condition and the reference sites as prescribed in the SMS3 implementation plan. 8b: PI to prepare and to provide EUL (or delegate) with a SMS3 Chapter for Annual Scientific Monitoring Reports as specified by the EUL (or delegate) each year and the SMS3 Sediment Quality Scientific Monitoring Final Report within 8 weeks of field termination. EUL (or delegate) after consultation with DAWE, NOPSEMA and WA DoT to approve Final Hydrocarbons in Marine Sediments Report within 3 months of field termination for dissemination.
9: Regulatory compliance reporting	9a: EUL (or delegate) to provide regulators (NOPSEMA, WA DoT and DAWE) with Annual Scientific Monitoring Reports that includes a SMS3 chapter and the SMS3 Sediment Quality Scientific Monitoring Final Report within 4 weeks of approval by the EUL (or delegate).
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred **and** data from the OMS1 and/or OMS6 has confirmed exposure to marine sediments, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	Field Study Termination: The PSC or EUL (or delegate) will terminate the study when, in consultation with NOPSEMA, DAWE and WA DoT: • Hydrocarbon concentrations and/or relevant sediment quality parameters (e.g. chemicals from dispersant) in offshore sediments have returned to within the natural dynamics of baseline state and/or control sites, **or** • Hydrocarbon concentrations and/or relevant sediment quality parameters (e.g. chemicals from dispersant) in offshore sediments are below relevant ANZG (2018) SQGV or other applicable benchmark values, **or** • The IC (or delegate) has advised that agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the monitoring, **and** • The PSC or EUL (or delegate) in conjunction with relevant government agency, considers that sediment quality values within protected areas (i.e. Australian Marine Parks, Ramsar wetlands or State marine protected areas) have not been impacted or have returned to within the natural dynamics of baseline state.

<table>
<tr><td></td><td><u>Study Termination:</u> Submission and approval of SMS3 Final Report.</td></tr>
<tr><td>Timing</td><td>External service providers have been activated within 24 hours of the initiation criteria being met,
A draft SAP, prepared by the TS, to be available within 48 hours of the initiation criteria being met,
Consultation with relevant agencies to commence as soon as practicable after initiation criteria being met,
Field surveys to commence within 72 hours of initiation criteria being met.
Note: the draft SAP may be revised as required due to the nature of an ongoing spill event, changing operational requirements and/or results from data collected to date.
Note: timing of mobilisation and field surveys is dependent on safe operating conditions (e.g. weather, sea state, etc.) and operational access to sites.</td></tr>
<tr><td>Monitoring Design</td><td>The following are monitoring designs recommended for different spill extents/behaviour; final design will be confirmed during preparation of the SAP by the Technical Specialist/s.
<table>
<tr><th>Spill Extent / Behaviour</th><th>Monitoring Design</th></tr>
<tr><td>Spill plume concentrated around source, dissipating with distance</td><td>Gradient approach</td></tr>
<tr><td>Spill plume has dissipated away from source</td><td>Gradient approach
Lines of Evidence</td></tr>
</table></td></tr>
<tr><td>Sampling Techniques</td><td>Sampling techniques will vary depending on the individual event and final monitoring design. The following types of sampling may be implemented under SMS3:
Subtidal sample collection:
Grab or core sampler.
Sediment box.
Intertidal sample collection:
Cores or auger
Sediment box</td></tr>
<tr><td>Sampling Frequency</td><td>Initial sampling frequency will be determined by during preparation of the SAP by the Technical Specialist/s.
Ongoing sampling frequency will be determined by the Technical Specialist/s in consultation with the EUL following each monitoring and reporting event.</td></tr>
<tr><td>Parameters</td><td>Sampling parameters will vary depending on the individual event and final monitoring design. The following types of parameters may be analysed under SMS3:
Oil concentrations (e.g. TRH, BTEX, PAH, MAH),
Dispersant chemicals (if applied),
Total organic carbon,
Physical parameters (e.g. PSD).</td></tr>
<tr><td>Competencies</td><td>PI with an experienced marine scientist with at least 5 years' experience in collecting marine sediment samples (or equivalent).
TS (field) will include experienced and qualified marine scientists with field experience in vessel-based sediment and water quality monitoring.
TS (office) to be experienced sediment quality analysts for SMS4 office-based analysis.
Laboratory services will be NATA certified.
CVs to be kept on file.
Commercial certified / surveyed plant (vessels).</td></tr>
</table>

Reporting	PI and TS responsible for the preparation, and EUL (or delegate) responsible for the approval and dissemination of the following: • SMS3 (Hydrocarbon Monitoring in Marine Sediments) implementation plan. • SMS3 Monitoring Hydrocarbons in Sediments Baseline Report within two seeks of spill. • SMS3 Survey Reports within one month of completion. • Long-Term Monitoring Phase Study revision of SMS4 implementation plan within one month of final survey completion. • SMS3 Chapter in Annual Reports. • SMS3 Final Report one month after study termination
Review and Auditing	• NATA Accredited laboratory services. • Chain of Custody Documentation for Samples. • Annual internal review of Strategy SMS3 implementation plan (methodology, procedures, processes, records, reporting and QA / QC) by EUL (or delegate). • Any non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	<u>IC:</u> • Overall responsibility for implementation of the strategy and implementation plan. <u>PSC:</u> • Facilitate sediment quality sampling in areas of active response measures during the hydrocarbon release. <u>EUL (or delegate):</u> • Ongoing review and approval of the SMS3 implementation plan and the long-term monitoring phase revision of the implementation plan. • Compliance with SMS3 implementation plan requirements. • Day-to-day coordination and review of monitoring results. • Carry out periodic reviews of implementation plan. • Oversee external audits • Communications with NOPSEMA's Environment Division and other regulators. • Approval and provision of any compliance reporting requirements. • Approve all reporting (Survey, Baseline, Chapter SMS4 in Annual, Final), and the Final and Long-Term Monitoring Phase implementation plans. • Provide advice to IC and PSC as required. <u>PI:</u> • Develop the long-term monitoring phase revision of the implementation plan. • Daily implementation of the implementation plan. • Plan, coordinate and implement daily Sediment Quality Survey. • Review Survey Reports, Baseline Report, SMS4 Chapters in Annual Reports, revision of implementation plan for Long term Monitoring Phase, Final Report. • Review of data provided for inputs into SMS8 Hind-cast Modelling. • Review of any compliance reports. • Provide advice as required to the EUL (or delegate). <u>TS:</u> • Undertake sediment quality monitoring activities. • Coordinate laboratories. • Carry out data analyses.

	• Prepare reports including the Hydrocarbon Monitoring in Marine Sediments Final Report. • Store and archive data.
Relevant References and Guidelines	• Hook et al 2016 Oil Spill Monitoring Handbook. • ANZECC & ARMCANZ (2000) Fresh and Marine Water Guidelines (including ISQC sediments).

3.3.4 SMS4 Strategy: Benthic Habitat Monitoring

Strategy Component	Description
Monitoring Performance Outcomes	Monitor subtidal and intertidal habitats (e.g. sponge gardens) including demersal fish and priority sensitive locations and one reference site to support the assessment of environmental impacts and recovery. This will be used to: • Quantify the distribution, abundance and community composition of marine organisms in soft sediment and hard substrate environments; • Quantify the level of exposure to affected communities; • Determine the impact and recovery of the hydrocarbon release and/or any response activities on those habitats.
Performance Standards	**Measurement Criteria**
1: Readiness to implement SMS4 program.	1a: PI and TS to be sourced from pool of resources under existing contracts (. 1b: PI to maintain a database of appropriate service providers, including vessels. 1c: PI to maintain a database of specialised monitoring equipment (e.g. video / drop cameras, side-scan sonar).
2: Reactive baseline monitoring and establishment of benthic habitat monitoring sites	2a: PI to consider outputs from OMS1 and OMS2 to prioritise sensitive priority areas for the establishment of monitoring sites and gathering reactive monitoring data. 2b: PI and TS to establish locations for monitoring sites within sensitive priority areas as well as at least one independent reference area 2c: TS to undertake surveys, and appropriately store/archive field records, photos, video and other data. 2d: PI to provide SMS4 Benthic Habitat Reactive Baseline Survey chapter of the Baseline Report (within 6 weeks of reactive baseline survey completion) to the EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC.
3: Acquisition and dissemination of existing benthic habitat baseline data.	3a: PI responsible for the acquisition of existing baseline sponge and macro-algae habitat and saltmarsh habitat data from various sources as per the procedure in the SMS4 implementation plan to establish the baseline dataset. 3b: PI to provide Baseline Data chapter of Baseline Report (within 8 weeks of hydrocarbon release) to EUL (or delegate). EUL (or delegate) to approve within 2 weeks of submission and distribute to PSC and other PIs.
4: Acquisition of routine benthic habitat surveys during the hydrocarbon release and for 3 months after the cessation of hydrocarbon releases	4a: Technical specialist to routinely carry out scientific surveys of benthic habitat sites at priority sensitive locations and reference site as prescribed in the SMS4 implementation plan during the hydrocarbon release and for 3 months after the cessation of the hydrocarbon release. Field records, photos, video and other data to be stored/archived. 4b: PI to provide a short report for each survey (within 4 weeks of completion of field survey) to EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC and other PIs.
5: Revise implementation plan for long-term monitoring phase of benthic habitats after the	5a: PI to consider final information / results from SMS8 (Hind-cast Modelling for Impact Assessment) in the revision of the implementation plan for the long-term monitoring phase of benthic habitats after cessation of the hydrocarbon release.

hydrocarbon release and carry out long-term monitoring phase	5b: PI revises SMS4 implementation plan for long-term monitoring phase of benthic habitats (within 4 weeks after SMS8 Final Report is approved) and provides to EUL (or delegate). EUL (or delegate) to approve revision to SMS4 implementation plan for long-term monitoring phase of benthic habitats within 4 weeks of submission after consultation with DAWE, NOPSEMA and WA DoT; and disseminates to TS. 5c: PI responsible for implementation of Long-Term Monitoring Phase SMS4 implementation plan.
6: Assess impact of hydrocarbon release on benthic habitats	6a: Assessment of potential impacts to habitats based on methodology in the SMS4 implementation plan and utilises SMS4 data. 6b: PI responsible to report data and to assess the impact of hydrocarbons on benthic habitats in the survey (single survey), annual (data to date, EP reporting commitment) and final (all data) reports relative to the established baseline condition and the reference sites. 6c: PI to prepare and to provide EUL (or delegate) with a SMS4 Chapter for Annual Scientific Monitoring Reports as specified by the EUL (or delegate) each year and the SMS4 Benthic Habitat Scientific Monitoring Final Report within 8 weeks of field termination. After consultation with DAWE, NOPSEMA and WA DoT, EUL (or delegate) to approve Final Benthic Habitat Report within 2 months of field termination for dissemination.
7: Regulatory compliance reporting	7a: EUL (or delegate) to provide regulators (NOPSEMA, WA DoT and DAWE) with Annual Scientific Monitoring Reports that includes a SMS4 Chapter and the SMS4 Benthic Habitat Scientific Monitoring Final Report within 4 weeks of approval by the EUL (or delegate).
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred **and** data from the OMS5, OMS6 or SMS8 has confirmed exposure to near-bottom waters or sediments, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	Field Study Termination: The PSC or EUL (or delegate) will terminate the study, in consultation with NOPSEMA, DAWE and WA DoT when: • Overall impacts to benthic habitats from hydrocarbon exposure have been quantified; • Recovery of impacted benthic habitats have been evaluated; and • Agreement with relevant stakeholders and regulators, based upon the nature and scale of the spill impacts are no longer attributable to the spill; **or** • The IC (or delegate) has advised that agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the monitoring, **and** • The PSC or EUL (or delegate) in conjunction with relevant government agency, considers that benthic habitat quality values within protected areas (i.e. Australian Marine Parks, Ramsar wetlands or State marine protected areas) have not been impacted or have returned to within the natural dynamics of baseline state. Study Termination: Submission and approval of SMS4 Final Report.
Timing	• External service providers have been activated within 24 hours of the initiation criteria being met, • A draft SAP, prepared by the TS, to be available within 48 hours of the initiation criteria being met, • Consultation with relevant agencies to commence as soon as practicable after initiation criteria being met, • Field surveys to commence within 5 days of initiation criteria being met.

<table>
<tr><td></td><td colspan="2">Note: the draft SAP may be revised as required due to the nature of an ongoing spill event, changing operational requirements and/or results from data collected to date.
Note: timing of mobilisation and field surveys is dependent on safe operating conditions (e.g. weather, sea state, etc.) and operational access to sites.</td></tr>
<tr><td rowspan="4">Monitoring Design</td><td colspan="2">The following are monitoring designs recommended for different spill extents/behaviour; final design will be confirmed during preparation of the SAP by the Technical Specialist/s.</td></tr>
<tr><td>Spill Extent / Behaviour</td><td>Monitoring Design</td></tr>
<tr><td>• Spill plume concentrated around source, dissipating with distance</td><td>• Gradient approach</td></tr>
<tr><td>• Spill plume has dissipated away from source</td><td>• Gradient approach
• Lines of Evidence</td></tr>
<tr><td>Scope</td><td colspan="2">Soft and hard substrate benthic habitats and their associated organisms covered by SMS4 include:
• Hard (scleractinian) corals, turf and coralline algae;
• Sponges and other filter feeders;
• Macroalgae (including turf and encrusting coralline algae) and seagrasses;
• Kelp;
• Large and conspicuous (i.e. epifaunal) motile invertebrates (e.g. crustaceans and molluscs).</td></tr>
<tr><td>Sampling Techniques</td><td colspan="2">Sampling techniques will vary depending on the individual event and final monitoring design. The following types of sampling may be implemented under SMS4:
• Dive / towed video / drop camera / ROV surveys:
  o Transects,
  o Quadrats,
  o Sediment grab (for soft-bottom habitat).
• Remote sensing.
• Biological sample collection.</td></tr>
<tr><td>Sampling Frequency</td><td colspan="2">• It is recommended that surveys are undertaken at least once a year (although initially this is likely to be at a greater frequency) until termination criteria are met.
• Initial sampling frequency will be determined by during preparation of the SAP by the Technical Specialist/s.
• Ongoing sampling frequency will be determined by the Technical Specialist/s in consultation with the EUL following each monitoring and reporting event.</td></tr>
<tr><td>Parameters</td><td colspan="2">Sampling parameters will vary depending on the individual event and final monitoring design. The following types of parameters may be analysed under SMS3:
• Habitat/substrate type,
• Abundance and percent cover,
• Diversity,
• Distribution,
• State (e.g. evidence of stress, necrosis, leaf condition etc.),
• Chemical analysis of tissue samples (e.g. TRH, BTEX, PAH, MAH).</td></tr>
<tr><td>Competencies</td><td colspan="2">• PI will be an experienced marine scientist with vessel-based marine benthic expertise (or equivalent).</td></tr>
</table>

	• TS will be experienced and qualified marine scientists with experience in undertaking marine benthic surveys including benthic monitoring and habitat analysis. • TS (office) to be experienced benthic habitat analysts for SMS4 office-based analysis. • Dive teams with Australian standard commercial certification. • Wet laboratory services will be required for organism sampling processing. • CVs to be kept on file. • Commercial certified / surveyed plant (vessels).
Reporting	PI and TS responsible for the preparation, and Environment Officer (or delegate) responsible for the approval and dissemination of the following: • SMS4 Benthic Habitat Monitoring implementation plan. • SMS4 Baseline Report within 2 weeks of the spill. • SMS4 Survey Reports within one month of survey completion. • Long-Term Monitoring Phase Study revision of SMS4 implementation plan within one month of final survey completion. • SMS4 Chapter in Annual Reports. • SMS4 Final Report one month after study termination.
Review and Auditing	• Random internal review of Strategy SMS4 implementation plan (methodology, procedures, processes, records, reporting and QA/QC) by EUL (or delegate) with duration between reviews no longer than 3 months. • Any non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	IC: • Overall responsibility for implementation of the strategy and implementation plan. PSC: • Facilitation of offshore benthic habitat monitoring in areas of active response measures during the hydrocarbon release. EUL (or delegate): • Ongoing review and approval of the SMS4 implementation plan and long-term monitoring phase revision of the implementation plan. • Day-to-day coordination and review of monitoring results. • Compliance with SMS4 implementation plan requirements. • Carry out periodic internal reviews • Oversee external audits of implementation plan. • Communications with NOPSEMA's Environment Division and other regulators. • Approval and provision of any compliance reporting requirements. • Approve all reporting (Survey, Baseline, Chapter SMS4 in Annual & Final), the implementation plan and revision for the Long-Term Monitoring Phase. • Provide advice to IC and PSC as required. PI: • Develop the Long-Term Monitoring Phase revision of the implementation plan. • Daily implementation of this implementation plan. • Plan, coordinate and implement daily Benthic Habitat Monitoring Survey • Daily communications between TS and EUL (or delegate) • Review all reporting (Survey Reports, Baseline Report, SMS4 Chapters in Annual Reports, Benthic Habitat Monitoring Final Report).

	• Review of any compliance reports. • Provide advice as required to the EUL (or delegate). TS: • Undertake benthic habitat monitoring activities. • Carry out data analyses. • Prepare reports including the Benthic Habitat Monitoring Final Report. • Store and archive data.
Relevant References and Guidelines	• Edgara et al. (2000) Impact of the Iron Baron oil spill on subtidal reef assemblages in Tasmania. • ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Paper No. 4 Volume 1 of National Water Quality Management Strategy • Cappo, M.; Harvey, E. S.; Shortis, M. R. Counting And Measuring Fish With Baited Video Techniques - An Overview. In: Lyle, J. M.; Furlani, D. M.; Buxton, C. D. (Ed.) . AFSB Conference And Workshop "Cutting-Edge Technologies In Fish And Fisheries Science", 2006, Hobart, Tasmani Workshop Proceedings ... Australian Society for Fish Biology, 2006 • Keough MJ and Carnell PE (2009) Ecological Performance Measures for Victorian Marine Protected Areas: Review of the existing biological sampling data Department of Zoology, University of Melbourne for Parks Victoria, Melbourne, 93pp

3.3.5 SMS5 Strategy: Seabird Population Monitoring

Strategy Component	Description
Monitoring Performance Outcomes	Monitor seabird populations to assess potential impacts to, and subsequent recovery following a hydrocarbon release. This will be used to: • Quantify the level of exposure to affected populations; • Assess any impacts to seabirds resulting from response activities; and • Determine the recovery of populations after hydrocarbon release.
Performance Standards	**Measurement Criteria**
1: Readiness to implement SMS5 Seabird Monitoring Survey program.	1a: PI and TS to be sourced from pool of resources under existing contracts (. 1b: PI to maintain a database of vessel service providers.
2: Reactive baseline monitoring and establishment of monitoring sites	2a: PI to consider outputs from OMS1 and OMS2 to prioritise sensitive priority areas for the establishment of monitoring sites and gathering reactive monitoring data. 2b: PI and TS to establish locations for monitoring sites within sensitive priority areas as well as at least one independent reference area 2c: TS to undertake surveys, and appropriately store/archive field records, photos, video and other data. 2d: PI to provide Reactive Baseline Survey chapter of the Baseline Report (within 6 weeks of reactive baseline survey completion) to the EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC.
3: Acquisition and dissemination of existing seabird population baseline data	3a: PI responsible for the acquisition of existing seabird population baseline data from various sources as per the procedure in the SMS5 implementation plan to establish the baseline dataset. 3b: PI to provide Baseline Data chapter of Baseline Report (within 8 weeks of hydrocarbon release) to EUL (or delegate). EUL (or delegate) to approve within 2 weeks of chapter submission, and distribute to PSC and other PIs.
4: Acquisition of seabird populations monitoring data	4a: Vessel-based collection and analysis of seabird population data from predicted impact and reference sites at known offshore aggregation areas, at

during the hydrocarbon release and for 3 months after the cessation of hydrocarbon release	frequencies prescribed in the SMS5 implementation plan by TS during the hydrocarbon release and for 3 months after the cessation of the hydrocarbon release. Technical specialist store / archive field records at secure site. 4b: PI to provide a short data report summarising each field survey within 4 weeks of completion of each field survey to EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC and other PIs. Potential for the use of seabird monitoring to determine if hazing should be proposed to prevent the oiling of avifauna. This would require a license if it was proposed before implementation.
5: Assess impact of hydrocarbon release on seabird populations and provision of performance reporting	5a: PI is responsible to assess and to report on monitoring of seabird populations for all vessel-based surveys (single survey), annual (data to date, EP performance report) and final (all data) reports relative to the established baseline condition and the reference sites. 5b: PI to prepare and to provide EUL (or delegate) the SMS5 Chapter for Annual Scientific Monitoring Reports as specified by the EUL (or delegate) each year and the SMS5 Seabird Population Scientific Monitoring Final Report within 8 weeks of field termination. After consultation with DAWE, NOPSEMA, WA DoT and DBCA, EUL (or delegate) to approve Final Seabird Population Monitoring Report within 3 months of field termination for dissemination.
6: Regulatory compliance reporting	6a: EUL (or delegate) to provide regulators (NOPSEMA, WA DoT and DAWE) with Annual Scientific Monitoring Reports that includes a SMS5 Chapter and the SMS5 Seabird Population Scientific Monitoring Final Report within 4 weeks of approval by the EUL (or delegate).
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred **and** data from the OMS7 has confirmed exposure to seabird population, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	<u>Field Study Termination:</u> The PSC or EUL (or delegate) will terminate the study when, in consultation with NOPSEMA, DAWE and WA DoT, DBCA: • Disturbance parameters (e.g. population size, breeding success) have returned to within the natural dynamics of baseline state and/or control sites, **or**The IC (or delegate) has advised that agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the monitoring, **and** • The PSC or EUL (or delegate) in conjunction with relevant government agency, considers that protected marine fauna (i.e. threatened or migratory species) have not been impacted or have returned to within the natural dynamics of baseline state (including any assessment against management requirements in Conservation Advices and/or Recovery Plans). • . <u>Study Termination:</u> Submission and approval of SMS5 Final Report.
Timing	• External service providers have been activated within 24 hours of the initiation criteria being met, • A draft SAP, prepared by the Technical Specialist/s, to be available within 72 hours of the initiation criteria being met, • Consultation with relevant agencies to commence as soon as practicable after initiation criteria being met, • Field surveys to commence within 5 days of initiation criteria being met. Note: the draft SAP may be revised as required due to the nature of an ongoing spill event, changing operational requirements and/or results from data collected to date. Note: timing of mobilisation and field surveys is dependent on safe operating conditions (e.g. weather, sea state, etc.) and operational access to sites.

<table>
<tr><td rowspan="3">Monitoring Design</td><td colspan="2">The following are monitoring designs recommended for different spill extents/behaviour; final design will be confirmed during preparation of the SAP by the Technical Specialist/s.</td></tr>
<tr><td>Spill Extent / Behaviour</td><td>Monitoring Design</td></tr>
<tr><td>Spill intersects with area of biological importance (e.g. foraging areas)</td><td>• BACI (if appropriate baseline data available)
• Control chart (if appropriate baseline data available)
• IvC
• Gradient approach
• Lines of Evidence</td></tr>
<tr><td>Sampling Technique</td><td colspan="2">Sampling techniques will vary depending on the individual event and final monitoring design. The following types of sampling may be implemented under SMS5:
• Systematic surveillance (e.g. transects):
  ○ Aerial observations from fixed-wing or helicopter,
  ○ Vessel-based observations.
• Unmanned surveillance:
  ○ UAV and/or satellite.
• Tissue sample collection and analysis.
• Opportunistic / incidental observations.
• Carcass collection and tissue sampling.</td></tr>
<tr><td>Sampling Frequency</td><td colspan="2">• Initial sampling frequency will be determined by during preparation of the SAP by the Technical Specialist/s.
• Ongoing sampling frequency will be determined by the Technical Specialist/s in consultation with the EUL following each monitoring and reporting event.</td></tr>
<tr><td>Parameters</td><td colspan="2">Sampling parameters will vary depending on the individual event and final monitoring design. The following types of parameters may be analysed under SMS5:
• Nest/burrow presence,
• Abundance (adults, juveniles, fledging/hatchling etc),
• Density,
• Distribution,
• State (e.g. evidence of stress, oil cover, injured etc.),
• Chemical analysis of tissue samples (e.g. TRH, BTEX, PAH, MAH),
• Presence and state of any carcass.</td></tr>
<tr><td>Competencies</td><td colspan="2">• PI will be an experienced ornithologist with at least 5 years coastal seabird experience (or equivalent); and
• TS (vessel-based) will be qualified ornithologist with experience in vessel-based and shore based monitoring activities.
• TS (office) to be experienced seabird analysts for SMS5 office-based analyses.
• Commercial certified / surveyed plant (vessels).
• CVs to be kept on file.</td></tr>
<tr><td>Reporting</td><td colspan="2">PI and TS responsible for the preparation, and EUL (or delegate) responsible for the approval and dissemination of the following:
• SMS5 (Seabird Population Monitoring) implementation plan.
• SMS5 Baseline Data Report within two weeks of a spill.
• SMS5 Survey Reports within one month of survey completion.
• SMS5 Chapter for Annual Reports.</td></tr>
</table>

	• SMS5 Final Report one month after study termination.
Review and Auditing	• Annual internal review of Strategy SMS5 implementation plan (methodology, procedures, processes, records, reporting and QA/QC) by EUL (or delegate). • Any non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	<u>IC:</u> • Overall responsibility for implementation of the strategy and implementation plan. <u>PSC:</u> • Facilitate seabird population monitoring in areas of active response activities during the hydrocarbon release. <u>EUL (or delegate):</u> • Day-to-day coordination and review of monitoring data. • Compliance with SMS5 implementation plan requirements. • Carry out internal periodic reviews of implementation plan. • Oversee external audits. • Communications with NOPSEMA's Environment Division. • Approval and provision of any compliance reporting requirements. • Approve all reporting (Reactive Baseline Survey Report, Baseline Data Report, Final Report, SMS5 Chapter in Annual Reports, implementation plan) and the Revised implementation plan for the Long-term Monitoring Phase. • Provide advice to IC and PSC. <u>PI:</u> • Daily implementation of this implementation plan. • Plan and coordinate vessel based seabird population monitoring. • Review, approve and disseminate monitoring information. • Review all reporting (Survey Reports, Baseline Report, SMS5 Seabird Population Monitoring Final Report, SMS5 Chapter in Annual Reports). • Review of any compliance reports. • Provide advice as required to the EUL (or delegate). <u>TS:</u> • Carry out field monitoring activities, subsequent data analysis and data reporting (field staff). • Collate existing baseline data and preparation of Baseline Data Report. • Prepare reports including Seabird Population Monitoring Final Report. • Store and archive data.
Relevant References and Guidelines	• Oil Spill Monitoring Handbook. (Hook et al, 2016). • Watson et al. (2009). A Rapid Assessment of the Impacts of the Montara Oil Leak on Birds, Cetaceans and Marine Reptiles. Prepared on behalf of the DEWHA.

3.3.6 SMS6 Strategy: Marine Megafauna Surveys

Strategy Component	Description
Monitoring Performance Outcomes	Undertake marine megafauna monitoring to assess potential impacts to, and subsequent recovery following a hydrocarbon release. This will be used to: • Assess any impacts and disturbance to marine megafauna from the hydrocarbon spill and/or any response activities; and • Determine the recovery of populations.
Performance Standards	**Measurement Criteria**
1: Readiness to implement SMS6 Marine Megafauna Surveys program.	1a: PI and TS to be sourced from pool of resources under existing contracts. 1b: PI to maintain a database of vessel and aircraft service providers
2: Reactive baseline monitoring and establishment of monitoring sites	2a: PI to consider outputs from OMS1 and OMS2 to prioritise sensitive priority areas for the establishment of monitoring sites and gathering reactive monitoring data. 2b: PI and TS to establish locations for monitoring sites within sensitive priority areas as well as at least one independent reference area 2c: TS to undertake surveys, and appropriately store/archive field records, photos, video and other data. 2d: PI to provide Reactive Baseline Survey chapter of the Baseline Report (within 6 weeks of reactive baseline survey completion) to the EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC.
3: Acquisition and dissemination of existing marine megafauna baseline data	3a: PI responsible for the acquisition of existing marine megafauna data from various sources as per the procedure in the SMS6 implementation plan to establish the baseline dataset. 3b: PI to provide Baseline Data chapter of the Baseline Report (within 8 weeks of hydrocarbon release) to EUL (or delegate). EUL (or delegate) to approve within 2 weeks of chapter submission, and to distribute to IC and other PIs.
4: Acquisition of marine megafauna survey data during the hydrocarbon release and for 3 months after the cessation of the hydrocarbon release	4a: Collection and analysis of marine megafauna data from priority sensitive locations and predicted impact and reference sites, at frequencies prescribed in the SMS6 implementation plan by TS during the hydrocarbon release. Technical specialist to store / archive field records. 4b: PI to provide a short data report summarising each field survey within 4 weeks of completion of survey to EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC and other PIs. The monitoring data could be used for consideration of hazing activities to prevent the oiling of marine megafauna. A license would be required before any hazing activities could be undertaken.
5: Revise implementation plan for long-term monitoring phase of marine megafauna surveys after the hydrocarbon release and carry out long-term monitoring phase	5a: PI to consider final information / results from SMS8 (Hind-cast Modelling for Impact Assessment) in the revision of the implementation plan for the long-term monitoring phase of marine megafauna after cessation of hydrocarbon release. 5b: PI revises SMS6 implementation plan for long-term monitoring phase of marine megafauna within 4 weeks after SMS8 Final Report approval and provides to EUL (or delegate). EUL (or delegate) to approve revision to SMS6 implementation plan for long-term monitoring phase of marine megafauna surveys within 4 weeks of submission after consultation with DAWE, NOPSEMA, WA DoT, DBCA; and disseminates to TS. 5c: PI responsible for implementation of revised long-term phase SMS6 implementation plan.
6: Assess impact of hydrocarbon release on marine megafauna and provision of performance reporting	6a: PI responsible to assess and to report on monitoring of marine megafauna for each survey (single survey), annual (data to date, EP performance report) and final (all data) reports relative to the established baseline condition and the reference sites (as relevant). 6b: PI to prepare and to provide EUL (or delegate) the SMS6 Chapter for Annual Scientific Monitoring Reports as specified by the EUL (or delegate) each year and

<table>
<tr><td></td><td>the SMS6 Marine Megafauna Scientific Monitoring Final Report within 8 weeks of final field survey. EUL (or delegate) after consultation with DAWE, NOPSEMA, WA DoT DBCA to approve Final Marine Megafauna Monitoring Report within 3 months of field termination for dissemination.</td></tr>
<tr><td>7: Regulatory compliance reporting</td><td>7a: EUL (or delegate) to provide regulators (NOPSEMA, DAWE and WA DoT, DBCA) with Annual Scientific Monitoring Reports that includes a SMS6 Chapter and the SMS6 Marine Megafauna Scientific Monitoring Final Report within 4 weeks of approval by the EUL (or delegate).
7b: Technical specialist to inform EUL (or delegate) of any injuries or mortality of marine megafauna within 12 hours of observation. EUL (or delegate) to report any injuries or mortality of marine megafauna to relevant regulators ASAP but within 48 hours of observation.</td></tr>
<tr><td colspan="2">Additional Information</td></tr>
<tr><td>Initiation Trigger</td><td>• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred and data from the OMS7 has confirmed exposure to marine megafauna, or
• The IC (or delegate) advises that either full or partial implementation of the study is to commence.</td></tr>
<tr><td>Termination Criteria</td><td><u>Field Termination:</u> The PSC or EUL (or delegate) will terminate the study when, in consultation with NOPSEMA, DAWE, DBCA and / or WA DoT it is deemed:
• Disturbance parameters (e.g. population size, breeding success) have returned to within the expected natural dynamics of baseline state and/or control sites, orThe IC (or delegate) has advised that agreement has been reached with the Jurisdictional Authority relevant to the spill to terminate the monitoring, and
• The PSC or EUL (or delegate) in conjunction with relevant government agency, considers that protected marine fauna (i.e. threatened or migratory species) have not been impacted or have returned to within the natural dynamics of baseline state (including any assessment against management requirements in Conservation Advices and/or Recovery Plans).
• .
<u>Study Termination:</u> Submission and approval of SMS6 Final Report.</td></tr>
<tr><td>Timing</td><td>• External service providers have been activated within 24 hours of the initiation criteria being met,
• A draft SAP, prepared by the Technical Specialist/s, to be available within 72 hours of the initiation criteria being met,
• Consultation with relevant agencies to commence as soon as practicable after initiation criteria being met,
• Field surveys to commence within 5 days of initiation criteria being met.
Note: the draft SAP may be revised as required due to the nature of an ongoing spill event, changing operational requirements and/or results from data collected to date.
Note: timing of mobilisation and field surveys is dependent on safe operating conditions (e.g. weather, sea state, etc.) and operational access to sites.</td></tr>
<tr><td>Monitoring Design</td><td>The following are monitoring designs recommended for different spill extents/behaviour; final design will be confirmed during preparation of the SAP by the Technical Specialist/s.<table><tr><td>Spill Extent / Behaviour</td><td>Monitoring Design</td></tr><tr><td>Spill intersects with area of biological importance (e.g. foraging areas)</td><td>• BACI (if appropriate baseline data available)
• Control chart (if appropriate baseline data available)
• IvC
• Gradient approach
• Lines of Evidence</td></tr></table></td></tr>
</table>

Scope	Marine megafauna covered by SMS6 include: • Pinnipeds, • Reptiles, • Sharks, • Cetaceans.

Sampling Technique	Sampling techniques will vary depending on the individual event and final monitoring design. The following types of sampling may be implemented under SMS6:
	• Systematic surveillance (e.g. transects):
	  ○ Aerial observations from fixed-wing or helicopter,
	  ○ Vessel-based observations.
	• Unmanned surveillance:
	  ○ UAV and/or satellite.
	• Tissue sample collection and analysis.
	• Opportunistic / incidental observations.
	• Carcass collection and tissue sampling.

Sampling Frequency	• It is recommended that surveys are undertaken at least once a year (although initially this is likely to be at a greater frequency) until termination criteria are met. • Initial sampling frequency will be determined by during preparation of the SAP by the Technical Specialist/s. • Ongoing sampling frequency will be determined by the Technical Specialist/s in consultation with the EUL following each monitoring and reporting event.
Parameters	Sampling parameters will vary depending on the individual event and final monitoring design. The following types of parameters may be analysed under Study S5: • Abundance (adults, juveniles, fledging/hatchling etc) • Density • Distribution • State (e.g. evidence of stress, oil cover, injured etc.) • Chemical analysis of tissue samples (e.g. TRH, BTEX, PAH, MAH) • Presence and state of any carcass
Competencies	• PI with significant experience in marine fauna management (or equivalent). Field experience in managing marine fauna surveys (aerial, boat-based, telemetry, acoustic). Experience in leading marine mega-fauna technical studies and reporting. • TS (vessel and aerial-based) will include experienced and qualified marine zoologists with at least five years' experience in surveys of marine mega-fauna. • TS (office) to be experienced marine mega-fauna analysts for SMS6 office-based analyses. • Commercial certified / surveyed plant (vessels and aircraft). • CVs to be kept on file.
Reporting	PI and TS responsible for the preparation, and the EUL (or delegate) responsible for the approval and dissemination of the following: • SMS6 (Marine Megafauna Monitoring) implementation plan. • SMS6 Baseline Data Report. • SMS6 Survey Reports. • Revision of SMS6 implementation plan for the Long-term Monitoring Phase.

	• SMS6 Chapters for Annual Reports. • SMS6 Final Report.
Review and Auditing	• Annual internal review of Strategy SMS6 implementation plan (methodology, procedures, processes, records, reporting and QA/QC) by EUL (or delegate). • Any non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	IC: • Overall responsibility for implementation of the Strategy and implementation plan. PSC: • Facilitation of marine megafauna monitoring in areas of response activities during the hydrocarbon release. EUL (or delegate): • Ongoing review and approval of the SMS6 implementation plan long-term monitoring phase revision of the implementation plan. • Day-to-day review and coordination of monitoring data; • Compliance with SMS6 implementation plan requirements. • Carry out periodic reviews of implementation plan. • Oversee external audits. • Communications with NOPSEMA's Environment Division, DAWE, WA DoT, DCBA and Department of Water and Environmental Regulation. • Approval and provision of compliance reporting requirements. • Report any injuries or fatalities of marine megafauna to the relevant regulator ASAP but within 48 hours of sighting. • Approval of Marine Megafauna Monitoring Final Report, Survey Reports, Baseline Data Report, SMS6 Chapter in Annual Reports, and the Long-term Monitoring Phase revision of the implementation plan. • Provide advice to IC and PSC as required. PI: • Development of the long-term monitoring phase revision of the implementation plan. • Daily implementation of this implementation plan. • Plan, coordinate, and implement field activities and data analysis • Daily communications between TS and EUL (or delegate) • Review Marine Megafauna Monitoring Final Report, Survey Reports, Baseline Report, SMS6 Chapter in Annual Reports. • Review compliance reports. • Reporting any injuries or fatalities of marine megafauna to the relevant regulator within 48 hours of sighting. • Provision of advice as required to the EUL (or delegate). TS: • Carry out monitoring activities. • Report any injuries or fatalities of marine megafauna to the EUL (or delegate) within 2 hours of sighting. • Perform data analyses. • Prepare reports. • Store and archive data.
Relevant References and Guidelines	• Oil Spill Monitoring Handbook (Hook et al, 2016). • DoEE (2017). Australian National Guidelines for Whale and Dolphin Watching. • Recovery Plan for Marine Turtles in Australia, 2017-2027.

3.3.7 SMS7 Strategy: Hydrocarbon Monitoring of Representative Commercial and Recreational Fish Species

Strategy Component	Description
Monitoring Performance Outcomes	Monitor for hydrocarbons in representative commercial and recreational fish species (including shellfish) to assess the physiological impacts to fisheries; seafood quality/safety and the fisheries recovery following a hydrocarbon release.
Performance Standards	**Measurement Criteria**
1: Readiness to implement SMS7 program.	1a: PI and TS to be sourced from pool of resources under existing contracts (). 1b: PI to maintain a database of vessel service provider. 1c: PI to maintain a database of accredited laboratories (e.g., CSIRO) for analysis of fish toxicological samples.
2: Reactive baseline monitoring and establishment of monitoring sites	2a: PI to consider outputs from OMS1 and OMS2 to prioritise sensitive priority areas for the establishment of monitoring sites and gathering reactive monitoring data. 2b: PI and TS to establish locations for monitoring sites within sensitive priority areas as well as at least one independent reference area 2c: TS to undertake surveys, and appropriately store/archive field records, photos, video and other data. 2d: PI to provide Reactive Baseline Survey chapter of the Baseline Report (within 6 weeks of reactive baseline survey completion) to the EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC.
3: Acquisition and dissemination of existing commercial and recreational fish data	3a: PI responsible for the acquisition of existing commercial and recreation fish data from various sources as per the procedure in the SMS7 implementation plan to confirm the commercial and recreational fish species caught in the area. 3b: A baseline of no hydrocarbon contamination has been assumed for this study for recreational and commercial fishing stock.
4: Acquisition of data for hydrocarbon monitoring of representative commercial and recreational fish species during the hydrocarbon release and for 3 months after the cessation of the hydrocarbon release	4a: Collection and analysis of representative commercial and recreational fish species at predicted impact and reference sites, to determine the presence and absence of hydrocarbons, at frequencies prescribed in the SMS7 implementation plan by TS during the hydrocarbon release and for 3 months after the cessation of the hydrocarbon release. Where possible, samples will be obtained from commercial catches at point of landing. BP will liaise with the DAFWA and / or AFMA regarding sampling and analysis of commercial fish stock. Technical specialist to store/archive field records. 4b: Laboratory analysis of fish samples at accredited laboratory (e.g. CSIRO). CoC to confirm sample collection, transport to appropriate laboratories, and sample receipt notification from the accredited laboratory to confirm arrival of fish samples within holding times. Documents stored / archived at secure site by TS. 4c: Laboratory Analysis Report issued by accredited laboratory with analysis techniques as defined in implementation plan (within 3 weeks of sample collection) and stored / archived by TS. 4d: PI to provide a short report for each survey (within 4 weeks of completion of field survey) to EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC and other PIs.
5: Revise implementation plan for long-term monitoring phase of hydrocarbon monitoring of representative commercial and recreational fish species after the hydrocarbon release and carry out long-term monitoring phase	5a: PI to consider final information / results from SMS8 (Hind-cast Modelling for Impact Assessment) in the revision of the implementation plan for the long-term monitoring phase of hydrocarbon monitoring in commercial and recreational fish species after cessation of the hydrocarbon release. 5b: PI revises SMS7 implementation plan for long-term monitoring phase of hydrocarbon monitoring in representative commercial and recreational fish species within 4 weeks after cessation of hydrocarbon release and provides to EUL (or delegate). EUL (or delegate) to approve revision to SMS7 implementation

	plan for long-term monitoring phase within 4 weeks of submission after consultation with DAWE, NOPSEMA, DPIRD and AFMA; and disseminates to TS. 5c: PI responsible for implementation of revised long-term phase SMS7 implementation plan.
6: Assess impact of hydrocarbon release on representative commercial and recreational fish species and performance reporting	6a: PI responsible to assess and to report the monitoring of hydrocarbons on representative commercial and recreational fish species for each survey (single survey), annual (data to date, EP performance report) and final (all data) report to the established baseline condition and the reference sites for each survey. 6b: PI to prepare and to provide EUL (or delegate) the SMS7 Chapter for Annual Scientific Monitoring Reports as specified by the EUL (or delegate) each year and the SMS7 Commercial & Recreational Fish Species Hydrocarbon Scientific Monitoring Final Report within 8 weeks of field termination. After consultation with DAWE, NOPSEMA, DPIRD and AFMA, EUL to approve Final Report within 3 months of field termination for dissemination.
7: Regulatory compliance reporting	7a: EUL (or delegate) to provide regulators (NOPSEMA, DAWE, DPIRD and / or AFMA) with Annual Scientific Monitoring Reports that includes a SMS7 Chapter and the SMS7 Commercial & Recreational Fish Species Hydrocarbon Scientific Monitoring Final Report within 4 weeks of approval by the EUL (or delegate).
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 offshore oil spill has occurred and data from OMS8 has confirmed the presence of fish taint, **or** • Allegations of damage are received from commercial fisheries or government agencies, **or** • The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	<u>Field Termination:</u> The PSC or EUL (or delegate) will terminate the study when, in consultation with NOPSEMA, DPIRD, DAWE and / or AFMA: • Fish or shellfish show no presence of tissue taint, **or** • PAH levels in fish and shellfish tissue have returned to within the expected natural dynamics of baseline state and/or control sites, **or** • PAH levels in fish and shellfish tissue are at or below regulatory levels of concern. <u>Study Termination</u>: Submission and approval of SMS7 Final Report.
Timing	• External service providers have been activated within 24 hours of the initiation criteria being met, • A draft SAP, prepared by the Technical Specialist/s, to be available within 72 hours initiation criteria being met, • Consultation with relevant agencies to commence as soon as practicable after initiation criteria being met, • Field surveys to commence within 5 days of initiation criteria being met. Note: the draft SAP may be revised as required due to the nature of an ongoing spill event, changing operational requirements and/or results from data collected to date. Note: timing of mobilisation and field surveys is dependent on safe operating conditions (e.g. weather, sea state, etc.) and operational access to sites.
Monitoring Design	The following are monitoring designs recommended for different spill extents/behaviour; final design will be confirmed during preparation of the SAP by the Technical Specialist/s. **Spill Extent / Behaviour**: Offshore spill — **Monitoring Design**: • Gradient approach • Lines of Evidence

Sampling Technique	Sampling techniques will vary depending on the individual event and final monitoring design. The following types of sampling may be implemented under SMS7:
	• Systematic fish sample collection:
	  ○ Olfactory evaluation,
	  ○ Tissue collection.
	• Opportunistic carcass collection and tissue sampling.

Sampling Frequency	• It is recommended that surveys are undertaken at approximately four-month intervals during the first year, and then at least once a year until termination criteria are met. Survey timing should coincide with that appropriate for the fish species of interest. • Initial sampling frequency will be determined by during preparation of the SAP by the Technical Specialist/s. • Ongoing sampling frequency will be determined by the Monitoring Provider in consultation with the EUL following each monitoring and reporting event.
Parameters	Sampling parameters will vary depending on the individual event and final monitoring design. The following types of parameters may be analysed under SMS7: • Odour and appearance, • Chemical analysis of tissue samples (e.g. TRH, BTEX, PAH, MAH), • Fish health indicators and biomarkers (e.g. liver enzymes, PAH metabolites).
Competencies	• PI will be a fisheries scientist with at least 5 years professional experience in epidemiological studies of marine fish and aquaculture species (or equivalent). • TS (field) sampling teams include experienced and qualified marine scientists with experience in the collection of fish samples. • Olfactory analysis must be led by a scientist experienced in the use of the duo-trio method. • TS (office) to be experienced fish analysts for SMS7 office-based analyses. • CVs to be kept on file. • Laboratory services will be NATA accredited.
Reporting	PI and TS responsible for the preparation, and EUL (or delegate) responsible for the approval and dissemination of the following: • SMS7 implementation plan. • SMS7 Baseline Data Report. • SMS7 Survey Reports. • Revised Study SMS7 implementation plan for Long-term Monitoring Phase. • SMS7 Chapter for Annual Reports. • SMS7 Final Report.
Review and Auditing	• Annual internal review of Strategy SMS7 implementation plan (methodology, procedures, processes, records, reporting and QA/QC) by EUL (or delegate). • Any non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	<u>IC:</u> • Overall responsibility for implementation of the SMS7 Strategy and implementation plan. <u>PSC:</u> • Facilitate sampling of representative commercial and recreational fish species in areas of response activities during the hydrocarbon release. <u>EUL (or delegate):</u>

	• Ongoing review and approval of the SMS7 implementation plan and long-term monitoring phase revision of the implementation plan. • Day-to-day coordination and review of the monitoring data; • Compliance with SMS7 implementation plan requirements. • Carry out periodic internal reviews of implementation plan. • Oversee external audits. • Liaise with State / or Commonwealth Fisheries Departments regarding sampling and monitoring of fish. • Communications with NOPSEMA's Environment Division, DAWE, DPIRD and AFMA. • Approval and provision of any compliance reporting requirements. • Approve all reporting (Survey Reports, Baseline Data Report, Final Report, SMS7 Chapter in Annual Reports, implementation plan) and the revision of the implementation plan for the Long-term Monitoring Phase. • Provide advice with IC and PSC as required. PI: • Daily implementation of this implementation plan. • Plan, coordinate and implement fish sampling at commercial and recreational charter boat landings. • Daily communications between TS and EUL (or delegate). • Review, approve and disseminate monitoring information. • Review all reporting (Survey Reports, Baseline Report, Hydrocarbon Monitoring in Representative Commercial and Recreational Fish Species Final Report, SMS7 Chapter in Annual Reports). • Revise the implementation plan for Long-term Monitoring Phase. • Review of data provided for inputs into SMS8 Hind-cast Modelling. • Review of any compliance reports. • Provide advice as required to the EUL (or delegate). TS: • Coordinate fish sampling at home ports. • Undertake fish sampling activities. • Coordination of laboratories. • Perform data analyses. • Prepare reports including Hydrocarbon Monitoring in Representative Commercial and Recreational Fish Species Final Report. • Store and archive data.
Relevant References and Guidelines	• Hook et al 2016 Oil Spill Monitoring Handbook. • ANZECC & ARMCANZ (2000) Fresh and Marine Water Guidelines • Yender et al. (2002). Managing Seafood Safety after an Oil Spill. • Reilly & York. (2001). Guidance on Sensory Testing and Monitoring of Seafood for Presence of Petroleum Taint Following an Oil Spill. • Gagnon et al. (1999). Biochemical and Chemical Parameters for Aquatic Ecosystem Health Assessments Adapted to the Australian Oil and Gas Industry.

3.3.8 SMS8 Strategy: Hind-cast Modelling for Impact Assessment

Strategy Component	Description
Monitoring Performance Outcomes	Undertake hind-cast simulations of a hydrocarbon release, validated with information / data from other OSMP studies to refine post-incident impact

	assessment and to inform long-term scientific monitoring specifications to support assessments of the impacts and recovery of environmental sensitivities affected by the hydrocarbon spill.
Performance Standards	**Measurement Criteria**
1: Readiness to implement SMS8 forecast modelling.	1a: EUL (or delegate) to extend existing ongoing contract with modelling service provider (RPS Response) for 6 months after termination criteria for OMS1 (Operational Forecast Modelling). 1b: RPS Response to be operationally ready to provide hind-cast modelling services within 1 week after cessation of OMS1 (Operational Forecast Modelling). 1c: SMS8 implementation plan for hind-cast modelling updated by RPS Response and approved by EUL (or delegate) within 1 week after cessation of OMS1 (Operational Forecast Modelling).
2: Conduct hindcast simulations to inform post-incident impact assessment	2a: PIs of relevant studies to provide RPS available pertinent information / data from OMS2 (Hydrocarbon Spill Surveillance and Tracking), SMS2 (Hydrocarbon Monitoring in Marine Waters) and SMS3 (Hydrocarbon Monitoring in Marine Sediments) in digital format with accompanying meta-data documents within 4 weeks after cessation of OMS1 (Operational Forecast Modelling). 2b: IC to provide RPS Response with pertinent information / data regarding response measures implemented during the incident in digital format with accompanying meta-data document within 4 weeks after cessation of OMS1 (Operational Forecast Modelling). 2c: RPS Response to provide the Hind-cast Modelling Impact Assessment Modelling Report on simulated estimates of environmental impacts in terms of surface slick, entrained hydrocarbon and dissolved aromatic exposures; within 3 months after cessation of OMS1 (Operational Forecast Modelling).
3: Refined post-incident impact assessment informs long-term monitoring specifications	3a: Provision of report to PIs of SMS2-SMS7 and SMS9 to inform modelling assessment of hydrocarbon distributions from incident to be considered in the long-term monitoring specifications (e.g., locations, frequency). 3b: RPS Response to run workshop with PIs from SMS2-SMS7 and SMS9 and EUL (or delegate) to provide subsequent Workshop Report on recommendations based on hind-cast modelling of long-term modelling specifications within 4 months after cessation of OMS1 (Operational Forecast Modelling).
Additional Information	
Initiation Trigger	Immediately after the cessation of OMS1 (Operational Forecast Modelling) by the EUL.
Termination Criteria	PSC or EUL (or delegate) approves Hind-cast Modelling Impact Assessment Modelling Report submitted by RPS Response and the Hind-cast Modelling Impact Assessment Workshop is conducted.
Timing	SMS8 to commence within 24 hours of the initiation criteria being met.
Competencies	RPS Response is the recognized industry leader in hind-cast modelling of hydrocarbon incidents; no competency test and training anticipated.
Reporting	RPS Response responsible for the preparation, and EUL (or delegate) is responsible for the approval and dissemination of the following: • RPS Response to provide SMS8 implementation plan updates within 1 week after cessation of OMS1 (Operational Forecast Modelling); • Final Hind-cast Modelling Impact Assessment Report within 6 months of study initiation.
Review and Auditing	• Internal review of SMS8 ‘readiness’ after termination of OMS1 (Operational Forecast Modelling) by EUL (or delegate). • Annual internal review of OMS1 Strategy and study implementation plan methodology, procedures, processes and records by EUL (or delegate). Non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.

Responsibilities	<u>IC:</u> • Overall responsibility for implementation of Strategy and Study Implementation Plan. <u>PSC:</u> • Provide necessary spill parameters to PI. <u>EUL (or delegate):</u> • Review and approval of any updates to the implementation plan. • Current contract with RPS includes hind-cast modelling of the spill period. • Day-to-day coordination and review of monitoring data; • Ensure RPS is operationally ready. • Compliance with SMS8 implementation plan requirements. • Carry out periodic internal reviews. • Oversee external audits. • Coordinate provision of information from OMS2, SMS2 and SMS3 to SMS8 PI. • Review and approve the Final Hind-cast Modelling Impact Assessment report. • Provide Final Hind-cast Modelling Impact Assessment Report to PIs of scientific studies SMS2 (Hydrocarbon Monitoring in Marine Waters), SMS3 (Hydrocarbon Monitoring of Marine Sediments), SMS4 (Subtidal Benthic Habitat Monitoring), SMS5 (Shore and Seabird Population Monitoring), SMS6 (Marine Megafauna Surveys), SMS7 (Hydrocarbon Monitoring of Fish) to assist in refinements to their long-term monitoring specifications. • Coordinate Hind-cast Modelling Impact Assessment workshop (led by RPS) for PIs (SMS2-SMS7) • Provide advice with respect to environmental issues as required to the EUL (or delegate). <u>PI (RPS):</u> • Ensure modelling 'readiness' within 1 week of study initiation • Lead the Hind-cast Modelling Impact Assessment workshop, organized by the EUL (or delegate) for the PIs of SMS2 –SMS7 • Provide hind-cast modelling after cessation of OMS1 (Operation Forecast Modelling) and associated reporting to estimate the impacts from the hydrocarbon spill to inform the long-term scientific monitoring program. <u>PIs of Studies OMS2, SMS2 and SMS3</u> are responsible for: • Provision of validation data and meta-data document for hind-cast modelling to RPS. <u>PIs of Studies SMS2-SMS7</u> are responsible for: • Preparation and attendance at Hind-cast Modelling Workshop.
Relevant References and Guidelines	RPS guidelines.

3.3.9 SMS9 Strategy: Socio-economic Surveys

Strategy Component	Description
Monitoring Performance Outcomes	The monitoring performance outcomes for this study is to carry out socio-economic monitoring studies to assess socio-economic, including cultural impacts and subsequent recovery pathways following a Level 2/3 hydrocarbon spill.
Performance Standards	**Measurement Criteria**
1: Readiness to implement SMS9 program.	1a: PI and TS to be sourced from pool of resources under existing contract.

2: Reactive baseline monitoring and establishment of monitoring sites	2a: PI to consider outputs from OMS1 and OMS2 to prioritise sensitive priority areas for the establishment of monitoring sites and gathering reactive monitoring data. 2b: PI and TS to establish locations for monitoring sites within sensitive priority areas as well as at least one independent reference area 2c: TS to undertake surveys, and appropriately store/archive field records, photos, video and other data. 2d: PI to provide Reactive Baseline Survey chapter of the Baseline Report (within 6 weeks of reactive baseline survey completion) to the EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC.
3: Acquisition and dissemination of existing socioeconomic baseline data	3a: PI responsible for the acquisition of existing socioeconomic and cultural data from various sources (e.g., Councils REMPLAN) as per the procedure in the SMS9 implementation plan to establish the baseline dataset. 3b: PI to provide Baseline Data chapter of the Baseline Report within 8 weeks of hydrocarbon release to EUL (or delegate). EUL (or delegate) to approve within 2 weeks of submission, and to distribute to PSC and other PIs.
4: Acquisition of data for socio-economic monitoring during the hydrocarbon release and for 3 months after the cessation of the hydrocarbon release	4a: Collection and analysis of representative socio-economic data at predicted impact and reference sites, to determine socio-economic impacts, at frequencies prescribed in the SMS9 implementation plan by TS during the hydrocarbon release and for 3 months after the cessation of the hydrocarbon release. Technical specialist to store/archive field records. 4b: PI to provide a short report for each survey (within 4 weeks of completion of field survey) to EUL (or delegate). EUL (or delegate) to approve within 1 week of submission and distribute to PSC and other PIs.
5: Revise implementation plan for long-term monitoring phase of socio-economic recovery and carry out long-term monitoring phase	5a: PI to consider final information / results from SMS8 (Hind-cast Modelling for Impact Assessment) in the revision of the implementation plan for the long-term monitoring phase of socio-economic impacts after cessation of the hydrocarbon release. 5b: PI revises SMS9 implementation plan for long-term monitoring phase of socio-economic impact within 4 weeks after cessation of hydrocarbon release and provides to EUL (or delegate). EUL (or delegate) to approve revision to SMS9 implementation plan for long-term monitoring phase within 4 weeks of submission after consultation with NOPSEMA and other regulators. 5c: PI responsible for implementation of revised long-term phase SMS9 implementation plan.
6: Assess impact of hydrocarbon release socio-economic indicators and performance reporting	6a: PI responsible to assess and to report the monitoring of socio-economic impacts for each survey (single survey), annual (data to date, EP performance report) and final (all data) report to the established baseline condition and the impacts for each survey. 6b: PI to prepare and to provide EUL (or delegate) the SMS9 Chapter for Annual Scientific Monitoring Reports as specified by the EUL (or delegate) each year and the SMS9 Socio-economic Scientific Monitoring Final Report within 8 weeks of field termination. After consultation with NOPSEMA and other regulators the EUL to approve Final Report within 3 months of field termination for dissemination.
7: Regulatory compliance reporting	7a: EUL (or delegate) to provide regulators (NOPSEMA) with Annual Scientific Monitoring Reports that includes a SMS9 Chapter and the SMS9 Socio-economic Scientific Monitoring Final Report within 4 weeks of approval by the EUL (or delegate).
Additional Information	
Initiation Trigger	• The IC (or delegate) has confirmed that a Level 2 or Level 3 spill has occurred **and** data from OMS1 and/or SMS8 indicates exposure to known areas of heritage or socioeconomic features, **or** • Allegations of damage are received from other users (e.g. tourism operators, heritage groups) or government agencies, **or**

	• The IC (or delegate) advises that either full or partial implementation of the study is to commence.
Termination Criteria	Field Termination: The PSC or EUL (or delegate) will terminate the study when, in consultation with NOPSEMA: • Characterisation of impacts to socio economic and cultural conditions has been established; and • Monitoring of recovery is reasonably satisfied for socio-economic conditions. Study Termination: Submission and approval of SMS9 Final Report.
Timing	SMS9 to commence within 72 hours of the initiation criteria being met.
Competencies	• PI with support from cultural experts and experienced economist with at least 5 years' experience in collecting and analysing socio economic data (or equivalent); • Technical specialist (office) to be experienced economists with experience in the collection and analysis of socio-economic data. • CVs to be kept on file
Reporting	PI and TS responsible for the preparation, and EUL (or delegate) responsible for the approval and dissemination of the following: • SMS9 implementation plan. • SMS9 Baseline Data Report. • SMS9 Survey Reports. • Revised SMS9 Implementation Plan for Long-term Monitoring Phase. • SMS9 Chapter for Annual Reports. • SMS9 Final Report.
Review and Auditing	• Annual internal review of Strategy SMS9 implementation plan (methodology, procedures, processes, records, reporting and QA/QC) by EUL (or delegate). • Any non-conformances recorded with follow-up by EUL (or delegate) within 2 weeks.
Responsibilities	IC: • Overall responsibility for implementation of the SMS9 Strategy and implementation plan. PSC: • Facilitate field access and surveying where necessary. EUL (or delegate): • Ongoing review and approval of the SMS9 implementation plan long-term monitoring phase revision of the implementation plan. • Compliance with SMS9 implementation plan requirements. • Carry out periodic internal reviews of implementation plan. • Day-to-day coordination and review of monitoring data; • Oversee external audits. • Liaise with State / or Commonwealth Departments regarding socio-economic monitoring and results. • Communications with NOPSEMA's Environment Division and other regulators. • Approval and provision of any compliance reporting requirements. • Approve all reporting (Survey Reports, Baseline Data Report, Final Report, SMS9 Chapter in Annual Reports, implementation plan) and the revision of the implementation plan for the Long-term Monitoring Phase. • Provide advice to GMO as required. PI:

	• Daily implementation of this implementation plan. • Daily communications between TS and EUL (or delegate). • Review, approve and disseminate monitoring information. • Review all reporting (Survey Reports, Baseline Report, Final Report, SMS9 Chapter in Annual Reports). • Revise the implementation plan for Long-term Monitoring Phase. • Review of data provided for inputs into SMS8 Hind-cast Modelling. • Review of any compliance reports. • Provide advice as required to the EUL (or delegate). TS: • Perform socio-economic impact analyses. • Prepare reports including Baseline Report, Survey Reports, SMS9 Chapter in Annual Report and Final Report. • Store and archive data.
Relevant References and Guidelines	N/A

4 References

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AMSA. 2003b. Oil Spill Monitoring: Background Paper. Prepared by Australian Maritime Safety Authority, Published by AMSA, Canberra. ISBN 0 642 70991 2

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NOPSEMA. 2018. Oil Pollution Risk Management – Guidance Note. Prepared by National Offshore Petroleum Safety and Environmental Management Authority, Report No. GN1488, February 2018.

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Yender, R., Michel, J., & Lord, C. 2002. Managing Seafood Safety after an Oil Spill. Published by the National Oceanic and Atmospheric Administration (NOAA).

Appendix A - Baseline Information

As described in the OSMP (Section 2.4.1), where practicable and suitable, reactive (pre-impact) baseline studies may also be triggered by a Level 2 or 3 hydrocarbon release, to gather additional data on the current state of the environment. A collation of known literature and studies relevant within the North West Shelf should be used to form the basis of this baseline pre-impact knowledge.

Data gaps within the existing baseline (for example any differences in methods, spatial and temporal variations in environmental condition, different monitoring locations etc.) will be identified as part of the SIP development process and addressed through the design of each scientific monitoring study to optimise the detection of environmental change.

Examples of datasets of known literature and studies relevant to environmental receptors within the North West Shelf that may provide suitable baseline data and/or contextual information in the event of a spill is provided below.

Source	Description	Relevant Scientific Monitoring Study
BP		
Small Scale Geotechnical and Geophysical Site Survey	Geophysical data and photographic records acquired in 2019 describes baseline benthic fauna and physico-chemical characteristics of sediment within the well site	SMS3: Sediment Quality SMS4: Benthic Habitat
Ironbark Drilling EP	Description of the environment within the EMBA associated with the exploration drilling program	SMS4: Benthic Habitat SMS5: Seabirds SMS6: Marine Megafauna SMS7: Fisheries SMS9: Socio-Economic
External Group /Agency		
ABARES	Fishery Status Reports	SMS7: Fisheries
CSIRO	Brewer, D.T., Lyne, V., Skewes, T.D., and Rothlisberg, P. 2007. Trophic Systems of the North West Marine Region. Report to The Department of the Environment and Water Resources. CSIRO Cleveland. 156 pp	SMS4: Benthic Habitat
CSIRO / UWA	Pilbara Marine Conservation Partnership, specifically including:	
	Coral Reef Health	SMS4: Benthic Habitat
	Macroalgae and seagrass biomass and diversity across the Pilbara Region	SMS4: Benthic Habitat
	Fish and Sharks	SMS6: Marine Megafauna
CSIRO / WA Government	North West Shelf Joint Environmental Management Study, specifically including:	
	Technical Report 2: Bibliography of research and data relevant to marine environmental management of Australia's North West Shelf	All
	Technical Report 18: Background quality for coastal marine waters of the North West Shelf, Western Australia	SMS2: Water Quality
	Technical Report 11: Benthic habitat dynamics and models on Australia's North West Shelf	SMS4: Benthic Habitat
	Technical Report 10: The spatial distribution of commercial fishery production on Australia's North West Shelf	SMS7: Fisheries

Source	Description	Relevant Scientific Monitoring Study
DAWE	Ramsar Site Ecological Character Description https://www.environment.gov.au/water/wetlands/publications	SMS2: Sediment Quality SMS3: Water Quality SMS4: Benthic Habitat SMS5: Seabirds SMS9: Socio-economic
	Marine Bioregional Plans https://www.environment.gov.au/marine/publications	SMS4: Benthic Habitat SMS5: Seabirds SMS6: Marine Megafauna SMS7: Fisheries SMS9: Socio-economic
	Species Group Report Cards https://www.environment.gov.au/marine/publications	SMS4: Benthic Habitat SMS5: Seabirds SMS6: Marine Megafauna SMS7: Fisheries
	Recovery Plans adopted under the EPBC Act http://www.environment.gov.au/cgi-bin/sprat/public/publicshowallrps.pl	SMS5: Seabirds SMS6: Marine Megafauna
Environment Australia	Blue whale migration and recognised aggregation areas mapping. Environment Australia. Canberra.	SMS6: Marine Megafauna
Geoscience Australia	Baker, C., Potter, A., Tran, M. and Heap, A.D., 2008. Geomorphology and Sedimentology of the Northwest Marine Region of Australia. Geoscience Australia, Record 2008/07. Geoscience Australia, Canberra. 220pp.	SMS4: Benthic Habitat
	Heap, A. D., Przeslawski, R., Radke, L., Trafford, J., Battershill, C., & Party, S. 2010. Seabed environments of the eastern Joseph Bonaparte Gulf, northern Australia: SOL4934, post-survey report. Geoscience Australia, Canberra, ACT, Australia.	SMS4: Benthic Habitat
	Przeslawski, R., Daniell, J., Nichol, S., Anderson, T. & Barrie, J.V., 2011. Seabed Habitats and Hazards of the Joseph Bonaparte Gulf and Timor Sea, Northern Australia. Record 2011/040. Geoscience Australia, Canberra.	SMS4: Benthic Habitat
Parks Australia	Australian Marine Parks scientific publications, specifically including:	
	Benthic habitats and biodiversity of Dampier and Montebello Marine Parks	SMS4: Benthic Habitat
	Reef Life Survey Assessment of Coral Reef Biodiversity in the North-West Commonwealth Network, 2017	SMS4: Benthic Habitat
	Reef Life Survey Assessment of Coral Reef Biodiversity in the North-west marine Parks Network, 2020	SMS4: Benthic Habitat
	A socio-economic overview of the coastal communities adjacent the North-west Marine Region	SMS9: Socio-Economic
WA EPA	Marine technical report series, specifically including:	
	Pilbara Coastal Water Quality Consultation Outcomes: Environmental Values and Environmental Quality Objectives	SMS2: Water Quality
	Background quality of the marine sediments of the Pilbara coast	SMS3: Sediment Quality
Journal / Articles		

Source	Description	Relevant Scientific Monitoring Study
APPEA Journal	Jenner, K.C.S., Jenner, M-N.M, and McCabe, K.A. 2001. Geographical and Temporal Movements of Humpback Whales in Western Australian Waters. In APPEA Journal 2001 (41): 749–765.	SMS6: Marine Megafauna
Australian Journal of Earth Sciences	Heap, A.D. and Harris, P.T. 2008. Geomorphology of the Australian margin and adjacent seafloor, Australian Journal of Earth Sciences 55(4): 555-585	SMS4: Benthic Habitat
International Whaling Commission	McCauley, R., Jenner, C., 2010. Migratory patterns and estimated population size of pygmy blue whales (Balaenoptera musculus brevicauda) traversing the Western Australian coast based on passive acoustics (International Whaling Commission Report No. SC/62/SH26). International Whaling Commission.	SMS6: Marine Megafauna
	Gales, N. I. C. K., Double, M. C., Robinson, S. A. R. A. H., Jenner, C. U. R. T., Jenner, M. I. C. H. E. L. I. N. E., King, E. R. I. C., ... & Paton, D. A. V. E. 2010. Satellite tracking of Australian humpback (Megaptera novaeangliae) and pygmy blue whales (Balaenoptera musculus brevicauda). White paper presented to the Scientific Committee of the International Whaling Commission. http://www.marinemammals.gov.au/__data/assets/pdf_file/0017/137312/sc-62-sh21.pdf	SMS6: Marine Megafauna
Journal of Experimental Marine Biology & Ecology	Carruthers, TJB, Dennison, WC, Kendrick, G, Waycott, M, Walker, DI & Cambridge, M, 2007. Seagrasses of south west Australia: a conceptual synthesis of the world's most diverse and extensive seagrass meadows. Journal of Experimental Marine Biology & Ecology, 350: 21-45.	SMS4: Benthic Habitat
Journal of Experimental Marine Biology & Ecology	Gage, J.D. 1996. Why are there so many species in deep-sea sediments? J Exp Mar Biol Ecol 200:257-286	SMS4: Benthic Habitat
Journal of the Royal Society of Western Australia	Beckley L. E., Muhling B.A., and Gaughan, D.J. 2009. Larval fishes off Western Australia: influence of the Leeuwin Current. Journal of the Royal Society of Western Australia 92, 101–109	SMS4: Benthic Habitat
Marine and Freshwater Research	Przeslawski, R., McArthur, M. A., & Anderson, T. J. 2013. Infaunal biodiversity patterns from Carnarvon shelf (Ningaloo reef), Western Australia. Marine and Freshwater Research, 64(6), 573-583.	SMS4: Benthic Habitat
Marine Biodiversity Records	Hoshke, A. & Whisson, G. 2016. First aggregation of grey nurse sharks (Carcharias Taurus) confirmed in Western Australia. Published by Marine Biodiversity Records 9(17).	SMS6: Marine Megafauna
Marine Mammal Science	Irvine, L. G., Thums, M., Hanson, C. E., McMahon, C. R., & Hindell, M. A. (2018). Evidence for a widely expanded humpback whale calving range along the Western Australian coast. Marine Mammal Science, 34(2), 294-310.	SMS6: Marine Megafauna
Oceanography	Hanson C., Waite A., Thompson P. A., & Pattiaratchi C. 2007. Phytoplankton community structure and nitrogen nutrition in Leeuwin Current and coastal waters off the Gascoyne region of Western Australia. Deep Sea Research Part II: Topical Studies in Oceanography, 54(8-10), 902-924. https://doi.org/10.1016/j.dsr2.2006.10.002	SMS2: Water Quality SMS4: Benthic Habitat

Source	Description	Relevant Scientific Monitoring Study
PLoS One	Double, M. C., Andrews-Goff, V., Jenner, K. C. S., Jenner, M.-N., Laverick, S. M., Branch, T. A., and Gales, N. J. (2014). "Migratory movements of pygmy blue whales (Balaenoptera musculus brevicauda) between Australia and Indonesia as revealed by satellite telemetry," PLoS One 9(4), e93578. https://doi.org/10.1371/journal.pone.0093578	SMS6: Marine Megafauna
Scientific Reports	Negri, A., Brinkman, D., Flores, F. et al. Acute ecotoxicology of natural oil and gas condensate to coral reef larvae. Sci Rep 6, 21153 (2016). https://doi.org/10.1038/srep21153	SMS1: Ecotoxicology
The Beagle	Milton, D. A. V. I. D. 2005. Birds of Ashmore Reef National Nature Reserve: an assessment of its importance for seabirds and waders. The Beagle, Records of the Museums of Art Galleries of the Northern Territory 2005, Supplement, 1, 133-141.	SMS5: Seabirds
The Journal of the Acoustical Society of America	Gavrilov A. N., McCauley R. D., Paskos G., and Alexey G. 2018. Southbound migration corridor of pygmy blue whales off the northwest coast of Australia based on data from ocean bottom seismographs. The Journal of the Acoustical Society of America. https://doi.org/10.1121/1.5063452	SMS6: Marine Megafauna
WAMSI Dredging Science Node	McMahon K, Statton J and Lavery P. 2017. Seagrasses of the northwest of Western Australia: biogeography and considerations for dredging-related research. Report of Theme 5 - Project 5.1.2 prepared for the Dredging Science Node, Western Australian Marine Science Institution, Perth, Western Australia. 39 pp.	SMS4: Benthic Habitat
Wildlife Research	Whiting, S. D., Long, J. L., Hadden, K. M., Lauder, A. D., & Koch, A. U. 2007. Insights into size, seasonality and biology of a nesting population of the Olive Ridley turtle in northern Australia. Wildlife Research, 34(3), 200-210.	SMS6: Marine Megafauna
Databases		
AFMA	Commonwealth-managed commercial fisheries data available by request	SMS7: Fisheries
AIMS	AIMS Data Centre https://apps.aims.gov.au/metadata/search	SMS2: Water Quality SMS3: Sediment Quality SMS4: Benthic Habitat SMS5: Seabirds SMS6: Marine Megafauna
AODN	Australian Ocean Data Network https://portal.aodn.org.au/search https://catalogue.aodn.org.au/geonetwork/srv/eng/main.home	SMS2: Water Quality SMS3: Sediment Quality SMS4: Benthic Habitat SMS5: Seabirds SMS6: Marine Megafauna
Birdlife Australia	Shorebirds 2020 http://www.birdlife.org.au/projects/shorebirds-2020	SMS5: Seabirds
CSIRO	the CAMRIS Marine Benthic Substrate Database https://data.csiro.au/dap/landingpage?pid=csiro%3A12843	SMS4: Benthic Habitat
CSIRO / NCRIS / GBIF	The Atlas of Living Australia https://www.ala.org.au/	SMS5: Seabirds SMS6: Marine Megafauna

Source	Description	Relevant Scientific Monitoring Study
DAWE	Species Profile and Threats Database https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl	SMS4: Benthic Habitat SMS5: Seabirds SMS6: Marine Megafauna SMS7: Fisheries
	Australasian Underwater Cultural Heritage Database https://www.environment.gov.au/heritage/underwater-heritage/auchd	SMS9: Socio-Economic
I-GEM	Industry-Government Environmental Meta-database (I-GEM) Access is via the DWER Index of Marine Surveys for Assessments (IMSA): https://biocollect.ala.org.au/imsa#max%3D20%26sort%3DdateCreatedSort	SMS2: Water Quality SMS3: Sediment Quality SMS4: Benthic Habitat SMS5: Seabirds SMS6: Marine Megafauna
IMSA	Index of Marine Surveys for Assessments Available: https://biocollect.ala.org.au/imsa#max%3D20%26sort%3DdateCreatedSort	SMS2: Water Quality SMS3: Sediment Quality SMS4: Benthic Habitat SMS5: Seabirds SMS6: Marine Megafauna
NOAA NCEI	World Ocean Atlas https://www.ncei.noaa.gov/products/world-ocean-atlas	SMS2: Water Quality
Reef Check Australia	Community-based reef health monitoring https://www.reefcheckaustralia.org/	SMS4: Benthic Habitat
WA DPIRD	FishCube State-managed commercial fisheries data available by request	SMS7: Fisheries
WA DoT	Western Australian Oil Spill Response Atlas https://www.transport.wa.gov.au/imarine/oil-spill-response-and-planning-tools.asp	SMS4: Benthic Habitat SMS5: Seabirds SMS6: Marine Megafauna SMS9: Socio-Economic

Appendix F

Stakeholder Engagement Materials

BP Ironbark exploration drilling consultation

As part of BP's public consultation process, the below information provides an overview of BP's proposed activity in the Carnarvon Basin, Western Australia. For updates on any future developments, please register your details* using this link.

**Please note: your name may be included in BP's Environmental Plan (EP) consultation documentation, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) and be viewable to the public.*

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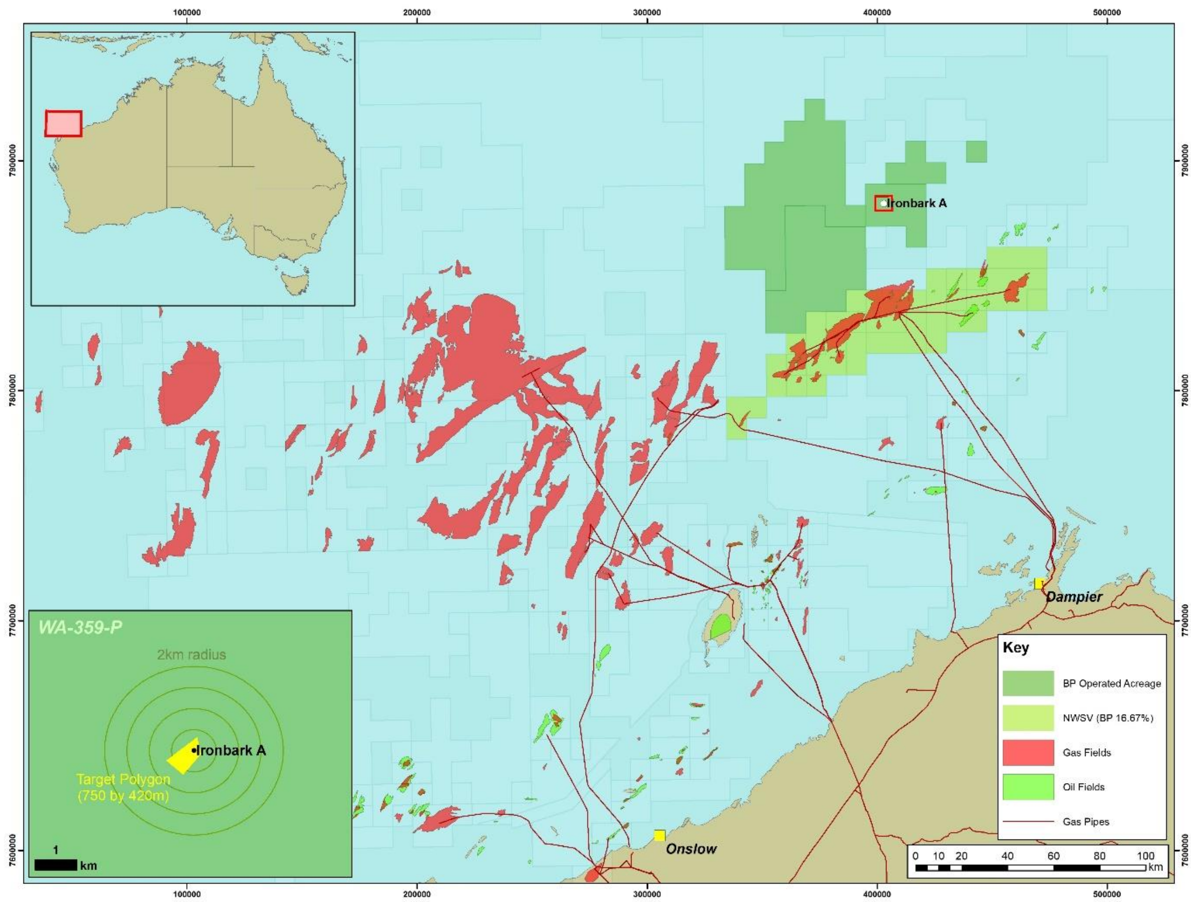
1. Activity

BP is proposing to conduct exploration drilling activities for a single exploration well in the Carnarvon Basin off Western Australia's north-west coast. The proposed Ironbark-1 exploration well is located in Permit WA-359-P, in Commonwealth waters.



2. Joint venture arrangement

The WA-359-P Joint Venture participating interests are:

- BP (operator) – 42.5%
- Cue – 21.5%
- Beach – 21%
- New Zealand Oil & Gas – 15%

3. Duration of the activity

Drilling activities are planned to commence in Q3 of 2020, although depending on Mobile Offshore Drilling Unit (MODU) availability, may commence between Q3 of 2020 and Q2 2021.

Drilling activities are expected to take approximately 70-90 days (excluding weather and operational delays). Drilling and support activities will typically be conducted on a 24-hour basis.

4. Longitude and latitude of the activity

Ironbark-1 exploration well coordinates are as follows:

Long: 116° 04' 35.80 / Lat: 19° 09' 34.01"

5. Distance from shore

The Ironbark-1 exploration well will be drilled within Permit WA-359-P, located approximately 200km from shore, in water depths of 300m.

6. Supply base information

Existing shore-based supply facilities in Dampier will be used to support the exploration drilling activities. Aspects of the activities to be conducted at the shore-based facilities is not within the assessment scope of the EP. Similarly, aspects associated with vessels transiting to and from the operational area and the shoreline do not form part of the assessment scope of the EP; these fall under the jurisdiction of AMSA and are managed under the Navigation Act 2012.

7. Exclusion zones

A 500m Petroleum Safety Zone will apply around the MODU for the duration of the drilling activities.

8. Vessel types and rig

Drilling will be undertaken using a MODU. Two to three support vessels, as well as helicopters will be required to support the exploration drilling activities.

9. Activities forming part of the exploration drilling program

- MODU positioning and anchoring.
- Drilling of the well.
- Installation and testing of the blow out preventers.
- Cementing of the well.
- Evaluation of the well using electric logging and Vertical Seismic Profiling.
- Well abandonment.
- Post-drilling ROV survey.
- Support operations, including vessel and helicopter movements.

10. Planned impacts considered in the EP

- Displacement of other marine users from the physical presence of the MODU and support vessels.
- Seabed disturbance from positioning / anchoring the MODU and drilling the well.
- Attraction of transient marine fauna to light emissions from MODU and vessel operations.
- Avoidance of transient marine fauna to underwater sound emissions from logging (VSP), MODU operations, vessel operations, and helicopter operations.
- Potential chronic effects to sensitive receptors from atmospheric emissions from MODU and vessel operations.
- Potential toxic and smothering effects to sensitive receptors from planned discharges, including drilling fluids and cuttings, cement, completion, spacer and other fluids, BOP control fluids used for the drilling of the well; and cooling water and brine, sewage, greywater and putrescible waste, and firefighting foam from MODU and vessel operations.

11. Unplanned risks considered in the EP

- Risk of fishing equipment damage from the physical presence of the wellhead
- Risk of interaction with marine fauna from vessel and MODU operations.
- Risk of change in ecosystem dynamics from introduction of invasive marine species.
- Risk of injury or toxic effects to marine fauna from accidental releases, including waste, small volumes of hazardous liquids (chemicals or hydrocarbons (diesel)), and drilling fluids from a riser disconnection or failure of drilling equipment.
- Risk of smothering or toxic effects to marine fauna from accidental release of diesel in the event of a vessel collision

BP also assessed the impacts and risks of the various spill response strategies that could be implemented in the event of a loss of well control.

12. Environmental setting of the activity

To conduct a comprehensive evaluation of impacts and risks associated with the exploration drilling activities, BP has considered the values and sensitivities of the following regions:

- Bonaparte Gulf,

- Kimberley,
- Pilbara,
- Gascoyne,
- Midwest; and.
- Southwest, and
- Christmas & Cocos Islands.

This includes a range of receptors, including:

- Presence of listed threatened or migratory species or threatened ecological communities identified in EPBC Protected Matter searches.
- Presence of Biologically Important Areas (BIAs) and habitats critical to the survival of the species.
- Presence of important behaviours (e.g. foraging, roosting or breeding) by fauna, including those identified in EPBC Protected Matter searches.

And considerations of:

- The importance of an area to other receptors (e.g. nursery habitat, food source, commercial species).
- Their importance of an area to human activities (e.g. recreation and tourism, aesthetics, economy).

Category 1 / 2 Stakeholder Letter Template

Tzila Katzel

Director Policy, Environmental and Community Affairs

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WESTERN AUSTRALIA 6831

Main Line: (61 8) 9420 1888
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Email: Tzila.katzel@se1.bp.com

Insert Date

Insert Address

To whom it may concern:

RE: BP Ironbark Exploration Drilling

BP plans to further explore the Ironbark prospect by drilling a single exploration well to determine the potential of a gas/condensate field in the Carnarvon Basin off Western Australia's north-west coast. The Ironbark prospect is identified as WA 359 P.

Your business has been identified as one whose interest or activities may be directly affected in the operational area for the Ironbark exploration drilling activity.

We have enclosed a BP Ironbark exploration drilling fact sheet with a wealth of information for your reference and would like to hear back from you. Your feedback is important to us.

If you have any queries relating to the information provided, please contact us at ironbarkinfo@bp.com.

Yours faithfully
BP Developments Australia Pty Ltd

Tzila Katzel

BP Ironbark Exploration Drilling Fact Sheet

Commercial fisheries

BP has identified several local businesses whose interests or activities may be directly affected in the operational area for its Ironbark Exploration Drilling activity. These include active license holders in the following commonwealth fisheries:

NW Slope Trawl Fishery
Southern Bluefin Tune Fishery
Wester Deepwater Trawl Fishery
Western Skipjack Fishery
Western Tuna and Billfish Fishery

You are being contacted as a Category 1 or 2 stakeholder.

1. What are we doing?

BP plans to further explore the Ironbark prospect by drilling a single exploration well to determine the potential of a gas/condensate field in the Carnarvon Basin off Western Australia's north-west coast. The ironbark prospect is identified as WA 359 P.

2. Where are we doing it?

The proposed well is in Commonwealth waters and is at a water depth of approximately 300m. Coordinates for the Ironbark-1 exploration well are:

Planned well	Longitude (E)	Latitude (S)	Approximate water depth
Ironbark-1	116° 04' 35.80	19° 09' 34.01"	~300m

3. When and for how long?

Drilling activities are planned to begin between June 2020 and June 2021. We will ensure impacted stakeholders are notified of the activity in advance.

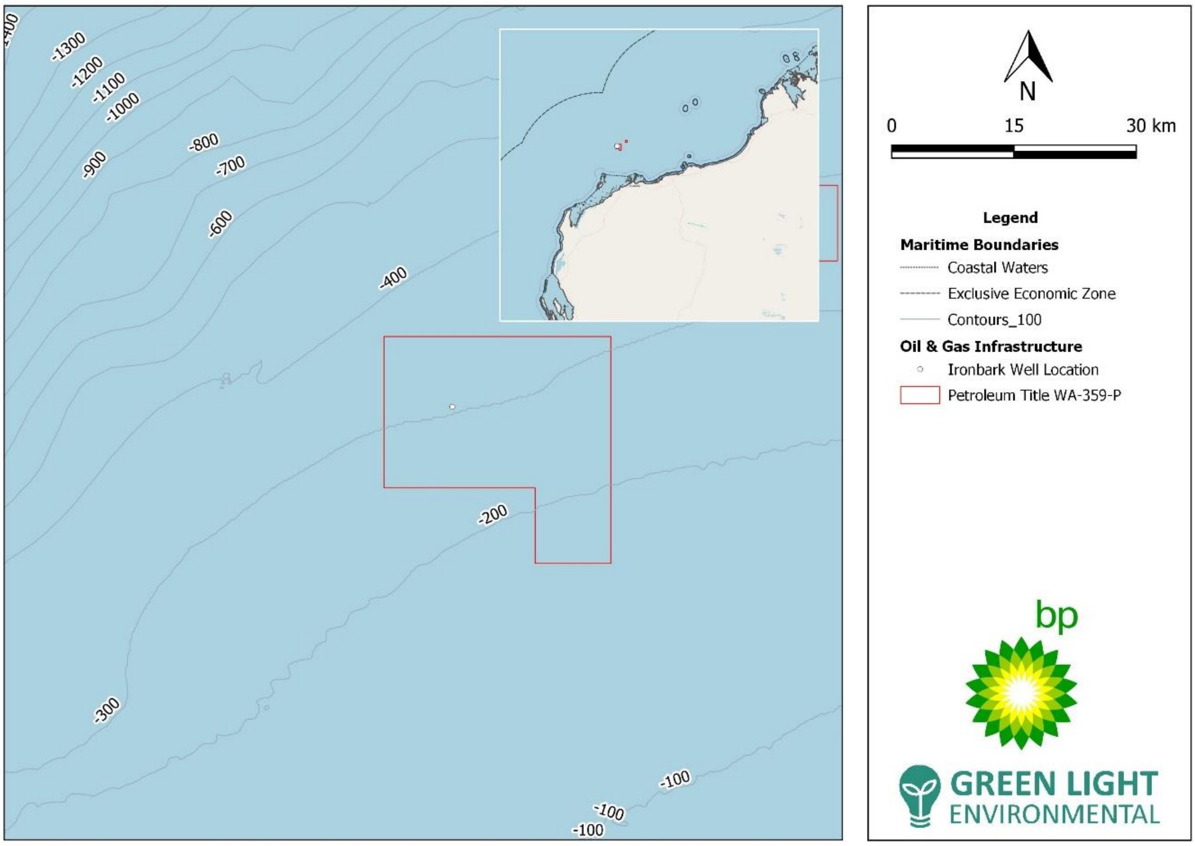
Drilling activities are expected to take around 90-100 days (excluding weather and operational delays). Drilling and support activities will be taking place 24 hours a day.

4. How are we doing it?

The Ironbark exploration well will be drilled by a mobile offshore drilling unit (MODU), the Ocean Apex. The Ocean Apex is already in Australia working with other oil and gas companies.

Anchors may be placed on the seabed and tested by the support vessels before the MODU arrives on site; the MODU will then be towed to location and anchored over the well site. BP will perform all formal notifications (Notice to Mariners etc.) before we begin any activities to help support the anchoring of the MODU. We will contact you as part of this notification process so you know in advance of any additional vessels in the vicinity.

Once positioned, the Ocean Apex will continue to be supported by two or three vessels, which will be either stationary or operating at slow speeds while working in the area. The Ocean Apex will also be serviced by helicopters, with an expected flight frequency of up to 10 times a week.



5. How might this impact commercial fisheries?

Local commercial fisheries could be impacted by:

- Physical presence – displacement of other marine users.
- Underwater sound.
- Planned discharges – drilling fluids (including completion, spacer and other fluids).
- Planned discharges – cement.
- Planned discharges – blow-out preventer (BOP) control fluids.
- Planned discharges – cooling water, brine and bilge.

a) Physical presence – displacement of other marine users

The operational area includes a 500m safety exclusion zone around the Ocean Apex. During the activity shipping or fishing activities will not be able to be conducted for 100 days in the exclusion zone.

State managed fisheries have recorded fishing activity within the operational area, however the fishing activity has been low volume. There has been some past vessel traffic in the operational area, however there are no designated shipping channels or navigational hazards limiting vessel avoidance movements.

We will ensure impacted stakeholders are notified of the activity in advance to pre-empt future planning and avoidance measures.

Once the activity is completed, the suspended/abandoned wellhead could be a hazard for bottom trawling fishing. The wellhead will be identified on appropriate marine charts and on-going consultation will be conducted to avoid wellhead interactions with trawling fishing or any other users of that area.

b) Underwater sound

Based on scientific literature[1], fish will generally avoid sound sources generated by the underwater activity. We anticipate possible short-term behaviour responses, such as avoidance of the sound sources during drilling. It is highly unlikely that underwater sound emissions from drilling activities will cause lethal impact or delayed impact to fish in the area. If you would like more details on the scientific studies used in our assessment on expected fish behaviour, please let us know and we will send this to you.

Our assessment of the drilling (specifically impulsive sound) on fish eggs or larvae shows almost insignificant impact especially when compared to natural mortality[2].

It is possible that temporary avoidance of fish species could impact commercial fisheries through a reduction in catch rates. However, for those commercial fishing licences which overlap the operational area, FishCube historical data between 2014-2018 shows variable fishing activity from State fisheries that target fishes: Pilbara Fish Trawl (Interim) Managed Fishery, Pilbara Trap Managed Fishery and Pilbara Line Fishery.

The Ironbark-1 well is at 300m, so benthic invertebrates are considered out of range of any impact.

The support vessels underwater sound will be like any other shipping vessel in the area. The sound from their operational activity is unlikely to impact variable fishing activity. We do not expect a reduction in catch rates for fishes due to our drilling program.

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[1] (McCauley et al 2017 cited in Richardson et al 2017, McPherson et al. 2016, Richardson et al 2017),

[2] (Saetre and Ona 1996 cited in Popper et al 2014; Richardson et al 2017).

c) Planned discharges – drilling fluids (including completion, spacer and other fluids)

BP commissioned modelling studies to predict the extent of exposure associated with drilling fluid discharges. It is expected that 250m away from the Ocean Apex, drilling fluid concentrations are below thresholds that have the potential to cause environmental impacts.

We do not expect any indirect impacts (such as impacts to plankton) to commercial fisheries as a result of this discharge within 250m.

d) Planned discharges – cement

We used a model to help us understand whether cement discharge from the drilling of this well would have any environmental impacts. We looked at an example of a similar well that we had drilled in a similar environment in 2013 to compare with any potential impacts. In the 2013 case, the cement plume was approximately 150m horizontally and 10m vertically. We assumed this size plume to understand the impacts for the Ironbark-1 drilling activity. As a result, there were no issues linked to plankton foraging or increased abundance. We do not expect any indirect impacts to commercial fisheries.

Modelling of cement discharges for another BP offshore project was used because it provides an appropriate (but conservative) comparison of the potential extent of exposure from this activity. The horizontal and vertical extents of the plume are approximately 150m and 10m, respectively.

There are no particular issues linked to planktonic foraging or increased planktonic abundance affected by this discharge within 150m, so there are no expected indirect impacts to commercial fisheries.

e) Planned discharges – blow-out preventer (BOP) control fluids

Modelling undertaken for another one of BP's offshore drilling projects indicate that a release of BOP fluids during function testing is expected to reach concentrations below aquatic toxicology thresholds 100m away from the Ocean Apex.

There are no particular issues linked to planktonic foraging or increased planktonic abundance affected by this discharge within 100m, so there are no expected indirect impacts to commercial fisheries.

f) Planned discharges – cooling water, brine, sewage, greywater, putrescible waste and bilge

Planned discharges of cooling water, brine, sewage, greywater, putrescible wastes and bilge water by MODUs and vessels are commonly practised both nationally and internationally. Water quality changes in the vicinity of the surface discharge will be quick to dissipate, and rapidly recover on completion of the activity.

The potential impacts and risks are well regulated via various treaties and legislation, both nationally and internationally, which specify industry best practice control measures. These are well understood and implemented by the industry.

There is potential for chemical discharges to result in localised impacts to surface marine fauna, however any impacts will be short term and negligible.

6. We would like to hear from you

Your feedback is important to us and we want to hear from you.

Information obtained from relevant stakeholders is crucial in the development of the Environment Plan under the *Offshore Petroleum Greenhouse Gas Storage Act 2006*. BP will use information obtained from relevant stakeholders to inform the:

- Description of the environment.
- Impact and risk assessment (providing an external context).
- Appropriateness of the control measures proposed.
- Define the 'as low as reasonably practicable' (ALARP) and acceptability assessments.

Information provided by relevant stakeholders will be referenced in the Environment Plan and evidence of consultation will be added; including details such as your name, role, contact details and organisation.

The Environment Plan will be published by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for public comment. If you consider your input or feedback as sensitive information, please let us know. We will ensure, with NOPSEMA, that sensitive information is excluded from the published Environment Plan for public comment.

If you have any queries relating to the information provided in this fact sheet, or would like further information on a topic, please contact us by email at ironbarkinfo@bp.com.

For more information visit the BP Australia website.

Category 3 Stakeholder Letter Template

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Director Policy, Environmental and Community Affairs

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Email: Tzila.katzel@se1.bp.com

Insert date

Insert address

To whom it may concern:

RE: BP Ironbark Exploration Drilling

BP plans to further explore the Ironbark prospect by drilling a single exploration well to determine the potential of a gas/condensate field in the Carnarvon Basin off Western Australis's north-west coast. The Ironbark prospect is identified as WA-359 P.

Your business has been identified as a relevant stakeholder – category 3. This means you may be impacted by the activity because you operate in the identified EMBA (Environment that may be Affected).

We have enclosed a fact sheet with information for your reference and would like to hear back from you. Your feedback is important to us.

If you have any queries relating to the information provided, please contact us at ironbarkinfo@bp.com.

Yours faithfully
BP Developments Australia Pty Ltd

Tzila Katzel

BP Ironbark Exploration Drilling Fact Sheet

Category 3 and 4

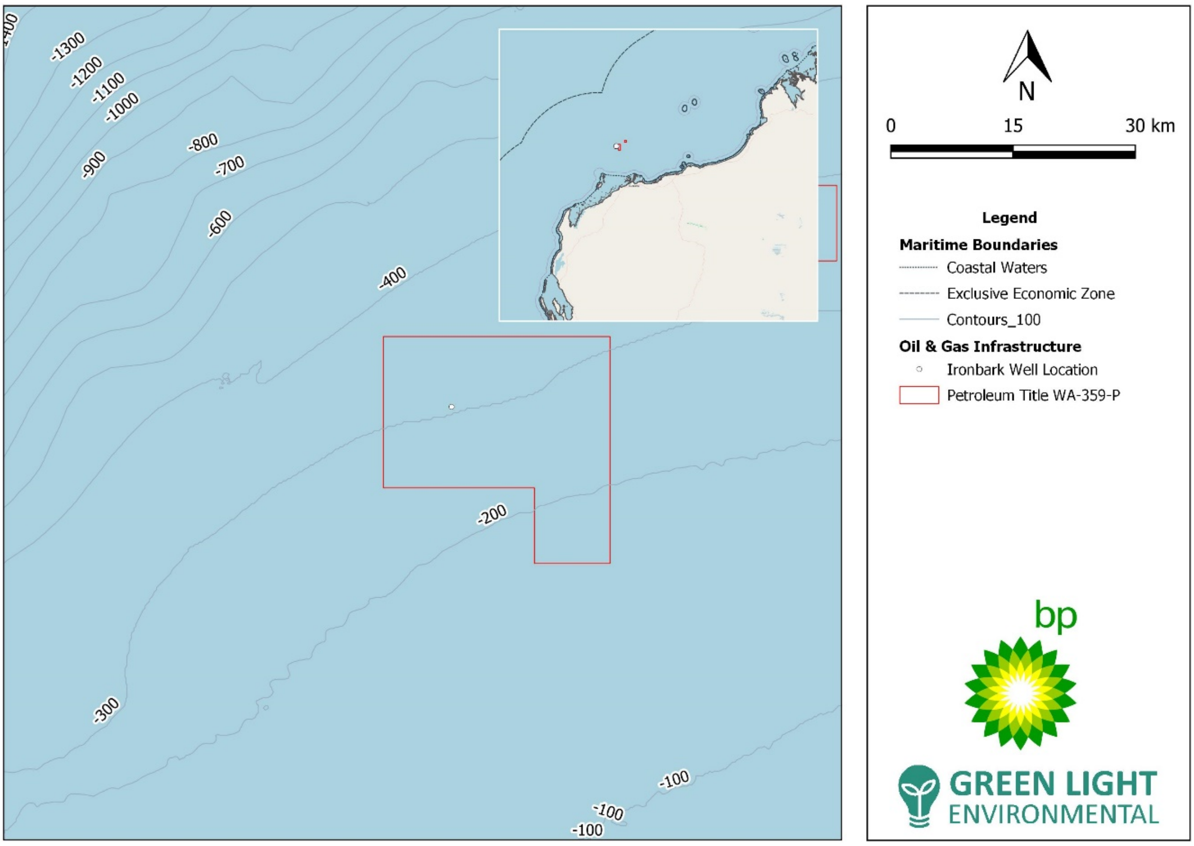
BP plans to further explore the Ironbark prospect in WA-359-P by drilling a single exploration well to determine the potential of a gas/condensate field in the Carnarvon Basin off Western Australia's north-west coast.

The proposed well is in Commonwealth waters and is at a water depth of approximately 300m. Coordinates for the Ironbark-1 exploration well are:

Planned well	Longitude (E)	Latitude (S)	Approximate water depth
Ironbark-1	116° 04' 35.80	19° 09' 34.01"	~300m

Drilling activities are planned to begin between June 2020 and June 2021. We will ensure impacted stakeholders are notified of the activity in advance.

Drilling activities are expected to take around 90-100 days (excluding weather and operational delays). Below is a map showing you the exact location of this activity.



As a category 3 or 4 stakeholder, you are unlikely to experience any impact from planned activities. However, in the event of an unlikely but high impact event, you or your organisation may be impacted directly or indirectly. We will ensure impacted stakeholders are notified of the activity in advance to pre-empt future planning and avoidance measures.

We would like to hear from you

Your feedback is important to us and we want to hear from you.

Information obtained from relevant stakeholders is crucial in the development of the Environment Plan under the *Offshore Petroleum Greenhouse Gas Storage Act 2006*. BP will use information obtained from relevant stakeholders to inform the:

- Description of the environment.
- Impact and risk assessment (providing an external context).
- Appropriateness of the control measures proposed.
- Define the 'as low as reasonably practicable' (ALARP) and acceptability assessments.

Information provided by relevant stakeholders will be referenced in the Environment Plan and evidence of consultation will be added; including details such as your name, role, contact details and organisation.

The Environment Plan will be published by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) for public comment. If you consider your input or feedback as sensitive information Please let us know. We will ensure, with NOPSEMA, that sensitive information is excluded from the published Environment Plan for public comment.

If you have any queries relating to the information provided in this fact sheet, or would like further information on a topic, please contact us by:

- email at ironbarkinfo@bp.com

For more information visit the BP Australia website.

BP Ironbark-1: Fact Sheet 5

This correspondence is to update you on the Ironbark-1 Exploration Drilling.

What are we doing?

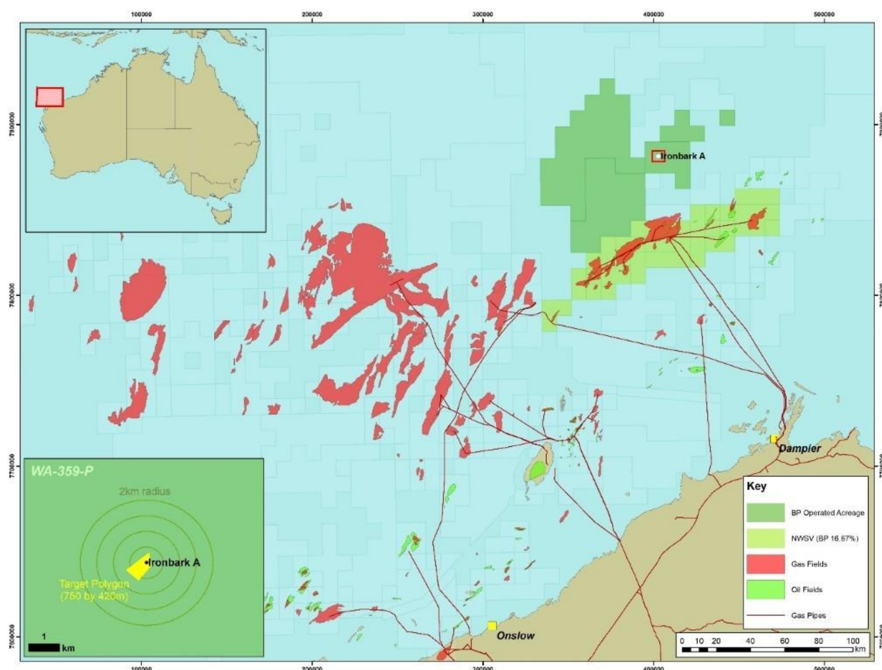
BP is conducting exploration drilling activities for a single exploration well, named Ironbark, in the Carnarvon Basin off Western Australia's north-west coast. This well is a prospect for a potential gas/condensate field.

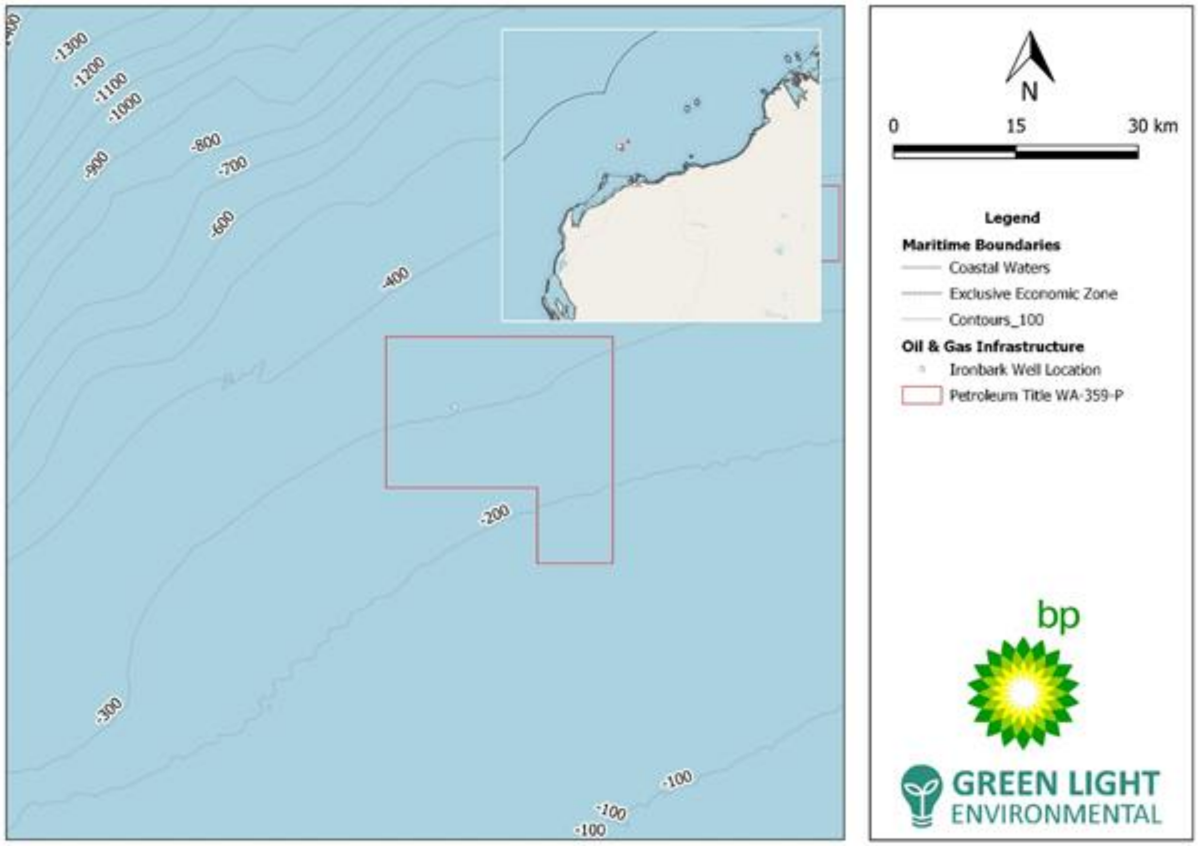
Where are we doing it?

The Ironbark exploration well coordinates are:

Long: 116° 04' 35.80 / Lat: 19° 09' 34.01"

Approximate water depth ~ 300m





How are we doing it?

The Ironbark exploration well will be drilled by a mobile offshore drilling unit (MODU). BP has contract the Ocean Apex. Ocean Apex is already in Australia working with other oil and gas companies. The current plan is for BP to mobilize the Ocean Apex in Q4 of 2020. We expect drilling activities to begin in October/November 2020. Anchors may be placed on the seabed and tested by support vessels before the MODU arrives on site; the Ocean Apex will be towed to location and anchored over the well site. BP will perform formal notification (Notice to Mariners et.) before we begin any activities to help support the anchoring of the MODU.

Supporting the Ocean Apex to deliver the drilling activity will be two AHTS vessels and one PSV. One of these will always be stationed at the platform. This is a total of 3 supporting supply vessels. The shore base will be at the Port of Dampier. The supply base will be in Karratha.

BP has contracted CHC Helicopter to transport the crew and other personal to and from the Ocean Apex. We expect between 3 and 4 helicopter transfers per week.

A 500m exclusion zone will be in place around the Ocean Apex for the duration of the activity.

When and for how long?

The drilling program will take approximately 100 days to complete. The program will begin in Q4 2020.

How will commercial fisheries be impacted?

Some commercial fisheries hold licenses that overlap BP's Ironbark exploration permit area of activity. Any license holder fishing within a 40-kilometre radius of the Ironbark site is likely to be impacted by the planned activity as they will see and possibly hear our operations in the area.

Local commercial fisheries could be impacted by:

- Physical presence – displacement of other marine users.
- Underwater sound.
- Planned discharges – drilling fluids (including completion, spacer and other fluids)
- Planned discharges – cement.
- Planned discharges – blow-out preventer (BOP) control fluids.
- Planned discharges – cooling water, brine and bilge.

Physical presence – displacement of other marine users

The operational area includes a 500m safety exclusion zone around the Ocean Apex. Shipping or fishing activities will not be able to be conducted for the100 day duration in the exclusion zone.

State managed fisheries have recorded fishing activity within the operational area, however the fishing activity has been low volume. There has been some past vessel traffic in the operational area, however there are no designated shipping channels or navigational hazards limiting vessel avoidance movements.

We will ensure impacted stakeholders are notified of the activity in advance to pre-empt future planning and avoidance measures.

Once the activity is completed, the suspended/abandoned wellhead could be a hazard for bottom trawling fishing. The wellhead will be identified on appropriate marine charts and on-going consultation will be conducted to avoid wellhead interactions with trawling fishing or any other users of that area.

Underwater sound

Based on scientific literature[1], fish will generally avoid sound sources generated by the underwater activity. We anticipate possible short-term behaviour responses, such as avoidance of the sound sources during drilling. It is highly unlikely that underwater sound emissions from drilling activities will cause lethal impact or delayed impact to fish in the area. If you would like more details on the scientific studies used in our assessment on expected fish behaviour, please let us know and we will send this to you.

Our assessment of the drilling (specifically impulsive sound) on fish eggs or larvae shows insignificant impact especially when compared to natural mortality[2].

It is possible that temporary avoidance of fish species could impact commercial fisheries through a reduction in catch rates. However, for those commercial fishing licences which overlap the operational area, FishCube historical data between 2014-2018 shows very limited fishing activity. The Ironbark-1 well is at 300m, so benthic invertebrates are considered out of range of any impact. The support vessels underwater sound will be like any other shipping vessel in the area. The sound from their operational activity is unlikely to impact variable fishing activity. We do not expect a reduction in catch rates for fishes due to our drilling program.

Planned discharges – drilling fluids (including completion, spacer and other fluids)
BP commissioned modelling studies to predict the extent of exposure associated with drilling fluid discharges. It is expected that 250m away from the Ocean Apex, drilling fluid concentrations are below thresholds that have the potential to cause environmental impacts. We do not expect any indirect impacts (such as impacts to plankton) to commercial fisheries as a result of this discharge within 250m.

Planned discharges – cement
We used a model to help us understand whether cement discharge from the drilling of this well would have any environmental impacts. We looked at an example of a similar well that we had drilled in a similar environment in 2013 to compare with any potential impacts. In the 2013 case, the cement plume was approximately 150m horizontally and 10m vertically. We assumed this size plume to understand the impacts for the Ironbark-1 drilling activity. As a result, there were no issues linked to plankton foraging or increased abundance. We do not expect any indirect impacts to commercial fisheries.

Modelling of cement discharges for another BP offshore project was used because it provides an appropriate (but conservative) comparison of the potential extent of exposure from this activity. The horizontal and vertical extents of the plume are approximately 150m and 10m, respectively.
There are no particular issues linked to planktonic foraging or increased planktonic abundance affected by this discharge within 150m, so there are no expected indirect impacts to commercial fisheries.

Planned discharges – blow-out preventer (BOP) control fluids
Modelling undertaken for another one of BP's offshore drilling projects indicates that a release of BOP fluids during function testing is expected to reach concentrations below aquatic toxicology thresholds 100m away from the Ocean Apex.
There are no particular issues linked to planktonic foraging or increased planktonic abundance affected by this discharge within 100m, so there are no expected indirect impacts to commercial fisheries.

Planned discharges – cooling water, brine, sewage, greywater, putrescible waste and bilge
Planned discharges of cooling water, brine, sewage, greywater, putrescible wastes and bilge water by MODUs and vessels are commonly practiced both nationally and internationally. Water quality changes in the vicinity of the surface discharge will be quick to dissipate, and rapidly recover on completion of the activity.
The potential impacts and risks are well regulated via various treaties and legislation, both nationally and internationally, which specify industry best practice control measures. These are well understood and implemented by the industry.
There is potential for chemical discharges to result in localised impacts to surface marine fauna, however any impacts will be short term and negligible.

What are unplanned events?

Unplanned events are those which are unlikely to occur but have been assessed so that all possible scenarios are considered, planned for, and suitable controls have been put in place. The scenarios below are those believed to have possible impact to commercial fishers.

Wellhead abandonment

After operations have been completed if the wellhead cannot be removed and must be abandoned this could cause damage to equipment for any fishing operators which trawl in that area. There is a very low likelihood of a well abandonment and all measures will be taken to avoid this.

Sea life interactions

There is a very low possibility of interaction with sea life with vessels and equipment, such as a ship striking marine life. The likelihood of this happening is minor, with our vessels moving very slowly and in a limited area and for only a short time.

Invasive marine species

Introduction of invasive marine species is possible through movement of vessels and equipment. Due to the deep water, strong currents, control measures and by following industry best-practice, this is considered as have a high potential impact, but as unlikely to occur.

Waste

An accidental release of waste from the MODU and vessels is possible, however multiple control measures – procedural and technical – have been put in place, so this is considered as unlikely.

Loss of containment

A small hydrocarbon or chemical spill is possible; however, control measures have been put in place and this is unlikely to occur. If a loss of containment did occur, its impact is considered low as handling, storage and transfer of chemicals and hydrocarbons is well-practiced for offshore marine activities. There is also a good understanding of potential spill sources and control measures put in place to managed these.

Loss of well control

Exploration drilling is a standard offshore activity, and BP has successfully drilled more than 70 exploration wells offshore. The activity and causes are well understood; however, if a loss of well control event did occur, there is the potential for a high impact.

An Oil Pollution Emergency Plan (OPEP) has been developed, which includes the equipment available and needed to control an oil spill, procedures for coordinating a response and reporting requirements.

We would like to hear from you. Please email us on ironbarkinfo@bp.com for more information or to raise a concern.

Your feedback is important to us and we want to hear from you.

Information obtained from relevant stakeholders is crucial in the development of the Environment Plan under the *Offshore Petroleum Greenhouse Gas Storage Act 2006*. BP will use information obtained from relevant stakeholders to inform the:

- Description of the environment.
- Impact and risk assessment (providing an external context).
- Appropriateness of the control measures proposed.
- Definition of the 'as low as reasonably practicable' (ALARP) and acceptability assessments.

Information provided by relevant stakeholders will be referenced in the Environment Plan and evidence of consultation will be added; including details such as your name, role, contact details and organization.

If you have any queries relating to the information provided in this fact sheet, or would like further information on a topic, please contact us by email at ironbarkinfo@bp.com
For more information visit the BP Australia website.

**Please note: your name may be included in BP's Environmental Plan (EP) consultation documentation, which will be submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) and be viewable to the public.*

Appendix G

BP Commitment to HSSE Performance

BP's Commitment to **health, safety, security** and **environmental** (HSSE) performance

Our HSSE goals are simply stated – no accidents, no harm to people and no damage to the environment.

We strive to be a safety leader in our industry, a world-class operator, a good corporate citizen and a great employer.

Nothing is more important to us than the health, safety and security of our workforce and the communities in which we operate, and behaving responsibly towards our shared environment. We must be vigilant, disciplined and always looking out for one another.

We are committed to:

– Complying with applicable laws and company policies and procedures.
– Systematically managing our operating activities and risks.
– Reporting our HSSE performance.
- Learning from internal and external HSSE events.

Everyone who works for BP has a part to play in meeting our HSSE commitment.

Bernard Looney,
Group Chief Executive
5 February 2020