

Babylon and Centaurus 3D Marine Seismic Survey Environment Plan Summary

November 2013

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1. INTRODUCTION

Woodside Energy Ltd (Woodside) as operator, proposes to undertake two three dimensional (3D) marine seismic surveys (MSS), referred to as the Babylon and Centaurus 3D MSS, in offshore Commonwealth waters.

This Environment Plan (EP) summary has been prepared as per the requirements of Regulation 11 (7) and (8) of the Environment Regulations. This document summarises the Babylon and Centaurus 3D MSS Environment Plan (EP), accepted under Regulation 11(1) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Commonwealth) (Environment Regulations) by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

The Babylon and Centaurus 3D MSS will take up to approximately 50 days to complete (approximately 28 and 21 days, respectively).

The Centaurus 3D MSS is planned to commence from February 2014 to March 2014. The Babylon 3D MSS is planned to commence no earlier than 1 March 2014 and will be completed no later than 31 May 2014. Planning is currently underway to commence the Centaurus 3D MSS component late February to early March 2014 and then transit to the Babylon 3D MSS component for commencement in mid to late March 2014.

The survey timing has been selected to best avoid windows of environmental sensitivity such as the humpback and pygmy whale migratory period and peak turtle nesting in the region. The actual survey commencement and duration will be dependent on survey vessel availability, operational constraints and prevailing weather conditions.

1.1 Location of the Activity

The proposed Babylon 3D MSS and Centaurus 3D MSS will occur in offshore Commonwealth waters, within the North West Province bioregion. The Babylon 3D MSS operational area is approximately 6 km north of the Muiron Islands (at its southernmost point) and 53 km north-northeast of Exmouth. The Centaurus 3D MSS operational area is approximately 60 km west-northwest of the Babylon 3D MSS operational area and approximately 111 km north-northwest of Exmouth (refer to **Figure 2-1**). Water depths range from approximately 65 m to 400 m and 1000 m to 1200 m, within the Babylon 3D MSS and Centaurus 3D MSS operational areas, respectively.

The Muiron Islands (approximately 6 km south) are the nearest landfall to the Babylon 3D MSS operational area. The North West cape (approximately 114 km south east) is the nearest landfall to the Centaurus 3D MSS.

The Babylon and Centaurus 3D MSS covers an area as defined in **Figure 1-1**. The Babylon 3D MSS proposed 'survey acquisition area'¹ (i.e. the area within which seismic acoustic emissions will occur for the purposes of acquiring data), is located in Petroleum Permits WA-483P, WA-476-P, WA-290-P, WA-49-R, WA-358-P, WA-10-L, WA-12-L, WA-486-P and covers approximately 1264 km².

The Centaurus 3D MSS proposed 'survey acquisition area'¹ (i.e. the area within which seismic acoustic emissions will occur for the purposes of acquiring data), is located in Petroleum Permit WA-478-P, WA-351-P and covers approximately 810 km².

An 'operational area' surrounds the 'survey acquisition area' providing a 'buffer' area of approximately 5 – 10 km in width making up a total area of approximately 3231 km² and 2343 km² for the Babylon and Centaurus 3D MSS' respectively. Within this 'operational area', the seismic source may be discharged at or below full capacity (power) for the purpose of run-ins and run-outs, source testing and soft starts. The boundary coordinates for the proposed Babylon and Centaurus 3D MSS 'survey acquisition areas' and 'operational areas' are presented in **Table 1-1 to Table 1-4**, and in **Figure 1-1**.

Table 1-1: Approximate Boundary coordinates for the 'Babylon 3D MSS 'survey acquisition area'*

Location Point	Latitude	Longitude
A	21°14'55.317"S	114°19'25.511"E
B	21°14'55.349"S	114°25'4.703"E
C	21°9'55.350"S	114°25'4.700"E
D	21°4'55.323"S	114°25'4.796"E
E	20°59'55.338"S	114°25'4.693"E
F	20°59'55.363"S	114°33'55.659"E
G	20°59'55.338"S	114°34'53.314"E
H	20°48'4.706"S	114°42'47.384"E
I	20°47'9.604"S	114°43'24.075"E
J	20°47'26.854"S	114°43'53.373"E
K	21°0'39.457"S	114°35'4.694"E
L	21°0'57.018"S	114°35'4.694"E
M	21°1'9.317"S	114°35'4.695"E
N	21°4'55.339"S	114°35'4.696"E
O	21°9'55.345"S	114°35'4.699"E
P	21°10'57.199"S	114°35'4.701"E
Q	21°10'57.146"S	114°37'9.279"E
R	21°15'1.900"S	114°37'9.336"E
S	21°21'19.316"S	114°37'9.427"E
T	21°21'19.249"S	114°40'17.571"E
U	21°21'51.753"S	114°40'17.590"E
V	21°21'51.818"S	114°37'9.434"E
W	21°24'55.318"S	114°37'9.471"E
X	21°24'55.369"S	114°33'30.191"E
Y	21°24'55.353"S	114°30'4.700"E
Z	21°29'55.352"S	114°30'4.693"E
1	21°29'55.353"S	114°25'4.696"E
2	21°29'55.326"S	114°20'4.707"E
3	21°24'55.357"S	114°20'4.709"E
4	21°24'55.363"S	114°19'25.423"E
5	21°14'55.317"S	114°19'25.511"E

*Datum: GDA94

Table 1-2: Approximate Boundary coordinates for the Babylon 3D MSS 'operational area'*

Location Point* ²	Latitude	Longitude
A	21°34'25.094"S	114°16'31.563"E
B	21°6'47.795"S	114°16'32.364"E
C	21°6'47.891"S	114°22'11.534"E
D	20°51'47.752"S	114°22'11.702"E
E	20°51'47.709"S	114°36'54.716"E
F	20°39'45.162"S	114°44'55.962"E
G	20°42'54.779"S	114°50'18.139"E

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H	21°1'26.200"S	114°37'57.786"E
I	21°2'49.564"S	114°37'57.822"E
J	21°2'49.465"S	114°40'2.266"E
K	21°18'36.739"S	114°40'2.820"E
L	21°18'36.342"S	114°47'31.068"E
M	21°24'33.906"S	114°47'31.568"E
N	21°24'34.248"S	114°40'59.620"E
O	21°24'34.276"S	114°40'3.015"E
P	21°29'57.011"S	114°40'3.142"E
Q	21°32'48.832"S	114°29'56.445"E
R	21°34'22.058"S	114°22'40.108"E
S	21°34'25.359"S	114°22'26.976"E
T	21°34'25.094"S	114°16'31.563"E

*Datum: GDA94

Table 1-3: Approximate Boundary coordinates for the Centaurus 3D MSS 'survey acquisition area'*.

Location Point	Latitude	Longitude
A	20°49'55.340"S	113°40'4.790"E
B	20°44'55.338"S	113°40'4.787"E
C	20°44'55.340"S	113°35'4.787"E
D	20°44'55.343"S	113°30'4.788"E
E	20°39'55.341"S	113°30'4.785"E
F	20°34'55.338"S	113°30'4.782"E
G	20°29'55.336"S	113°30'4.779"E
H	20°29'55.333"S	113°35'4.779"E
I	20°29'55.331"S	113°40'4.778"E
J	20°29'55.328"S	113°45'4.778"E
K	20°34'55.331"S	113°45'4.781"E
L	20°39'55.333"S	113°45'4.784"E
M	20°44'55.335"S	113°45'4.787"E
N	20°49'55.338"S	113°45'4.790"E
O	20°49'55.341"S	113°44'50.963"E
P	20°54'7.604"S	113°44'50.948"E
Q	20°54'7.609"S	113°44'16.380"E
S	20°49'55.348"S	113°44'16.412"E
T	20°49'55.348"S	113°44'16.412"E
U	20°49'55.350"S	113°44'1.611"E
V	20°49'55.340"S	113°40'4.790"E

*Datum: GDA94

Table 1-4: Approximate Boundary coordinates for the Centaurus 3D MSS 'operational area'*.

Location Point	Latitude	Longitude
A	20°21'48.140"S	113°27'12.445"E

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B	20°21'47.977"S	113°47'56.834"E
C	20°58'2.532"S	113°47'57.539"E
D	20°58'2.142"S	113°31'26.072"E
E	20°53'2.503"S	113°31'26.397"E
F	20°53'2.393"S	113°27'11.875"E
G	20°21'48.140"S	113°27'12.445"E

*Datum: GDA94

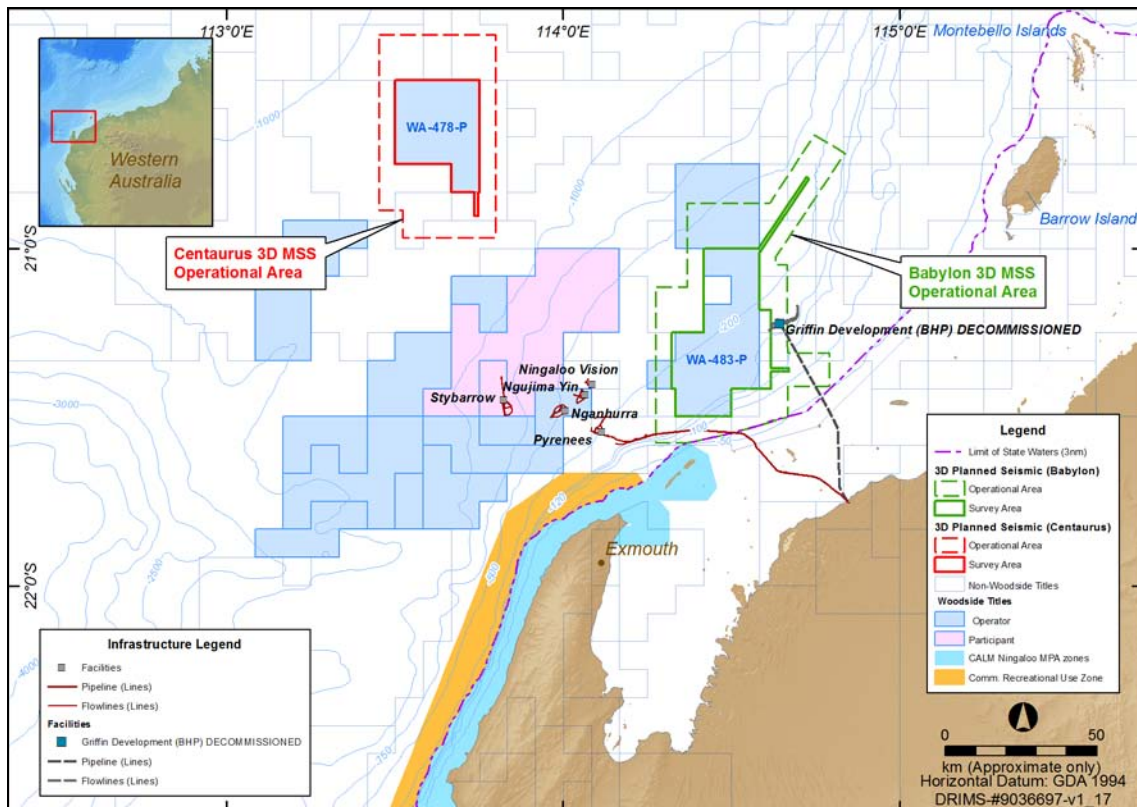


Figure 1-1: Babylon and Centaurus 3D MSS Location Map

2. DESCRIPTION OF THE ENVIRONMENT

In accordance with Regulation 13(2) of the Environment Regulations, a description of the existing environment that may potentially be affected by planned and unplanned activities relating to the proposed Babylon and Centaurus 3D MSS is presented in this section. It includes a description of relevant natural, cultural and socio-economic aspects of the environment, as well as details of relevant values and sensitivities.

2.1 Regional Setting

The Babylon and Centaurus 3D MSS operational areas are located entirely in Commonwealth waters, within the North West Marine Region (NWMR). The Babylon 3D MSS operational area extends from the continental shelf (adjacent to the State water boundary) to offshore waters (encompassing a depth range of 65 - 400 m).

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The Babylon 3D MSS survey area ranges in depths from 100– 380 m. The boundary of the Babylon 3D MSS operational area is approximately 6 km north of the Muiron Islands and 53 km north-northeast of Exmouth. The Centaurus 3D MSS operational area is located further offshore (as compared to Babylon) in survey water depths of 1,000 to 1,200 m. The boundary of the Centaurus 3D MSS operational area is 60 km west-northwest of the Babylon 3D MSS operational area and approximately 111 km north-northwest of Exmouth. The Centaurus 3D MSS operational area is within the North West Province (NWP) and the Babylon 3D MSS operational area lies within both the NWP and the North West Shelf Province (NWSP). Both the NWP and NWSP are bioregions within the NWMR, as defined under the Integrated Marine and Coastal Regionalisation of Australia (IMCRA v4.0) and shown in **Figure 2-1**.

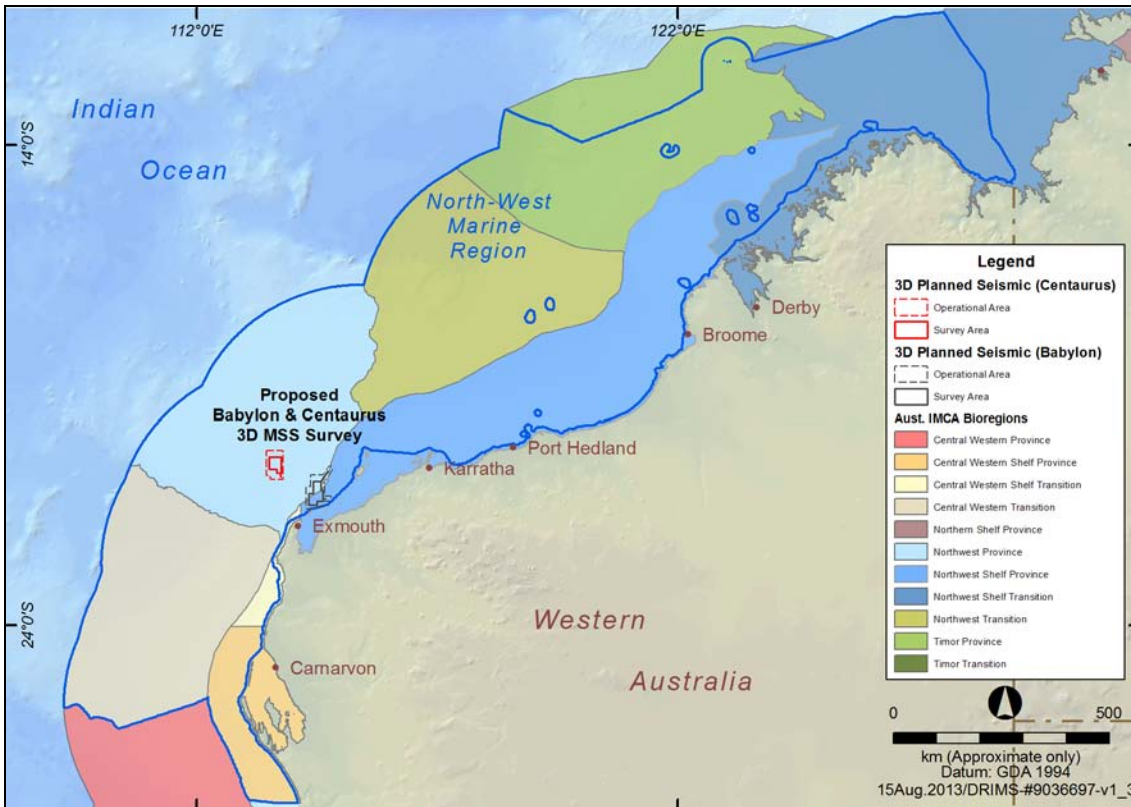


Figure 2-1: North West Marine Region and the North-west Province (Source - DEWHA 2008a) and the location of the Babylon and Centaurus 3D MSS operational areas.

2.2 Physical Environment

This subsection describes the ambient physical environment and the metocean conditions that are expected for both the Babylon and Centaurus 3D MSS, unless stated otherwise.

2.2.1 Bathymetry and Seabed Composition

Babylon 3D MSS

The Babylon 3D MSS operational area is located in water approximately 65 – 400 m deep. The operational area overlies an area where the continental shelf broadens considerably and associated with the shelf area are a number of sand and limestone island groups, including the Muiron Islands, Mackerel Islands, Barrow Island, the Lowendal Islands and the Montebello Islands. The NWS shelf break typically occurs at around 200 m depth, with the slope extending to around 1,000 m, where a significant terrace feature known as the

Exmouth Plateau occurs (Baker *et al.* 2008). To the south of the Babylon 3D MSS operational area, the continental shelf continues into a narrow feature dominated by the Ningaloo reef system (Harris *et al.* 2003). The continental slope to the south continues as a steeply sloping feature, punctuated by canyons and sloping away to the abyssal plain further offshore (Harris *et al.* 2003). Seabed sediments of the continental slope and as expected within and around the Babylon 3D MSS operational area are generally dominated by carbonate silts and muds, with sand and gravel fractions increasing closer to the shelf break on the upper slope (Baker *et al.* 2008).

Centaurus 3D MSS

The Centaurus 3D MSS survey area is located in waters approximately 1,000 to 1,200 m deep, within the NWP (where 80% of this bioregion encompasses depths between 1,000 and 3,000 m over geomorphic features including the continental slope and valley/troughs, as defined by Baker *et al.* (2008). The seabed area of the NWP is composed of unconsolidated sediments generally dominated by muds and also sand, with relatively high calcium carbonate content (Baker *et al.* 2008).

2.3 Biological Environment

2.3.1 Benthic Communities

Benthic habitats of the offshore continental shelf and slope (such as the Babylon and Centaurus 3D MSS operational areas) are characterised as predominantly bare, unconsolidated, muddy substrates (Baker *et al.* 2008). Such seabed habitat is broadly represented in the region and typically hosts a sparse assemblage of filter- and deposit-feeding epibenthic fauna, for example, the Enfield and Vincent fields (Woodside 2005). Environmental surveys in the region have recorded a diverse, but broadly represented species inventory comprising infauna (organisms inhabiting the seabed sediments) dominated by polychaete worms and crustaceans (RPS 2012). Offshore, deeper region epifauna (benthic organisms on the seabed) are typically sparse, patchy in distribution and associated with areas of hard substrate. Epifauna are typically closely associated with substrate type and areas of hard substrate generally exhibit more diverse benthic communities (Heyward *et al.* 2001). Offshore seabed surveys across the continental shelf and slope of the NWSP have detected a general reduction in epibenthic coverage with increasing depth (Fulton *et al.* 2006). This region-wide CSIRO survey revealed larger epifauna (>25 cm such as sponges) are rare beyond the 100 m depth contour (Fulton *et al.* 2006). Benthic community assessment has been carried out for the Vincent Field (permit area WA-28L) approximately 26 km to the west of the Babylon permit area (WA-483-P). The ROV surveys revealed four main invertebrate groups representative of the deepwater benthos: crustaceans, echinoderms and filter-feeders such as sponges and gorgonians (octocorals), and species diversity decreased with depth across the surveyed areas (Woodside 2005).

2.3.2 Protected Marine Fauna

A search using the DoE (formally known as SEWPaC) online protected matters search tool was carried out encompassing the operational area for both the Babylon and Centaurus 3D MSS. Results of the protected matters search are presented in **Table 2-1**. The search for the Babylon and Centaurus 3D MSS operational areas reported the following (as under the EPBC Act). A total of 55 listed marine species, 14 threatened marine species and 21 migratory species that may occur within, or traverse the operational areas.

Table 2-1: EPBC Act Protected Matters Search for the Babylon and Centaurus 3D MSS Operational Areas

Type	Species	Common Name	Status
Mammals	<i>Balaenoptera musculus</i>	Blue Whale	Endangered/ Migratory
	<i>Megaptera novaeangliae</i>	Humpback Whale	Vulnerable / Migratory
	<i>Eubalaena australis</i>	Southern Right Whale	Endangered/ Migratory

	<i>Balaenoptera bonaerensis</i>	Antarctic Minke Whale	Migratory
	<i>Balaenoptera edeni</i>	Bryde's Whale	Migratory
	<i>Orcinus orca</i>	Killer Whale	Migratory
	<i>Physeter macrocephalus</i>	Sperm Whale	Migratory
	<i>Sousa chinensis</i>	Indo-Pacific Humpback Dolphin	Migratory
	<i>Tursiops aduncus</i>	Spotted Bottlenose Dolphin	Migratory
	<i>Dugong dugon</i>	Dugong	Migratory
Marine Reptiles	<i>Aipysurus apraefrontalis</i>	Short-nosed Seasnake	Critically Endangered
	<i>Caretta caretta</i>	Loggerhead Turtle	Endangered/ Migratory
	<i>Chelonia mydas</i>	Green Turtle	Vulnerable/ Migratory
	<i>Dermochelys coriacea</i>	Leatherback Turtle	Endangered/ Migratory
	<i>Eretmochelys imbricata</i>	Hawksbill Turtle	Vulnerable/ Migratory
	<i>Natator depressus</i>	Flatback Turtle	Vulnerable/ Migratory
Seabirds	<i>Macronectes giganteus</i>	Southern Giant Petrel	Endangered
	<i>Pterodroma mollis</i>	Soft-plumaged Petrel	Vulnerable
	<i>Puffinus carneipes</i>	Flesh-footed Shearwater	Migratory
Sharks	<i>Rhincodon typus</i>	Whale Shark	Vulnerable/ Migratory
	<i>Carcharodon carcharias</i>	Great White Shark	Vulnerable/ Migratory
	<i>Carcharias Taurus</i>	Grey Nurse Shark	Vulnerable
	<i>Isurus oxyrinchus</i>	Shortfin Mako	Migratory
	<i>Isurus paucus</i>	Longfin Mako	Migratory

Source: DSEWPac Protected Matters Search Tool, accessed 1st August 2013

2.3.2.1 Commonwealth Fisheries

Commonwealth-managed fisheries include all commercial fisheries operating within the Australian Fishing Zone, which extends 200 nautical miles from the mainland coast. Several Commonwealth-managed fisheries potentially operate within, or are adjacent to, the Babylon and Centaurus 3D MSS operational area and these are:

- Western Deepwater Trawl Fishery;
- North West Slope Trawl Fishery;
- Western Tuna and Billfish Fishery;
- Western Skipjack Tuna Fishery; and
- Southern Bluefin Tuna Fishery.

2.3.2.2 State Fisheries

State managed fisheries (Gascoyne and North Coast State Fisheries) are generally active to the north and south of the Babylon and Centaurus 3D MSS operational area and include the following:

- Gascoyne Demersal Scalefish Fishery (to the south);
- West Australian Mackerel Fishery;
- Pilbara Trawl, Trap and Line Fishery (North Coast Demersal Fishery) (to the north);
- Exmouth Gulf Prawn Managed Fishery;
- Onslow Prawn Managed Fishery;

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- Pearl Oyster Managed Fishery and associated aquaculture;
- Marine Aquarium and Specimen Shell Collection Fishery;
- Abalone Fishery (as far north as Shark Bay); and
- West Coast Deep Sea Crustacean (Interim) Managed Fishery

2.3.3 Tourism and Recreational Fishing

Tourism is one of the major industries of the region and contributes significantly to the local economy in terms of both income and employment. The potential for growth and further expansion in tourism and recreational activities in the Pilbara and Gascoyne regions is recognised, particularly, with the development of regional centres and a workforce associated with the resources sector (Gascoyne Development Commission 2012). The main marine nature-based tourist activities are snorkelling and scuba diving, whale shark encounters and whale watching. Most diving takes place relatively close to shore, e.g. Ningaloo coast including Bundegi Reefs, and around the reefs fringing the offshore islands, eg., Muiron Islands. Whale watching and whale shark encounters take place during the seasonal migration/aggregation periods and these activities generally occur within the Ningaloo Marine Park. It is expected that whale shark tourism operators focus their operations adjacent to the Ningaloo reef, coinciding with the known whale shark tracking spatial distribution. Marine nature-based tourism attracts over 270,000 annual visitors to the region with an estimated \$127 million spent per year by visitors to Ningaloo Marine Park and Cape Range National Park (MPRA 2005).

The warm, dry winter climate of the North West Cape area along with accessible fish stocks have made it a focal point for winter recreation by the Western Australian community it is a popular area for recreational fishers (Smallwood *et al.* 2011). Recreational fishers predominantly target tropical species such as emperors, snappers, groupers, mackerels, trevallies and other game fish (DoF 2011). Recreational angling activities include shore-based fishing, private boat and charter boat fishing, with the peak in activity between April and October (DoF 2011; Smallwood *et al.* 2011). Recreational fishing activities by local residents and visitors is also popular in the Pilbara offshore and nearshore areas and this includes charter boat trips to the Pilbara islands on day or overnight trips (DEC 2013). The islands frequently visited include Mackerel Island (near Thevenard) and the more remote, offshore islands of the Montebellos and Lowendal Islands.

2.3.4 Existing Petroleum Activities

The NWMR and particularly the North West Cape region have a high level of oil and gas industry presence and activities offshore. A number of offshore oil production facilities are located in the region, however, none of these are located within either the Babylon or Centaurus operational areas. The BHP-B Griffin Development was located on the eastern edge of the Babylon 3D MSS operational area, however this facility has now been decommissioned and only subsea infrastructure remains. Woodside has contacted BHP-B to ascertain the level and depth of the remaining subsea infrastructure. Subsea flow lines associated with the Macedon project also transect the southern edge of the Babylon 3D MSS operational area. Facilities nearby but outside of the Babylon and Centaurus 3D MSS operational areas include the Nganhurra Floating Production Storage and Offloading (FPSO), Ngujima-Yin FPSO, Stybarrow Venture FPSO, Pyrenees FPSO facility and Ningaloo Vision FPSO.

2.3.5 Shipping

The region is subject to commercial shipping en-route from ports such as Fremantle and Geraldton heading north, and movements out of Broome, Port Hedland and Dampier heading south along the West Australian coast. Shipping in the region is expected to include:

- international bulk freighters

- domestic support/supply vessels servicing offshore facilities
- construction vessels/barges/dredges
- offshore survey vessels.

The Australian Maritime Safety Authority (AMSA) has introduced a network of commercial shipping fairways¹ on the NWS in order to reduce the risk of potential vessel collisions with offshore infrastructure. The fairways are not mandatory, but AMSA strongly recommends commercial vessels remain within the fairway when transiting the region. One of these fairways passes through the Centaurus 3D MSS area in a north south direction.

2.3.6 Defence Activities

The Australian Department of Defence operates recognized training areas and special purpose military areas for training and exercises to ensure Australia's defense capabilities. The Royal Australian Air Force maintains a base at Learmonth, North West Cape. The Minister for Defence has the authority, under the *Defence Force Regulations 1952*, to declare and Gazette any area of sea or air space as a Defence Practice Area (DPA), for carrying out Defence operations or practice. When a DPA is activated, a Notice to Mariners (NTM) will be issued to notify marine operations that unauthorised access to the area will be prohibited. A small portion of the proposed Centaurus 3D MSS operational area (not the survey area) encroaches on the Learmonth Air Weapons Air Range (overwater portion).

The Royal Australian Air Force base supports operational and exercise deployments as required. According to the Annual Australian Notices to Mariners (Australian Hydrographic Service, 2013) some military flying training may occur in the vicinity of the survey area. The United States Navy maintains a supply base at Point Murat (approximately 15 km north of Exmouth), with some associated military shipping activity.

2.3.7 National and Cultural Heritage

The Ningaloo Coast is registered as a National Heritage Place and comprises a coastal strip and marine areas (including the Ningaloo Commonwealth Marine Reserve), reefs and islands.

Historic shipwrecks of National and State heritage value are protected under the *Historic Shipwrecks Act 1976 (Cwlth)* and *Maritime Archaeology Act 1973 (WA)*. The National Shipwreck Database lists seven shipwrecks that occur in the vicinity of North West Cape (DSEWPaC 2012t). However, there are no Historic Shipwreck Protected Zones or wreck sites within the Babylon and Centaurus 3D MSS operational areas.

Cultural heritage sites are located along the Ningaloo coast with more than 140 Aboriginal heritage sites registered within the Ningaloo Coast including artefact scatters, middens, engravings, ceremonial and mythological areas, grinding patches and grooves, burial sites and manmade structures. Aboriginal heritage areas are coastal and the proposed Babylon operational area is approximately 37 km from the Ningaloo Coast (note that there are no known Aboriginal sites on the Muiron Islands). Therefore it is not expected that the campaign would intersect or impact any of these sites nor result in the loss of one or more aboriginal heritage values.

2.3.8 Commonwealth and State Marine Parks and Reserves

The Centaurus 3D MSS operational area overlaps with the multiple use zone of the Gascoyne Commonwealth Marine Reserve and the Babylon 3D MSS operational area abuts in part the outer boundary of the World Heritage Area of Ningaloo and the Muiron Islands (which are also protected as a

¹ <http://www.ret.gov.au/Documents/par2011/release-areas/documents/2011%20Areas%20Special%20Notices.doc>

Commonwealth Marine Reserve and Marine Park). Other marine protected areas within close proximity to the Babylon 3D MSS operational area are the Montebello Commonwealth Marine Reserve, Montebello Islands Marine Park/ Barrow Island Marine Management Area. A number of islands such as the Pilbara Islands- Southern Island group (Serrurier, Bessieres and Thevenard) and the Lowendal Islands are classified under State Nature Reserve protection primarily for seabird and shorebird populations utilising coastal habitats. Existing and proposed State and Commonwealth Marine Protected Areas (MPAs) of relevance to the Babylon and Centaurus 3D MSS operational area are presented in **Figure 2-3**.

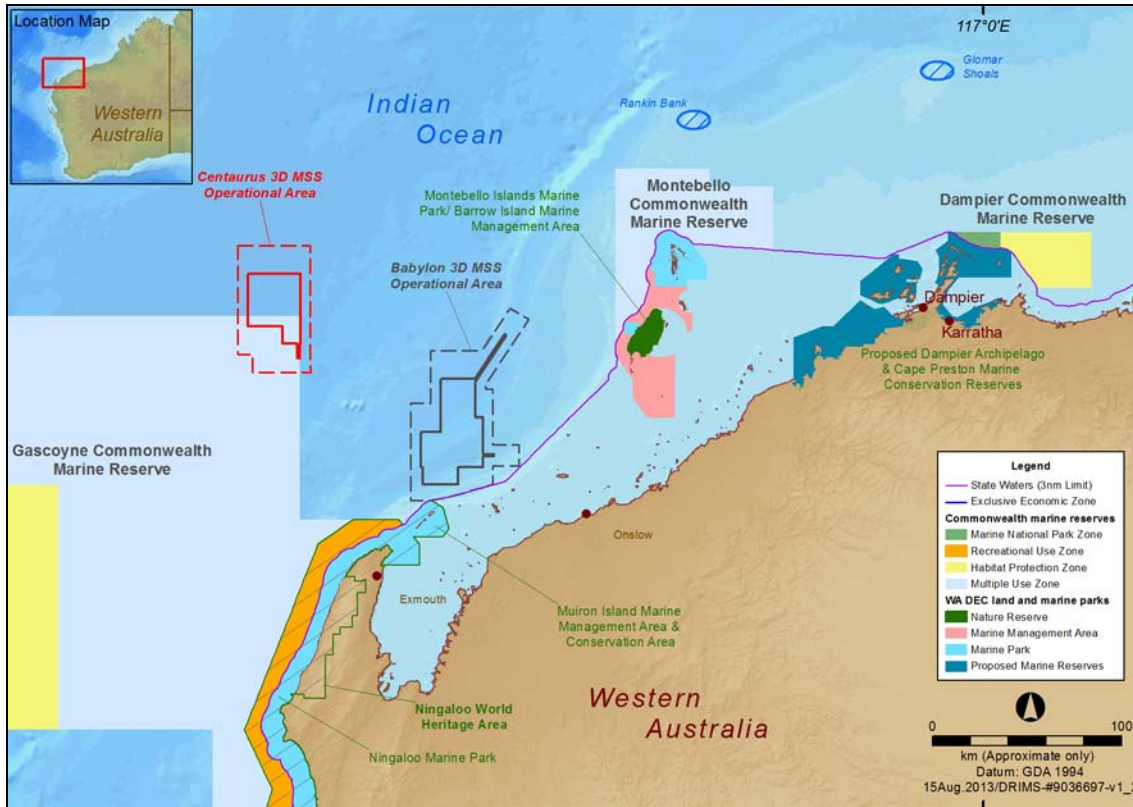


Figure 2-2: Existing and Proposed Marine Parks and Reserves

3. DESCRIPTION OF THE ACTIVITY

The proposed Babylon and Centaurus 3D MSS will be conducted using standard seismic equipment and operational techniques (i.e. standard towed streamers). Seismic streamers will sit at depths of between 6 and 10 m. The same purpose-built seismic vessel will likely be used for both the Babylon 3D MSS and Centaurus 3D MSS.

During the proposed Babylon and Centaurus 3D MSS activities, the seismic vessel will traverse a series of pre-determined sail lines (approximately 45 km long) within the survey acquisition areas generally at a speed of less than 5 knots, while acquiring data, unless in an emergency. As the vessel travels along the survey lines a series of noise pulses generated from the acoustic source will be directed down through the water column and seabed. The released sound is attenuated and reflected at geological boundaries and the reflected signals are detected using sensitive microphones arranged along up to fourteen hydrophone cables (streamers) towed behind the seismic vessel. The reflected sound is then processed to provide information about the structure and composition of geological formations below the seabed in an attempt to identify hydrocarbon reservoirs.

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3.1.1 Seismic Source

The proposed Babylon and Centaurus 3D MSS seismic source will comprise an airgun array with a maximum volume of up to 4,000 in³ capacity with an operating pressure of approximately 13,800 kPa (2,000 psi). The source array will be towed at depth of 6 to 10 m (+/- 1 m). The source arrays will be fired alternately with a shotpoint interval of approximately 18.75 m horizontal distance. The source produces sound pulses (sound pressure level – SPL) within a few meters of the source in the order of 245-260 dB re 1µPa at frequencies extending up to approximately 200 Hz due to absorption within the water column.

3.1.2 Receiver Technology

The proposed Babylon and Centaurus 3D MSS will use a seismic vessel to tow up to 14 solid streamers, each of which will be up to 7000 m in length. The streamer/s will be towed at a depth of approximately 8 – 10 m (+/- 2m). Both are towed in the water column relative to water depth and be spaced approximately 100 m apart.

The streamers contain steering devices in the form of remote controlled wings, integral to the streamer, which enable both precise depth control and horizontal steering. Horizontal streamer steering provides feather (where the streamer tends to veer offline a little due to wind and currents) correction, safe streamer separation control, and active steering.

4. MAJOR ENVIRONMENTAL HAZARDS AND CONTROLS

Woodside undertook an environmental risk assessment to understand the potential environmental risks associated with the Babylon 3D MSS to ensure they are reduced to As Low As Reasonably Practicable (ALARP) and will be of an acceptable level using a method consistent with Woodside standards.

A summary of key environmental hazards and control measures to be applied to the Babylon and Centaurus 3D MSS activities are shown in **Appendix A**. These are consistent with Woodside corporate and project-specific objectives, standards and criteria. All control measures associated with the hazards will be used to reduce environmental risk to ALARP and will be of an acceptable level.

5. MANAGEMENT APPROACH

The Babylon and Centaurus 3D MSS will be managed in compliance with the *Babylon and Centaurus 3D MSS Environment Plan* accepted by NOPSEMA under the Environment Regulations, other relevant environmental legislation and Woodside's Management System (e.g. Woodside Environment Policy).

The objective of the EP is to ensure that potential adverse impacts on the environment associated with the Babylon and Centaurus 3D MSS, during both routine and non-routine operations, are identified, and will be reduced to ALARP and will be of an acceptable level.

The Babylon and Centaurus 3D MSS EP details for each environmental aspect (identified and assessed in the Environmental Risk Assessment – *Section 4 of the Environment Plan*) specific performance objectives and standards, and identifies the range of controls (controls available in **Appendix A** of this summary) to be implemented (consistent with the standards) to achieve the performance objectives and identifies the specific measurement criteria used to demonstrate that these performance objectives are achieved.

The implementation strategy detailed in the Babylon and Centaurus 3D MSS EP identifies the roles/responsibilities and training/competency requirements for all personnel (Woodside and its contractors) in relation to implementing controls, managing non-conformance, emergency response and meeting monitoring, auditing, and reporting requirements during the activity. The Babylon and Centaurus 3D MSS EP details the types of monitoring and auditing that will be undertaken, the reporting requirements for environmental incidents and reporting on overall compliance of the survey with the EP.

6. CONSULTATION

Woodside conducted a stakeholder assessment for the proposed activity to identify relevant and interested stakeholders based on the well location, proposed activities and timing.

A consultation fact sheet was sent electronically to all identified stakeholders prior to lodgement of the EP with NOPSEMA for assessment and acceptance. This advice was supported by engagement with potentially affected stakeholders.

Woodside received feedback on the proposed activity from a range of stakeholders, including government agencies, recreational fishing organisations and conservation groups. Issues of interest or concern included the location of the proposed survey across shipping fairways and commercial fishing areas, as well as potential impacts on marine mammals.

Woodside considered this feedback in its development of management measures specific to this survey. Woodside will continue to accept feedback from stakeholders during the survey.

7. CONTACT DETAILS

For further information about this activity, please contact:

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APPENDIX A: Summary of Major Environmental Hazards and Control Measure to be applied to the Babylon and Centaurus 3D MSS

Source of Risk (Hazard)	Potential Environmental Impact	Control/ Mitigation Measures
PLANNED (ROUTINE AND NON-ROUTINE) ACTIVITIES		
Vessel noise emissions during normal operations (excluding survey acoustic sources)	Short-term localised disturbance to marine fauna such as alteration of behaviours and localised displacement.	<p>Interaction between survey vessels and cetaceans (whales and dolphins) within the operational area will be consistent with EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.04) – Interacting with cetaceans</p> <ul style="list-style-type: none"> • survey vessels will not travel at greater than 6 knots within 300 m of a cetacean (caution zone) and minimise noise; • Survey vessels will not approach closer than 100 m for a cetaceans (with the exception animals bow riding); <p>Exception: The above requirement does not apply to survey vessels operating under limited/constrained manoeuvrability including but not limited to seismic vessels towing equipment and acquiring data, and in the event of an emergency.</p> <p>The implementation of Performance Standard #1 applying to cetaceans, and also applying to whale sharks, and turtles during the survey.</p>
Interference with/exclusion of commercial fishing operations and shipping	Interference with/ exclusion of fishing/charter boat operations	<p>Survey vessels compliant with Marine Orders Part 30: Prevention of Collisions (Issue 8) and Marine Orders Part 21: Safety of navigation and emergency procedures, Issue 8, specifically:</p> <ul style="list-style-type: none"> • Use of standard maritime safety procedures (including radio contact, display of navigational beacons and lights). <p>The Australian Maritime Safety Authority (AMSA) Rescue Coordination Centre (RCC)) (as part of marine safety division) is notified of the seismic vessel movements prior to mobilisation* so that AMSA RCC ensures that navigation Auscoast warnings can be issued and kept up to date <i>*Notifications will be made for both the Babylon and Centaurus survey components.</i></p> <p>The Australian Hydrographic Service (AHS) is advised of the survey details (survey details, location, timing) two weeks prior to mobilisation* so that AHS can then issue a notice to mariners. <i>*Notifications will be made for both the Babylon and Centaurus survey components.</i></p> <p>At least one dedicated high speed chase vessel will be employed to assist seismic source vessel to mitigate interference associated with concurrent seismic and third party vessel operations.</p>
Interference with / exclusion of recreational fishing operations and tourism operations	Temporary Interference with/ exclusion of recreational fishing and tourism operations	<p>Survey vessels compliant with Marine Orders Part 30: Prevention of Collisions (Issue 8) and Marine Orders Part 21: Safety of navigation and emergency procedures, Issue 8, specifically:</p> <ul style="list-style-type: none"> • Use of standard maritime safety procedures (including radio contact, display of navigational beacons and lights). <p>The Australian Maritime Safety Authority (AMSA) Rescue Coordination Centre (RCC)) (as part of marine safety division) is notified of the seismic vessel movements prior to mobilisation* so that AMSA RCC ensures that navigation Auscoast warnings can be issued and kept up to date <i>*Notifications will be made for both the Babylon and Centaurus survey components.</i></p> <p>The Australian Hydrographic Service (AHS) is advised of the survey details (survey details, location, timing) two weeks prior to mobilisation* so that AHS can then issue a notice to mariners. <i>*Notifications will be made for both the Babylon and Centaurus survey components.</i></p> <p>The Exmouth Game Fishing Club is notified two weeks prior to the survey vessel arriving into the Babylon 3D MSS operational area, including:</p> <ul style="list-style-type: none"> - Proposed survey mobilisation date - Map of survey area and acquisition lines - Relevant contact details for survey duration communication <ul style="list-style-type: none"> o VHF Radio Channel o Satellite call sign o Vessel Call Signs <p>If the Babylon 3D survey timing overlaps with the GAMEX and Australian International Billfish Tournament then Woodside will also provide The Exmouth Game Fishing Club with information additional to that outlined in #7A which includes:</p> <ul style="list-style-type: none"> - Daily latitude and longitude coordinates of completed survey lines <p>Diving operators identified during stakeholder consultation will be notified, three weeks prior to the survey vessel arriving into the Babylon 3D MSS operational area, including:</p> <ul style="list-style-type: none"> - Proposed survey mobilisation date - Map of survey area and acquisition lines - Relevant contact details for survey duration communication <ul style="list-style-type: none"> o VHF Radio Channel o Satellite call sign o Vessel Call Signs <p>If diving operations are identified to be present within 10km of the active survey vessel the diving vessel will be contacted and requested to keep diving operations at least 10 km distance from the active source at all times.</p> <p>At least one dedicated high speed chase vessel will be employed to assist seismic source vessel to mitigate interference associated with concurrent seismic and third party vessel operations.</p>

Source of Risk (Hazard)	Potential Environmental Impact	Control/ Mitigation Measures
Transfer of ballast water	Introduction and establishment of invasive marine species from ballast water	Adherence the Australian Ballast Water Management Requirements (AQIS 2008); <ul style="list-style-type: none"> As a minimum, all vessels mobilised from outside of Australia must undertake ballast water exchange > 50 nm from land and >200m water depth; or any alternative methods for ballast water management are approved by DAFF Biosecurity in writing before the event. Ballast water exchange records maintained
Transport of biofouling on the vessel hull, internal niches and in-water equipment	Introduction and establishment of invasive marine species from biofouling	Adherence to the Woodside Energy Limited Invasive Marine Species Management Plan (WEL Doc No. A3000AH4345570). <ul style="list-style-type: none"> Woodside's IMS risk assessment process will be applied to all vessels and submersible equipment planning to enter and operate within nearshore waters around Australia. Nearshore areas include all waters within 12 nautical miles of land and in all waters less than 50 m deep at LAT. Based on the outcomes of each IMS risk assessment, management measures commensurate with the risk will be implemented to minimise the likelihood of new IMS being introduced, or established IMS being spread within Australian waters. The Department of Fisheries will be notified within 24 hours of any known or suspected introduced marine species detected in Western Australian State waters Streamer deployment during transit to and from the operational areas will not occur in water closer than 12 nm to shore, or in waters less than 50 m deep.
Vessel Lighting	Disturbance to marine fauna	Lighting will be minimised to sources required for safety reasons for the Babylon 3D MSS
Underwater noise emissions from operation of seismic source	Disturbance to marine fauna, particularly whales, marine turtles, and fish, potentially as physical damage or as a behavioural effect	Operation of the seismic source within the operational area will be compliant with EPBC Act Policy Statement 2.1- Interactions between offshore seismic activities and whales (DEWHA 2008) – Procedures: <ul style="list-style-type: none"> A SEA/MFO or trained bridge crew member will be on watch onboard the seismic vessel to undertake observations for Policy 2.1 applicable species during daylight hours. Precaution Zones (measured in horizontal radius from acoustic source) <ul style="list-style-type: none"> Observation zone: 3 km+; Low power zone: 2 km; and Shut-down zone: 500 m Observation and Compliance Reporting <ul style="list-style-type: none"> Use of vessel crew to supplement dedicated marine fauna observer in whale observations and monitoring compliance of Policy Statement 2.1. Record kept of whale observations During Survey <ul style="list-style-type: none"> Pre start-up Visual Observation Soft start Procedure Start-up Delay Procedure Operations Procedure Stop Work Procedure Night-time and Low Visibility Procedure <p>Additional procedures to manage the operation of the seismic source in relation to whale sharks and marine turtles will be implemented as outlined below:</p> <ul style="list-style-type: none"> A SEA/MFO or trained bridge crew member will be on watch onboard the seismic vessel to undertake observations for turtles and whale sharks during daylight hours. Precaution zone (measured in horizontal radius from acoustic source) <ul style="list-style-type: none"> Observation and shutdown zone 500 m. During Survey <ul style="list-style-type: none"> Pre start-up Visual Observation (final 10 minutes of the cetacean pre-start up observation period) Soft start Observations (final 10 minutes of the cetacean soft start period) Start-up Delay Procedure (applied if whale shark or turtle is sighted within the 500m shutdown zone, recommence soft start if animal/ s observed to move outside of the 500 m shut down zone or a period of 10 minutes has passed since last sighting) Operations Procedure (continuous observations focusing on 500 m zone) Stop Work Procedure (applied to whale shark and turtle sightings in 500m shutdown zone) Observation and Compliance Reporting <ul style="list-style-type: none"> Use of vessel crew to supplement dedicated marine fauna observer in whale shark and turtle observations and monitoring compliance. Record kept of whale shark and turtle sightings Record kept of observation effort, observation conditions, source operations and procedures implemented <p>Two dedicated Marine Fauna Observers will be employed onboard the seismic vessel for the duration of the Babylon 3D MSS.</p> No discharge of the seismic source outside of the operational area.

Source of Risk (Hazard)	Potential Environmental Impact	Control/ Mitigation Measures
Emission from fuel use or waste combustion	Contribution to global greenhouse gas emissions; and Consumption of non-renewable natural resources	Compliance with MARPOL 73/78 Annex VI - as applied in Australia under Commonwealth Protection of the Sea (Prevention of Pollution from Ships) Act 1983 Regulations for the Prevention of Air Pollution from Ships - Marine Orders – Part 97 (Part IIID Marine Pollution Prevention – Air Pollution) – where applicable to vessel class including: <ul style="list-style-type: none"> • Vessel has a valid International Air Pollution Prevention Certificate (IAPP) Use of low sulphur fuel when it is available
Discharge of bilge water, grey water, sewage and putrescible wastes	Localised eutrophication of the water column; and localised adverse effect to marine biota.	Sewage, Grey water and Putrescible Waste: Compliance with MARPOL 73/78 - as applied in Australia under Commonwealth Protection of the Sea (Prevention of Pollution from Ships) Act 1983); AMSA Marine Orders - Part 96: Marine Pollution Prevention – Sewage, - as required by vessel class: <ul style="list-style-type: none"> • all sewage, grey water and putrescible waste holding tanks are to be fully operational prior to survey commencement. • operational onboard sewage treatment plant approved by the International Maritime Organisation (IMO). • a valid International Sewage Pollution Prevention Certificate (ISPP). • All MARPOL discharge boundaries requirements are met Bilge Water: Compliance with MARPOL 73/78 - as applied in Australia under Commonwealth Protection of the Sea (Prevention of Pollution from Ships) Act 1983); AMSA Marine Orders - Part 91 Marine Pollution Prevention – Oil, as required by vessel class; <ul style="list-style-type: none"> • Bilge water contaminated with hydrocarbons must be contained and disposed of onshore, except if the oil content of the effluent without dilution does not exceed 15 ppm or an IMO approved oil/water separator (as required by vessel class) is used to treat the bilge water. Survey vessels will not enter the Ningaloo World Heritage Area, unless in the case of an emergency.
Interference with the heritage values of Ningaloo Marine Park, World Heritage Area	Interference with the heritage and cultural values associated with the Ningaloo World Heritage Area.	Survey vessels will not enter the Ningaloo World Heritage Area, unless in the case of an emergency.
UNPLANNED ACTIVITIES (ACCIDENTS OR INCIDENTS)		
Collision between survey vessels and marine fauna	Injury or fatality to protected marine fauna	Interaction between survey vessels and cetaceans (whales and dolphins) within the operational area will be consistent with EPBC Regulations 2000 – Part 8 Division 8.1 (Regulation 8.04) – Interacting with cetaceans <ul style="list-style-type: none"> • survey vessel will not travel at greater than 6 knots within 300 m of a cetacean (caution zone) and minimise noise; • survey vessel will not approach closer than 100 m for a cetacean (with the exception animals bow riding). Exception: The above requirement does not apply to survey vessels operating under limited/constrained manoeuvrability including but not limited to seismic vessels towing equipment and acquiring data, and in the event of an emergency. The implementation of Performance Standard #1 applying to cetaceans, and also applying to whale sharks, and turtles during the survey. Compliance with required notifications of activities affecting cetaceans under the EPBC Regulations.
Release of Hazardous and non-hazardous waste	Pollution and contamination of the environment and secondary impacts of marine fauna (e.g. Ingestion, entanglement)	Current Vessel Waste Management Plan (or equivalent) in place detailing wastes generated and disposal requirements. Must contain as a minimum: <ul style="list-style-type: none"> • All waste storage facilities in good working order and designed in such a way as to prevent or contain any discharges. • All hazardous wastes will be segregated prior to onshore disposal. No incidents of significant releases of waste materials to the marine environment. Any accidental release of significant wastes to the marine environment will be recovered where safe and practicable to do so.
Loss or grounding of towed equipment	Damage to benthic communities	Operational procedures will be in-place on board the seismic vessel for deployment and retrieval of towed equipment. Streamers cleaned when bio-fouling presents a significant risk to streamer integrity. Streamers equipped with pressure-activated, self-inflating buoys designed to bring the equipment to the surface if lost accidentally. Lost towed equipment will be relocated and recovered where safe and practicable to do so. Streamer deployment during transit to and from the operational areas will not occur in water closer than 12 nm to shore, or in waters less than 50 m deep.
Streamer fluid release caused by loss of integrity of streamer	Pollution of the marine environment adverse effects on marine life	Operational procedures will be in-place on board the seismic for deployment and retrieval of towed equipment. Streamers equipped with pressure-activated, self-inflating buoys designed to bring the equipment to the surface if lost accidentally. Solid streamers will be used for the Babylon and Centaurus 3D MSS Lost towed equipment will be relocated and recovered where safe and practicable to do so.

Source of Risk (Hazard)	Potential Environmental Impact	Control/ Mitigation Measures
Hydrocarbon release caused by topsides (vessel) loss of containment	Temporary reduction in water quality and potential impacts to megafauna species such as migratory whales, marine reptiles and marine birds if within the immediate spill affected area or the ZoC with the first day of the spill.	<p>Compliance with MARPOL 73/78 as applied in Australia under the Commonwealth Protection of the Sea (Prevention of Pollution from Ships) Act 1983 - Part IIIB: and Marine Orders - Part 91: Marine Pollution Prevention – Oil), –as applicable to vessel class:</p> <ul style="list-style-type: none"> • Current Shipboard Oil Pollution Emergency Plans (SOPEP) in place. • Survey vessels hold a valid IOPP Certificate as applicable to vessel class. <p>Storage: Any hydrocarbon storage above deck must be designed and maintained to have at least one barrier (i.e. form of bunding) to contain and prevent deck spills entering the marine environment. This can include containment lips on deck (primary bunding) and/or secondary containment measures (bunding, containment pallet, transport packs, absorbent pad barriers) in place.</p> <p>Equipment: Equipment located on deck utilising hydrocarbons (e.g. cranes, winches or other hydraulic equipment) will be maintained to reduce risk of loss of hydrocarbon containment to the marine environment.</p> <p>Exceptions: <i>The above requirement does not apply to hydraulic hoses that are located on crane knuckles that protrude outside of the deck boundary and additionally, the Gun Deck where wash ports on the ship's side, which are designed to allow excess sea water to drain quickly from the deck to prevent the sea water free surface effect compromising the stability of the vessel - these ports will be secured closed in fine weather conditions when safe to do so.</i></p> <p>Equipment: Equipment located on deck utilising hydrocarbons (e.g. cranes, winches or other hydraulic equipment) will be maintained to reduce risk of loss of hydrocarbon containment to the marine environment.</p> <p>Spill Response: Spill response bins/kits are maintained and located in close proximity to hydrocarbon storage areas and deck areas for use to contain and recover deck spills.</p>
Hydrocarbon release caused by loss of structural integrity	Temporary reduction in water quality and potential impacts to megafauna species such as migratory whales, marine reptiles and marine birds if within the immediate spill affected area or the ZoC with the first day of the spill.	<p>Survey vessels compliant with Marine Orders Part 30: Prevention of Collisions (Issue 8) and Marine Orders Part 21: Safety of navigation and emergency procedures, Issue 8, specifically:</p> <ul style="list-style-type: none"> • Use of standard maritime safety procedures (including radio contact, display of navigational beacons and lights). <p>Compliance with MARPOL 73/78 as applied in Australia under the Commonwealth Protection of the Sea (Prevention of Pollution from Ships) Act 1983 - Part IIIB: and Marine Orders - Part 91: Marine Pollution Prevention – Oil), –as applicable to vessel class:</p> <ul style="list-style-type: none"> • Current Shipboard Oil Pollution Emergency Plans (SOPEP) in place. • Survey vessels hold a valid IOPP Certificate, where required, under vessel class. <p>At least one dedicated high speed chase vessel will be employed to assist seismic source vessel to mitigate interference associated with concurrent seismic and third party vessel operations.</p> <p>Procedure (or equivalent) relating to seismic and support vessel working in close proximity (e.g. transfer of supplies) including:</p> <ul style="list-style-type: none"> • Resupply and crew transfers will commence during daylight hours only and when sea conditions are appropriate (calm) as determined by the vessel master; and • radio communication will be maintained between the seismic and support vessel. <p>No close proximity operations / activities (such as bunkering, supply or equipment transfer, crew change, unless in case of emergency) will be undertaken within 12nm of the outer boundary of the Ningaloo World Heritage Area.</p> <p>Implementation of the Babylon and Centaurus 3D Marine Seismic Survey First Strike Action Plan and Shipboard Oil Pollution Emergency Plans (SOPEP) when a hydrocarbon spill has occurred.</p>
Hydrocarbon release during bunkering operations	Temporary reduction in water quality and potential impacts to megafauna species such as migratory whales, marine reptiles and marine birds if within the immediate spill affected area or the ZoC with the first day of the spill.	<p>Compliance with MARPOL 73/78 as applied in Australia under the Commonwealth Protection of the Sea (Prevention of Pollution from Ships) Act 1983 - Part IIIB: and Marine Orders - Part 91: Marine Pollution Prevention – Oil), –as applicable to vessel class:</p> <ul style="list-style-type: none"> • Current Shipboard Oil Pollution Emergency Plans (SOPEP) in place. • Survey vessels hold a valid IOPP Certificate as applicable to vessel class. <p>Spill Response: Spill response bins/kits are maintained and located in close proximity to hydrocarbon storage areas and deck areas for use to contain and recover deck spills.</p> <p>No close proximity operations / activities (such as bunkering, supply or equipment transfer, crew change, unless in case of emergency) will be undertaken within 12nm of the outer boundary of the Ningaloo World Heritage Area.</p> <p>Implementation of the Babylon and Centaurus 3D Marine Seismic Survey First Strike Action Plan and Shipboard Oil Pollution Emergency Plans (SOPEP) when a hydrocarbon spill has occurred.</p> <p>Operational procedures and equipment will be in-place and implemented on board the survey vessels for bunkering operations and will be subject to the following Woodside requirements:</p> <p>Procedures:</p> <ul style="list-style-type: none"> • Bunkering will occur during daylight hours only and when sea conditions are appropriate as determined by the vessel master; • JHA (or equivalent) in place and reviewed before each fuel transfer; • Bunkering operations will be manned with constant visual monitoring of gauges, hoses, fittings and sea surface; and • Radio communication between seismic and support vessel <p>Equipment:</p> <ul style="list-style-type: none"> • Bulk transfer hose (visually check for integrity) • Dry break couplings (or similar in place checked for integrity)

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