Australian Government

Geoscience Australia

ENVIRONMENT PLAN SUMMARY

Browse Basin Marine Survey 2014

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1.0 INTRODUCTION

1.1 Overview

Geoscience Australia (GA) is proposing a marine survey to collect data to support a CO_2 storage assessment in the Browse Basin, offshore Western Australia. The program is part of the National CO_2 Infrastructure Plan (NCIP) to accelerate the identification and development of sites suitable for the long-term storage of CO_2 that are within reasonable distances of major energy and industrial emission sources. Data collected on the survey will be used by GA to support the work programs of the Department of Industry (DoI) and Department of the Environment (DotE).

Direct detection of seeps may be unfeasible in some environments, such as those with diffuse seeps, strong currents or periodic seepage. Surrogates may therefore be a more appropriate indicator of seeps than direct measures in these cases. Such surrogates can include both physical (e.g. geochemical or geological parameters) and biological (e.g. indicator species or communities) factors. However, in order to attribute a relationship between such factors and potential seeps, environmental baseline data from non-seep areas must also be obtained. Such baseline data can also be used for future monitoring activities since it will provide an indication of natural variability in the ecosystem.

1.2 Location

The overall research area (Figure A) is largely focussed on the Caswell Sub-basin of the Browse Basin including the outer portions of the Yampi and Leveque Shelves. The research area covers approximately 69,000 km^2, including shelf, upper slope and basin floor areas in water depths ranging from approximately 100 to 1,000 m, bounded by the coordinates -15°S, -14.35°S, 124.9°E and 121.47°E. Data collection will occur within five regions within the research area, as shown in Figure B.

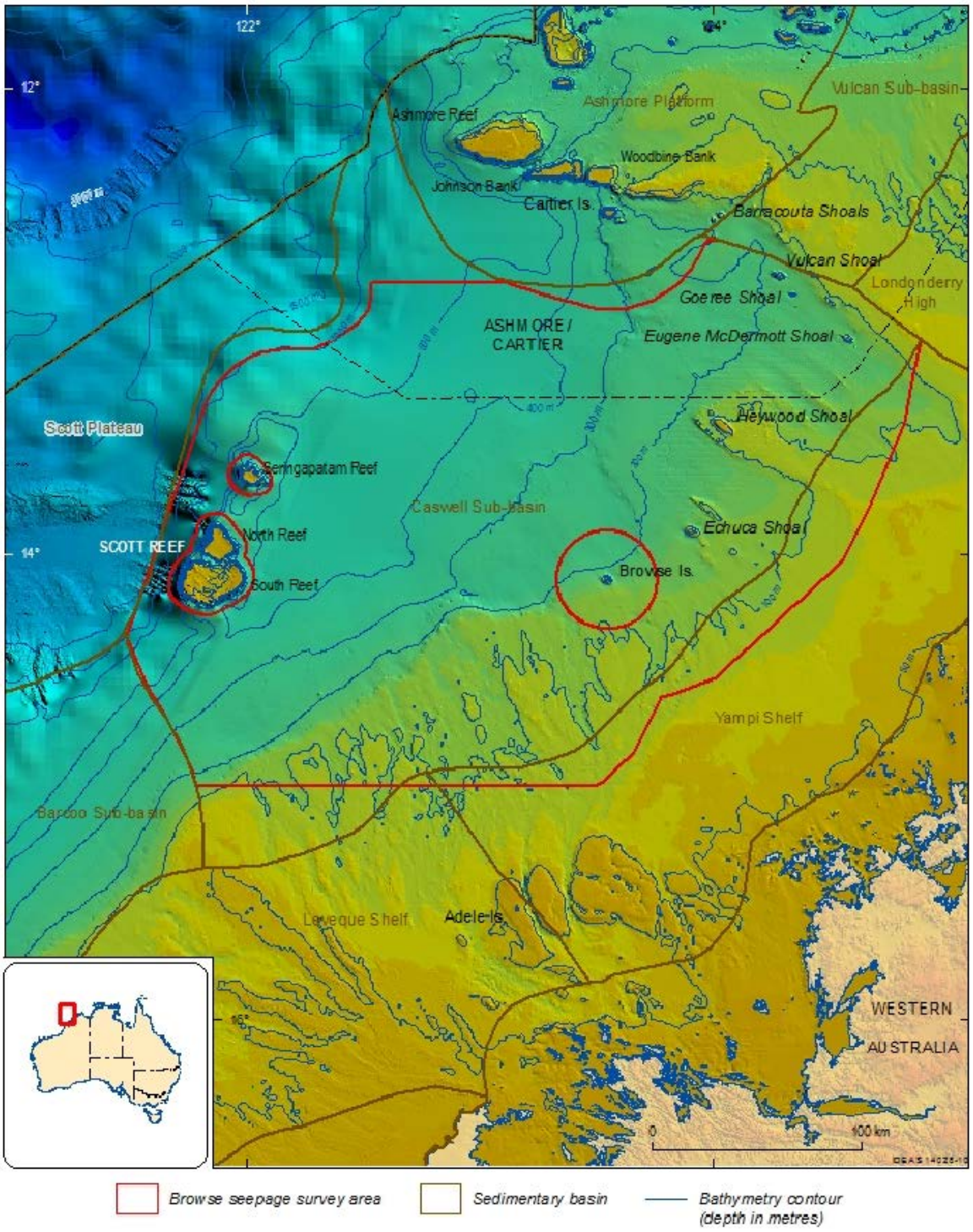

Figure A: Proposed Research Area (Red Boundary)

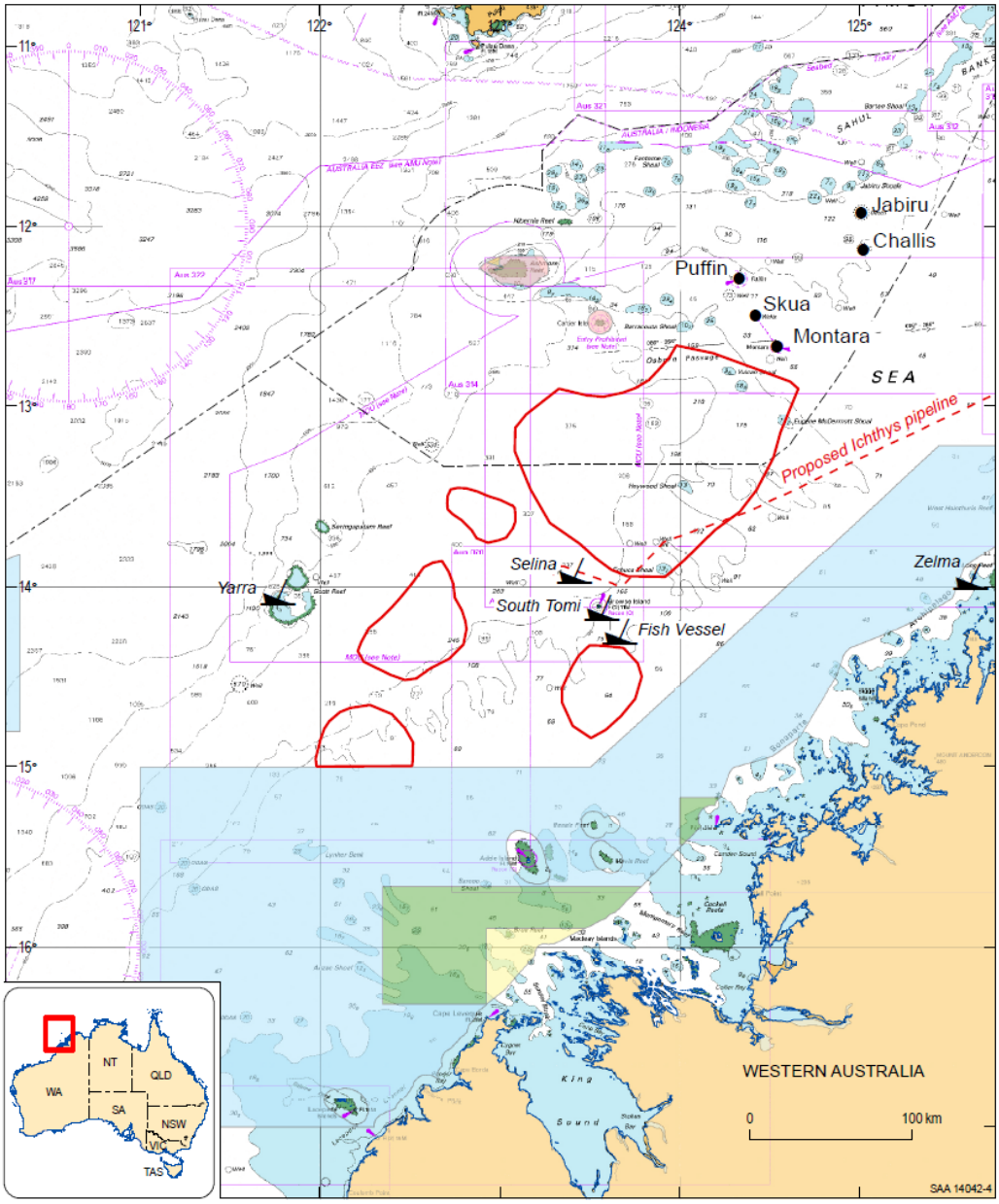

Figure B: Sampling locations (Red Boundary)

1.3 Exclusion Zones

A number of exclusion zones are in place, as follows:

- 500 m exclusion zones around petroleum activities.
- No activities will occur within Commonwealth Marine Reserves.
- No activities will occur within WA State waters.

- No activities will occur in Commonwealth waters inside of Scott Reef South.
- No activities will occur within the 20 km exclusion zone around Browse Island.
- No vessel transit or subsea equipment to be deployed within WA – 50 – L (Ichthys pipeline development).
- No vessel transit or subsea equipment to be deployed within 3 NM of Shell Prelude drilling area provided by Shell.
- No AUV, ROV or sampling operations will occur within 100 m of Shell oceanographic moorings or the Lasseter-1 abandoned well.

The exclusion zones have been added to the navigation GIS on board and no operations or transit will be conducted in these areas.

2.0 RECEIVING ENVIRONMENT

2.1 Regional Overview

The Integrated Marine and Coastal Regionalisation of Australia (IMCRA) was developed by the Australian government as a regional framework for planning and biodiversity protection. It divides Australia's oceans into 41 provincial bioregions, comprising 24 provinces (regions of biotic endemism) and 17 transitions (less well-defined mixing areas that capture the overlap of demersal fish species ranges between the provinces). The research area lies largely within the Timor and Northwest provinces, with a small area of overlap with the Northwest transition in the north-eastern part of the research area.

2.2 Geomorphology and Bathymetry

The Browse Basin hydrocarbon province extends from the inner shelf to the base of the continental slope. The continental shelf, which includes part of the Northwest and Sahul Shelves, is broad (100–250 km) with relatively low relief and transitions into the upper slope at between 100-150 m water depths. The seabed topography of the basin is highly variable. Significant geomorphic features include plateaus and terraces (Scott, Rowley), banks and shoals (Lynher, Heywood), reefs (Scott, Seringapatam, Beagle), slope, canyons, and valleys. Along the shelf break, the bank reaches depths as shallow as 65 m. Within the Leveque Shelf, intermittent large calcarenite ridges and sand waves overlaying otherwise flat seabed areas have been observed. The sand waves can be up to 9 m high and with slopes of up to 7 degrees. Emergent reef systems are absent.

2.3 Climate and Meteorology

The region experiences a dry (arid tropical) climate with two distinct seasons: the north-west (summer) monsoon (October to March) and, the north-east to south-east (winter) monsoon (April to September), with a rapid transitional period between each season. On average, approximately 90% of the annual mean rainfall (779.2 mm) occurs in the period between December and March and is associated with storm activity. Winds during the summer monsoon are typically westerly/north-westerly and humid while during the winter monsoon winds are typically drier south-easterlies which originate from over the Australian mainland. The mean monthly maximum (and minimum) temperature recorded at Browse Island between 1992 and 2006 ranged between 31.6 °C (29.0 °C) in April and 28.7 °C in July and August (25.8 °C).

The region is subject to cyclone activity, and the cyclone season officially runs from November to May, with approximately five tropical cyclones occurring per year on average. Highest cyclone activity in the region typically occurs during March and April. Between 1996/7 and 2006/7, the Bureau of Meteorology (BOM) tracked a total of 17 tropical cyclones passing within 200 km of Browse Island.

2.4 Oceanography

Surface currents in waters on the Sahul Shelf show a strong seasonal component and are linked to the seasonal monsoonal winds. During the south-eastern winter monsoon the surface flow across the shelf is to the west, and is driven by locally generated winds and an east-west pressure gradient. During the north-westerly summer monsoon the surface current weakens and can even reverse direction over the inner part of the shelf. Surface flow through the Timor Sea is an important driving factor in the southward flowing Leeuwin Current, which is an important oceanographic feature along the west coast of Australia.

During the summer monsoon rainfall in the region can reduce surface salinities. During the summer monsoon there is a weak thermocline, with a decrease in temperature of 3-4 °C from the warmer surface waters to the cooler mid-depth to bottom waters. During the winter monsoon the mixed layer is isothermal to around 70 m.

Tides in the region are semi-diurnal (two high and two low tides each day) with a spring tidal range of 4 m and a neap tidal range of 1.8 m. Tidal currents are a component of the broader circulation in the region, with tidal currents of 0.6 m/s and 0.2 m/s for spring and neap tides, respectively. Surface waves in the region comprise of locally generated surface wind waves and distant swell waves, which are typically generated in the southern Indian Ocean.

2.5 Matters Protected by the EPBC Act

The EPBC Act Protected Matters Search report (including 20 km buffer) identified 13 threatened species. These are identified and described in section 2.6.2. Other matters protected by the EPBC Act include:

- Scott Reef and surrounds (Commonwealth Heritage Places and Register of the National Estate)
- Seringapatam Reef and surrounds (Commonwealth Heritage Places and Register of the National Estate)
- Historic Shipwreck at Browse Island
- the Kimberley Commonwealth Marine Reserve
- Key Ecological Features, including:
    - Ancient coastline at 125 m depth contour

- Continental Slope Demersal Fish
- Seringapatam Reef and Commonwealth waters.

Biologically Important Areas (BIAs) were identified for a number of species, including:

- Pygmy blue whales. The BIA (migration) is to the north west of the research area, and as such, only low numbers would be expected during their southern migration.
- Marine turtles. The BIAs (nesting, inter-nesting, foraging) are outside of the research area, and as such, only low numbers would be expected. Minor avoidance behaviour would be expected at most.
- Whale sharks. The BIA for whale sharks (foraging) overlaps the refined sampling areas. It is possible that whale sharks may be encountered. Minor avoidance behaviour would be expected at most.

2.6 Biological Environment

2.6.1 Benthic Communities

There are a number of subtidal reefs, banks and shoals in the vicinity of, or within northern part of the Browse Basin Marine Survey research area (see Figure A) that are not listed as marine parks or reserves. These islands and reefs are associated with benthic communities consisting predominantly of sand and coral rubble, with noteworthy hard coral, soft coral, algae and seagrasses. The reefs host similar benthic communities, with areas of relatively high live coral cover, although episodes of coral bleaching have been recorded. Benthic organisms that depend on photosynthesis such as seagrasses, macroalgae and zooxanthellate corals are typically restricted to shallower waters around the reefs; although in the clear tropical waters may be found at considerable depths.

Areas within the research area include Echuca, Heywood, Eugene McDermott, Goeree and Vulcan Shoals. Areas outside of the research area, but in relatively close proximity include Hibernia Reef, Johnson Bank, Barracouta Shoals and Adele Island.

2.6.2 Corals

The major mass spawning of scleractinian corals in WA waters occurs over a few consecutive nights around the last quarter of the moon (7-9 nights after the full moon) on neap, nocturnal ebb tides in March and April (autumn) each year. A smaller secondary period of coral spawning on Scott Reef in the spring (around September or October). Coral larval settlement densities after the spring

spawning were consistently between 10 and 20 times lower than after the spawning in autumn.

The full moon is predicted to occur on the night of 8 October 2014 and the last quarter on 16 October 2014. The survey timing for the first leg overlaps the spawning, dispersal and settlement period for approximately five days. There is an approximate 25 km buffer to the nearest part of Scott Reef and a; 20 km buffer around Browse Island, and is similarly distant from Ashmore Reef and Cartier Island. The survey does overlap Heywood, Eugene McDermott, Goeree and Vulcan Shoals.

2.7 Protected Species

2.7.1 Seabirds and Shorebirds

A number of seabirds and shorebirds may occur in the vicinity of the Browse Basin Marine Survey, with several species recorded on Ashmore Reef and Cartier Island areas. Both Ashmore Reef and Cartier Island are protected as reserves under the EPBC Act and are considered important habitat for a number of seabirds and shorebirds. One threatened and seven migratory EPBC Act listed seabirds and shorebirds may occur within the vicinity of the Browse Basin Marine Survey (Table A).

Table A: EPBC Act listed seabirds and shorebirds

Scientific Name	Common Name	EPBC Act Status
Anous tenuirostris melanops	Australian Lesser Noddy	Vulnerable
Calonectris(Puffinus) leucomelas	Streaked Shearwater	Migratory
Fregata ariel	Lesser Frigatebird*	Migratory
Fregata minor	Great Frigatebird*	Migratory
Sterna albifrons	Little Tern	Migratory
Sterna bengalensis	Lesser Crested Tern	Migratory
Sula leucogaster	Brown Booby*	Migratory
Sula sula	Red-footed Booby*	Migratory

* Indicates species that have been confirmed to breed at Ashmore Reef

The only threatened seabird that is expected to potentially occur in the region of the Browse Basin Marine Survey is the Australian lesser noddy (*Anous tenuirostris melanops*), which is listed as Vulnerable under the EPBC Act. The species is known to breed on the Houtman Abrolhos islands off the mid-west coast of Western Australia. The species may also breed on Ashmore Reef however this has not been confirmed conclusively. The species was not observed by on Ashmore Reef or Cartier Island, although the closely related

lesser noddy (*Anous tenuirostris*) was recorded as present. The species may occur in the vicinity of the Browse Basin Marine Survey.

The seven migratory seabird species likely to occur, including the five species known to nest on Ashmore Reef (Table A), are highly mobile and are all expected to range throughout the entire survey area. All of these species would forage widely over the waters surrounding the emergent roosting sites and nesting sites. Different species nest in different seasons and nesting birds may be present during both wet and the dry seasons.

2.7.2 Marine Mammals

Two species of marine mammals, the blue whale (*Balaenoptera musculus*) and the humpback whale (*Megaptera novaeangliae*), are listed as threatened under the EPBC Act. Eight marine mammal species that may potentially occur in the vicinity of the Browse Basin Marine Survey are listed as Migratory (Table B). Such species may be seasonally abundant in the vicinity of the Browse Basin Marine Survey. The area is recognised as an area through which blue whales migrate and humpback whales are known to aggregate, breed and calve in the wider region.

Table B: EPBC Act listed marine mammals

Scientific Name	Common Name	EPBC Act Status
Balaenoptera bonaerensis	Antarctic Minke Whale	Migratory
Balaenoptera edeni	Bryde's Whale	Migratory
Balaenoptera musculus	Blue Whale	Endangered, Migratory
Megaptera novaeangliae	Humpback Whale	Vulnerable, Migratory
Orcaella heinsohni	Australian Snubfin Dolphin	Migratory
Orcinus orca	Killer Whale	Migratory
Physeter macrocephalus	Sperm Whale	Migratory
Tursiops aduncus (Arafura/Timor Sea populations)	Indian Ocean Bottlenose Dolphin (Arafura/Timor Sea populations)	Migratory

2.7.2.1 Pygmy Blue Whale

The pygmy blue whale (*Balaenoptera musculus brevicauda*) is expected to potentially occur within the area of the Browse Basin Marine Survey. Consultation with the Centre for Whale Research has indicated that the period October through December is when southbound pygmy blue whales move though this region. They tend to pass along the shelf edge at depths of 500 m out to 1,000 m, moving faster on the southern migration and coming in close to the coast in the Exmouth to Montebello Islands area. GA has committed to providing sighting information to the Centre for Whale Research.

The *Blue, Fin and Sei Whale Recovery Plan 2005–2010* considers feeding aggregation areas as critical habitat. The National Conservation Values Atlas shows that the biologically important area (BIA) for pygmy blue whales (for migration between May and December) is outside of the refined sampling areas. It is possible that pygmy blue whales on their southern migration may be encountered, but only in very low numbers. As there are no known feeding, breeding or aggregation areas in the vicinity of the Browse Survey, minor avoidance behaviour would be expected at most.

2.7.2.2 Humpback Whale

The humpback whale (*Megaptera novaeangliae)* has a cosmopolitan distribution in temperate waters, with whales off Western Australia undertaking an annual migration between feeding grounds in the Southern Ocean and calving and breeding areas off northern Western Australia. They commence their northerly migration from Antarctic waters in May, migrating north along the WA coast reaching the north-west marine region waters in June. Immature individuals and lactating females arrive first, followed by non-pregnant females and adult males, with pregnant females arriving last. The period of peak northern migration into the calving grounds is late July. Breeding/calving takes place between mid-August and early September between Broome and the northern end of Camden Sound. The peak of southern migration out of the calving grounds is early September.

Humpback whales may occur in the vicinity of Scott Reef at any time during the migration season in small numbers. Whales were detected in low numbers both inside and outside of Scott Reef from late-June to mid-October with peak of the signals detected during late July, late August and early September. Six times more Humpback whales were heard to the south-east of Scott Reef than the north-east and more were heard outside the reef than inside the southern lagoon. This suggests that humpbacks are localised inshore towards the 200 m isobath with Scott Reef being on the edge of the Kimberley area utilised.

2.7.3 Marine Reptiles

There are seven threatened species listed under the EPBC Act:

- Short-nosed seasnake (*Aipysurus apraefrontalis*) (Critically Endangered)
- Loggerhead turtle (*Caretta caretta*) (Endangered)
- Green turtle (*Chelonia mydas*) (Vulnerable)
- Leatherback turtle (*Dermochelys coriacea*) (Endangered)
- Hawksbill turtle (*Eretmochelys imbricata*) (Vulnerable)
- Olive Ridley turtle (*Lepidochelys olivacea*) (Endangered)
- Flatback turtle (*Natator depressus*) (Vulnerable).

The short-nosed seasnake (*Aipysurus apraefrontalis*) has been recorded from Ashmore and Hibernia Reefs, with some records of the species occurring in

Exmouth Gulf. The species typically occurs in shallow water (<10 m) in the protected parts of the reef flat and as such is unlikely to be encountered by the survey vessel.

The loggerhead turtle (*Caretta caretta*) is distributed throughout tropical, subtropical and temperate waters globally. In Western Australia, most documented nesting occurs between Shark Bay and North West Cape, approximately 1,000 km south-west of the area of the Browse Basin Marine Survey. Given the distance offshore of the Browse Basin Marine Survey and great distances to known key nesting habitats, the species is unlikely to be encountered during the Browse Basin Marine Survey.

The green turtle (*Chelonia mydas*) is a widely distributed turtle species that nests, forages and migrates throughout northern Australia. Nesting occurs on sandy beaches throughout northern Australia, with Western Australia supporting one of the largest green turtle populations in the world, estimated at tens of thousands of individuals. The species has been documented as nesting at Ashmore and Cartier Islands, with the number of individuals nesting there thought to be in the hundreds. Nesting also occurs on Sandy Islet (Scott Reef) with an estimated nesting population between 389 and 1,476. Peak nesting season is thought to be in mid-summer, although nesting may occur in the region year round. During nesting, female green turtles are thought to stay within 5-10 km of their nesting beach between laying clutches. Outside nesting season green turtles may forage widely, up to 2,600 km. Green turtles feed primarily on seagrasses and algae and as such foraging habitat is unlikely to occur in or around Browse Basin Marine Survey sampling locations due to the depth. Green turtles may be encountered during the Browse Basin Marine Survey.

The leatherback turtle (*Dermochelys coriacea*) is the largest of all turtle species, reaching up to 1.6 m carapace length. The species can utilise colder waters than other species due to physiological adaptations and is regularly observed in temperate as well as tropical waters around Australia. Nesting has rarely been observed in Australia (only within the Northern Territory and Queensland), with no mating or major documented nesting sites known. The species may occur in the vicinity of the Browse Basin Marine Survey; however they are unlikely to be encountered in significant numbers.

The hawksbill turtle (*Eretmochelys imbricata*) has a widespread tropical distribution and in Australia utilises a number of significant nesting beaches, however Scott Reef, Ashmore Reef and Cartier Island are not recognised as being critical nesting beaches. Nesting and breeding in northern Western Australia is concentrated around the Lowendal and Montebello Islands, approximately 900 km to the south west, and occurs primarily during October to January, although may occur year round at some locations. Hawksbill turtles may occur in the vicinity of the Browse Basin Marine Survey.

The olive ridley turtle (*Lepidochelis olivacea*) has a circumtropical distribution, with nesting recorded in the Northern Territory and Queensland. No nesting has been recorded in Western Australia. Given the lack of nesting habitat in the vicinity in the area of the survey, foraging or migrating olive ridley turtles are expected to be encountered only in low numbers during the survey.

The flatback turtle (*Natator depressus*) is only found in tropical waters of northern Australia, Papua New Guinea and West Papua (Indonesia), with nesting confined to Australia. Key nesting sites have been identified in Queensland, the Northern Territory and Western Australia. Cape Domet, in the Joseph Bonaparte Gulf, is the most significant rookery in the region (approximately 415 km to the east), with Eighty Mile Beach also considered an important rookery (approximately 400+ km to the south). Nesting at Cape Domet has been documented year-round, with peak nesting occurring in July. Nesting at Eight Mile Beach occurs between October and November. It is expected that flatback turtles may be encountered during the Browse Basin Marine Survey.

2.7.4 Sharks and Rays

Six EPBC Act listed species of sharks and rays may occur in the vicinity of the Browse Basin Marine Survey (Table C). Of these, three are listed as Vulnerable and five as Migratory.

Table C: EPBC Act listed sharks and rays potentially occurring

Scientific Name	Common Name	EPBC Act Status
Carcharodon carcharias	Great White Shark	Vulnerable, Migratory
Pristis zijsron	Green Sawfish	Vulnerable
Rhincodon typus	Whale Shark	Vulnerable, Migratory
Isurus oxyrinchus	Shortfin Mako	Migratory
Isurus paucus	Longfin Mako	Migratory
Manta birostris	Giant Manta Ray	Migratory

The great white shark (*Carcharodon carcharias*) is widely, but sparsely, found in all seas including cold temperate waters in both hemispheres. It is most frequently observed and captured in coastal temperate and subtropical regions. It has also been observed in tropical areas. Great white sharks are widely, but not evenly, distributed in Australian waters; observations are more frequent in and around some fur seal and sea lion colonies. Although unlikely, it is possible that great white sharks may be encountered in the shallower parts of the research area.

The green sawfish (*Pristis zijsron*) has a preference for muddy, soft-bottom habitats such as the upper reaches of estuaries and turbid river systems. It has been recorded in very shallow water (<1 m) to offshore trawl grounds in over 70

m of water and historically recorded in the coastal waters off Broome, Western Australia. Although unlikely, it is possible that green sawfish may be encountered in the shallower parts of the research area.

The whale shark (*Rhincodon typus*) was identified as potentially occurring within the survey region. This species is broadly distributed in tropical and temperate seas worldwide, feeding on phytoplankton, macroalgae, plankton, krill and small squid or vertebrates. Whale sharks aggregate annually off the Western Australian coast at Ningaloo Reef between March and June. Sharks tagged at this aggregation have been shown to migrate northwards into the Timor Sea, possibly along the shelf break, although there were relatively few tagged animals monitored during the study. Another individual tagged at Christmas Island also migrated eastwards through the Timor Sea. Whale sharks have also been recorded near to Scott Reef. As such whale sharks may occur within the area of the Browse Basin Marine Survey, although in low densities.

2.8 Socio-Economic Environment

2.8.1 Native Title

An email response from the National Native Title Tribunal stated that there are no relevant Native Title claims in the research area.

2.8.2 Historic Shipwrecks

The *Historic Shipwrecks Act 1976* protects historic wrecks and associated relics that are more than 75 years old, and those declared by the Minister, and in Commonwealth waters. A search of the Australian Historic Shipwrecks Database found one historic shipwreck documented within the area of the Browse Basin Marine Survey. The *Berteaux*, a barquentine rigged sailing vessel, was wrecked approximately 20 km SSE of Browse Island.

Prior to conducting any physical sampling, an appropriate remote sensing survey of the areas will be undertaken. If any other shipwrecks (or relics) are discovered during the course of the survey, GA will notify the Western Australian Museum Maritime Archaeology Department as soon as possible.

2.8.3 Commercial Fishing

A number of Commonwealth and state managed fisheries either overlap the area of the Browse Basin Marine Survey, or have been suggested for assessment through consultation with the Australian Fisheries Management Authority (AFMA) and/or the Western Australian Department of Fisheries (DoF).

2.8.3.1 Commonwealth Fisheries

The Western Tuna and Billfish Fishery is a Commonwealth fishery targeting four main pelagic species, which are all highly migratory (broadbill swordfish, bigeye tuna, yellowfin tuna, albacore tuna). The number of vessels operating in the fishery has declined in recent years, with less than five vessels operating in the fishery since 2007. Effort data shows fishing effort is concentrated offshore of the 200 m isobath and to the south of the Browse Basin Marine Survey. As such, vessels within this fishery are very unlikely to be encountered during the Browse Basin Marine Survey.

The North West Slope Trawl Fishery extends from 114°E to about 125°E off the Western Australian coast between the 200 m isobath and the outer limit of the Australian Fishing Zone. The number of boats in the fishery has been declining since 2001 from a high of 13 vessels to two vessels in 2008. The fishery primarily targets scampi. Effort in the fishery is primarily concentrated to the south west of the survey area, with some recorded activity within the survey are). As such, vessels within this fishery are very unlikely to be encountered during the Browse Basin Marine Survey.

The Western Skipjack Fishery targets only skipjack tuna. While the area of the proposed activity lies within the boundary of the fishery, effort within this fishery is mainly confined to the southern coast of Australia. In recent years, there has been very minimal activity, with only two vessels operating in 2009 and no vessels operating in 2010, 2011 and 2012. As such, vessels active in this fishery are unlikely to be encountered during the Browse Basin Marine Survey.

The Southern Bluefin Tuna Fishery targets southern bluefin tuna and effort in this fishery is concentrated in the Great Australian Bight. Southern bluefin tuna spawn in the North West Shelf region of Western Australia between September and March. Migrating adult tuna may transit through the region. Vessels participating in this fishery are unlikely to be encountered during the Browse Basin Marine Survey.

2.8.3.2 Western Australian Fisheries

The Browse Survey area is primarily located within Area 2, Zone C of the Kimberley section of the Northern Demersal Scalefish Fishery. About a third of the survey area is in Zone B and a small part in Zone A. The total catch for the Kimberly section was 1,116 t in 2010. Of this, only 199 t was from Zones A and C combined. The target species are reef associated fishes so it is possible that encounters with commercial fishers may occur over the submerged shoals and shallower areas. The total allowable effort set for 2010 was 1,038 fishing days in Zone B and 616 days in Zone B (Zone C was considered developmental). There were seven vessels operating 11 licences during 2010. Assuming all seven boats are operating at the same time during the Browse survey would mean that seven

vessels would be present for 148 days in Zone B (68 days in Zone B, part survey area only overlaps tiny part, so not considered further). Note that the Browse survey are overlaps less than a third of the total area of Zone B. Based on this, it is considered Possible to Likely that vessels operating in this fishery would be encountered. GA will continue to consult with the fishing stakeholders identified to avoid any conflicts.

The Mackerel Managed Fishery uses near-surface trolling gear from small vessels in coastal areas around reefs, shoals and headlands to target Spanish mackerel. Jig fishing is also used to capture grey mackerel, with other species from the genera Scomberomorus, Grammatorcynus and Acanthocybium also contributing to commercial catches. The total catch of Spanish mackerel in the 2010 year was estimated to be 283.6 t, with 154.0 t from the Kimberley (Area 1), with effort of approximately 420 kg/day from the three boats operating. This equates to each boat operating for approximately 120 days per year. It is unknown how much use of the area of the Browse survey is used by the MMF, but it is considered possible that fishers may be encountered. GA will continue to consult with the fishing stakeholders identified to avoid any conflicts.

The boundaries of the Broome Managed Prawn Fishery and the Kimberley Managed Prawn Fishery both partially overlap the area of the Browse Basin Marine Survey. The gear used consists of otter trawls and are typically restricted to depths less than 60 m. These fisheries are closed seasonally, with fishing generally taking place between April and November. Advice from the Western Australian DoF indicated that vessels active in these fisheries are concentrated in inshore areas and will not be present in the vicinity of the Browse Basin Marine Survey.

The Northern Shark Fisheries consist of the state managed Western Australian North Coast Shark Fishery and the Joint Authority Northern Shark Fishery. No activity has been reported in either of these fisheries during 2009/2010 or 2010/2011, with low levels of activity reported prior to these years. Given there are no active operators in these fisheries, the Browse Basin Marine Survey will not encounter vessels participating in this fishery.

The main area of the Beche-de-mer Fishery extends north from Exmouth Gulf to the Northern Territory border with catches also taken from the Shark Bay area and the south coast of Western Australia. The harvesting of beche-de-mer is only allowed by diving or direct collection by hand and is prohibited within any marine park, aquatic reserve or sanctuary area. It is considered unlikely that the Browse Basin Marine Survey would encounter vessels participating in this fishery.

The Marine Aquarium Fish Managed Fishery has 12 licences operating in Western Australia's state waters spanning the coastline from the Northern Territory border in the north to the South Australian border in the south. During

the past two years the fishery has been active in waters from Esperance to Broome with popular areas being around the Capes, Perth, Geraldton, Exmouth and Dampier. It is primarily a dive-based fishery which uses hand-held nets or hand-held tools to capture target species. As the Browse Basin Marine Survey occurs in Commonwealth waters, no interactions are anticipated.

The Trochus Fishery in King Sound is the sole trochus fishery in Western Australia. Members of the Ardyaloon Incorporated Aboriginal Community target *Trochus niloticus* on the edge of islands and reef systems exposed during low tide in the waters of King Sound and Buccaneer Archipelago. As the Browse Basin Marine Survey occurs in Commonwealth waters, no interactions are anticipated.

The Pearl Oyster Managed Fishery is a quota based dive fishery operating in shallow coastal waters of the North West Shelf targeting Indo-Pacific silver-lipped pearl oysters. The Browse Basin Marine Survey research area overlaps Zone 3 of the fishery, which has a maximum of nine licensees granted access. As the fishery operates in shallow waters, no interactions are anticipated with the Browse Basin Marine Survey.

The Specimen Shell Managed Fishery operates throughout Western Australian waters between the high water mark and the 200 m isobath. Of the 33 licences, only six are active. The fishery is primarily a dive fishery, although one licensee has an exemption to allow the use of an ROV to 300 m. It is considered unlikely that encounters between fishing vessels and the survey vessel would occur.

There are a number of pearl and aquaculture leases in coastal areas of the Kimberley's. As the Browse Basin Marine Survey occurs in Commonwealth waters, no interactions are anticipated.

The Kimberly Developing Mud Crab fishery targets the green (giant) mud crab and the brown (orange) mud crab via the use of crab traps, between Broome and Cambridge Gulf near the Western Australia and Northern Territory border, with fishing effort concentrated around Cambridge Gulf, Admiralty Gulf, York Sound and King Sound. Operators tend to fish remote waters for long periods of time in large mother ships, using small dinghies known as doreys to enter mangrove estuaries with crab traps generally checked each daylight high tide. As such, no interaction with the Browse Basin Marine Survey is expected.

2.8.4 Fish Spawning

The WA Department of Fisheries advised that the following species have spawning aggregation times within the North Coast Bioregion which may overlap the planned survey:

- Spanish mackerel (Oct – Jan)

- Rankin cod (Aug – Oct)
- Red emperor (Oct – Mar)
- Blacktip shark (Nov – Dec)
- Sandbar shark (Oct – Jan)

The only equipment used for the Browse survey that operates at frequencies within the audible range for fish is the shipboard sub-bottom profiler. Received underwater sound levels are well below thresholds at very short distances. It is considered highly unlikely that any impacts would occur.

2.8.5 Recreational Fishing

Recreational fishing activity is expected to be very low or non-existent within the area of the Browse Basin Marine Survey during the survey given the great distance offshore (>200 km) from the Australian mainland. Recreational fishing is expected to be concentrated inshore adjacent to populated areas. Interactions with the Browse Basin Marine Survey are not expected.

2.8.6 Shipping

The main commercial shipping routes are located approximately 50-100 km to the west of the research area. The dominant vessel types were small tugs, support and supply vessels. Consultation with AMSA indicated that the research area is generally outside of major traffic routes, but noting that support craft and tugs may be evident for the adjacent gas fields (depending on timings). GA has committed to notifying the AMSA Rescue Coordination Centre (RCC) prior to the survey commencing and the Australian Hydrographic Service (AHS) at least two weeks ahead of the proposed survey date for Notice to Mariners (NTM) promulgation, including the name of vessels, contact details, location, duration and any other relevant information.

2.8.7 Tourism

Recreational boating in the area of the proposed survey may consist of cruising yachts sailing between northern Australia and Indonesia. Cruising yachts typically occur seasonally in the region, with higher numbers of yachts during June to August. These vessels are expected to be present in very low numbers.

Fishing charters and tours may occur, but are not common due to the distance offshore, the prohibition of camping on the islands and the requirement for any fish caught to be consumed immediately. The islands are also the site of bird watching tours due to the diversity and abundance of birds. As with fishing tours, these are not common occurrences and are typically one off specialist trips. As such, encounters between the survey vessel and nature based tourism activities in the area of the Browse Basin Marine Survey are considered to be unlikely.

2.8.8 Traditional Fishing

The area in which the Browse Basin Marine Survey will take place is subject to the Australian Indonesian Memorandum of Understanding 1975 (MoU). Indonesian traditional fishermen are defined under the MoU as "fishermen who have traditionally taken fish and sedentary organisms in Australian waters by methods which have been the tradition over decades of time". The 50,000 km^2 area subject to the MoU extends to within Australia's 200 nautical mile exclusive economic zone.

Indonesian traditional fishers operate small wooden vessels, known as perahu. Fishermen targeting the area are likely to originate from the Indonesian Rote Island group, the nearest island of which lies approximately 121 km north-east from the area of the Browse Basin Marine Survey. Traditional fishing vessels may be encountered while undertaking the Browse Basin Marine Survey.

Consultation with the Department of Agriculture, Fisheries and Forestry (DAFF) has indicated that Indonesian fishermen will be present during survey, but mainly around Scott Reef..

2.8.9 Petroleum Activities

The research area contains several gas fields which are currently starting to be developed (Prelude, Ichthys, Browse, Crux). It also includes a number of permits and existing wells. There is no requirement by GA for the Vessel or its equipment to enter within a 500 m radius of any installations.

2.8.10 Defence

The Australian Defence Force has a restricted area off the Kimberley coast which may be used for training, research, testing and exercises. The southern part of the research area overlaps the RAAF Curtin Air Weapons Range which is a restricted airspace (R811).

As part of the consultation process, the Department of Defence advised that there is the possibility that unexploded ordnance (UXO) may be present on and in the sea floor in the area.

2.9 Particular Values and Sensitivities

2.9.1 Scott and Seringapatam Reefs and Surrounds

Scott and Seringapatam Reefs are large, emergent shelf atolls located on the edge of the broad continental shelf, about 300 km from mainland north-western Australia. Scott Reef is about 23 km south-west of Seringapatam Reef.

They are characterised by a combination of physical environmental conditions that result from their position at the edge of one of the widest continental shelves in the world. These conditions include clear deep oceanic water and an unusually large tidal range. They are regionally important as they support diverse aggregations of marine life, have high primary productivity relative to other parts of the region, have high species richness and are relatively pristine.

Parts of Scott Reef in coastal waters are protected under Western Australian legislation, as is Sandy Islet; a small low-lying sandy islet used by migrating seabirds and is a nesting site for green turtles. It should be noted no activities described in this EP will occur in areas under Western Australian jurisdiction.

At its closest point, the survey area is approximately 25 km from Scott Reef.

2.9.2 Kimberley Marine Commonwealth Reserve

The Kimberley Commonwealth Marine Reserve is an important foraging area for migratory seabirds, dugong, dolphins and threatened and migratory turtles. The southern part of the research area adjoins the Multiple Use Zone. No activities will occur within the Kimberley Commonwealth Marine Reserve.

2.9.3 Ashmore Reef Commonwealth Marine Reserve

The Ashmore Reef Commonwealth Marine Reserve covers 583 km^2 and includes two extensive lagoons, shifting sand flats and cays, seagrass meadows, a large reef flat covering an area of 239 km^2. Within the reserve are three small islands known as East, Middle and West Islands.

Ashmore Reef has been designated as a Ramsar Wetland of International Importance due to the importance of the islands in providing a resting place for migratory shorebirds and supporting large breeding colonies of seabirds. The reserve provides a staging point for many migratory wading birds from October to November and March to April as part of the migration between Australia and the northern hemisphere. Migratory shorebirds use the reserve's islands and sand cays as feeding and resting areas during their migration.

Ashmore Reef and the surrounding marine environment support the following biologically important features:

- a small (less than 50) genetically distinct dugong population
- high density and diversity of sea snakes
- high diversity of corals,
- three endemic species of mollusc
- high endemism of sponges
- high diversity of sea cucumbers
- nesting beaches for marine turtles.

The nearest point of the research area lies approximately 25 km to the west-south-west.

2.9.4 Cartier Island Commonwealth Marine Reserve

Cartier Island Commonwealth Marine Reserve is approximately 40 km south-west of the research area. The area around the island includes a variety of habitats including a mature reef flat, a small submerged pinnacle, known as Wave Governor Bank and two shallow pools to the north-east of the island. Although not listed as a Ramsar Wetland, Cartier Island shares many of the environmental values described for Ashmore Reef.

2.9.5 Browse Island Nature Reserve

Browse Island is an important green turtle and seabird nesting site. It is surrounded by extensive coral reefs. The island is a Western Australian Class “C” Nature Reserve (No. 22697) vested with the Conservation Commission and managed by the Department of Environment and Conservation (DEC), and an IUCN Category 1A protected area. The Browse Island Nature Reserve also includes the unnamed WA41775 reserve and a historic shipwreck.

GA has committed to a 20 km buffer around Browse Island.

3.0 DESCRIPTION OF THE ACTIVITY

3.1 Research Vessel

The proposed survey will be undertaken by the research vessel RV *Tangaroa*. The vessel is registered in New Zealand and is owned and operated by the National Institute of Water and Atmospheric Research (NIWA), which is a Crown Research Institute of New Zealand. Vessel specifications are summarised in Table D. No support vessels will be utilised during the survey. No refuelling, reprovisioning or crew transfers at sea will be required during the survey. The vessel will operate on a 24-hour basis. The vessel will transit between sample locations cruising at a speed of approximately 10.5 knots. The vessel carries up to 15 crew, with a maximum number of people on board (POB) of 40.

The vessel has an ice strengthened, steel displacement hull designed for operation in ice floes up to 0.4 m thick, with reinforcing strengthening the hull, reducing the likelihood of rupture in the event of grounding or a collision. The vessel has a maximum fuel capacity of 620 m^3. All tanks are capable of being isolated and the contents pumped to other tanks on board. The largest individual tank is approximately 63 m^3.

Table D: RV *Tangaroa* Summary Specifications

Length	70.0 m
Beam	13.8 m
Maximum Draft	7.0 m
Gross Tonnage	2,291 tonnes
Built	1991 (Mjellem & Karlsen Verft, Norway)
Fuel Type	Marine Gas Oil (MGO)
Total Fuel Capacity (maximum)	620 m^3
Largest Fuel Tank	63 m^3
Cruising Speed	10.5 knots

The RV *Tangaroa* uses Marine Gas Oil (MGO) and does not utilise heavy fuel oil. MGO is produced through distillation and as such, it contains a higher proportion of lighter hydrocarbons than other marine fuel types such as intermediate fuel oil or heavy fuel oil. Typical MGO at 15 °C has a density and viscosity of 0.8291 g/cm^3 and 4.0 cP, respectively. The proportion of aromatic hydrocarbons in MGO with a boiling point <380 °C is 3%. The characteristics of typical MGO are provided in Table E. Based on these characteristics, MGO meets the definition of non-persistent oil as defined by the International Maritime Organisation (IMO) and the Environmental Protection Authority of the United States, although a small fraction of MGO (5%) is considered persistent.

Table E: Typical MGO Hydrocarbon Composition Characteristics

Component	Volatiles	Semi-volatiles	Low Volatility	Residual
Fraction	C4-C10	C11-C15	C16-C20	>C20
Boiling Point (°C)	<180	180-265	265-280	>380
Persistence*	Non-persistent			Persistent
% of Total	6	34.6	54.4	5

3.2 Survey Activities

The proposed survey will consist of bathymetry and data collection at around five sites and transiting between locations. Multibeam and backscatter data will be collected during transits. The survey will:

- Acquire geological, water column and seabed habitat data to support an assessment of CO_2 storage potential.
- Identify and sample features indicative of active or extinct natural fluid seepage, namely
  - seabed features (e.g. pock-marks, scarps, banks)
  - water column indicators (e.g. hydroacoustic gas flares)
  - subsurface structures (e.g. gas chimneys, faults)
  - biological communities (e.g. sponge, coral gardens).
- Provide baseline information for decision making by mapping and characterising seabed habitats.

Upon arrival at each site, acquisition of multi-beam, single beam and sub-bottom profile data will be undertaken simultaneously. It is estimated that 50–70% of the total survey time will be allocated to multi-beam and high-resolution shallow sub-bottom profiler acquisition.

The combination of operations will be determined on a station-by-station basis and dependant on the nature of the seabed environment and prevailing weather conditions. Physical sampling (grabs or cores) will always be preceded by preliminary investigation using multibeam and sidescan sonar, or, ROV/AUV and underwater towed video and thus will occur in close proximity to the video transect. Physical sampling in areas of significant benthic habitats will be avoided.

3.3 Survey Equipment

3.3.1 Acoustic Equipment

3.3.1.1 Shipboard Acoustic Equipment

A Konsberg EM 302 multi-beam echo-sounder will be used to collect bathymetry data during transits and over 100% of the selected study areas (see Table A). The frequency of the echo-sounder(s) will be optimised to map in less than 1,000 m water depth.

A Konsberg EA600 – 12 kHz single beam echo-sounder will be used to collect water depth and water column data. The system will be used simultaneously with the multi-beam sonar system. The single beam sonar operates at a source level of 171 dB re 1µPa.

A high-resolution sub-bottom profiler (SBP) system (Kongsberg TOPAS PS18) will be used to map the stratigraphy of the upper 50–100 m of the sub-surface sediments in water depths ranging between ~100 and 1,000 m. SBP data will be acquired simultaneously with the acquisition of the multibeam echo sounder data and on occasion. The system has primary and secondary source levels of approximately 242 dB and 208 dB ($_{p\text{-}p}$ re 1µPa at 1 m), respectively.

3.3.1.2 Acoustic Equipment on AUV

A multi-beam echo-sounder (Kongsberg EM2000) will be used to collect bathymetry data over 100% of targeted areas of the seabed. It operates at a single, nominal frequency of 200 kHz and a source level of 218 dB re 1 uPa at 1 m.

A high-resolution sub-bottom profiler system (Edgetech Full Spectrum – Chirp) will be used to map the stratigraphy of the upper 50-100 m of the sub-surface sediments in water depths ranging between ~100 and 1,000 m. SBP data will be acquired simultaneously with the acquisition of the AUV multibeam echosounder data. The frequency ranges between 2 and 16 kHz. Peak source level is estimated at 210 dB re 1 uPa.

A sidescan system (Edgetech Full Spectrum) will be used to map the stratigraphy of the upper 50–100 m of the sub-surface sediments in water depths ranging between ~100 and 1,000 m. Sidescan data will be acquired simultaneously with the acquisition of the AUV multibeam echosounder and SBP data. The system operates at dual-frequencies, 120 and 410 kHz. The system has an estimated maximum source level of approximately 226 dB re 1 uPa (Edgetech 2014).

As the AUV will be flown between 8 and 50 m of the seabed it is not considered credible that whales or whale sharks would be subjected to underwater noise

from equipment on the AUV. It is considered possible that site attached species directly under its path may be temporarily affected while the AUV passes overhead. The sidescan sonar and multibeam echo sounder operate at high frequencies and have wide swathe angles. However, the low height of the AUV means that their swathes would be relatively narrow. The sub-bottom profiler is highly directional and would impact even less area than the sidescan sonar and multibeam echo sounder.

3.3.1.3 Potential Impacts

It should be noted that the underwater noise generated by the equipment described above does is very different to seismic and pile driving. The review of the equipment, sensitivities and thresholds, combined with the additional information on pygmy blue whales, whale sharks, commercial fishes and turtle nesting, indicate that underwater noise impacts are unlikely and would constitute no more than avoidance behaviour by mobile fauna. The received levels of sound are likely to be very low within very close proximity to the vessel or the AUV. There are no significant biological activities expected to occur within close proximity to the survey activities. As such, it is considered highly unlikely that impacts would occur.

3.3.2 Other Equipment

3.3.2.1 Autonomous Underwater Vehicle (AUV)

An AUV (Echo Surveyor III, Hugin 1000) will be used for targeted surveys of the seabed. The AUV will be flown between 8 and 50 m off the seabed. The AUV platform is equipped with:

- Multi-beam echo-sounder
- Sub-bottom profiler
- Sidescan sonar
- Black and white still camera
- Methane and CO_2 sensors (potentially).

Black and white still camera photographs (1 Hz sampling) will be used for limited area investigation and photomosaicing. Methane and CO_2 sensors may potentially be used.

3.3.2.2 Remotely Operated Vehicle (ROV)

A Seaeye Panther Plus ROV with positioning (HIPAP) and inertial navigation systems will be used to undertake targeted reconnaissance, mapping and sampling of potential seepage sites at water depths of up to 1,000 m. Data acquisition capability for the ROV will include:

- forward looking colour video footage

- forward and rear looking black and white video footage.
- camera system with flash capable of colour still photographs.
- physical samples of rocks and sediments using mechanical arm.
- gas-tight water sampling device for contained fluid sampling
- sediment cores (up to 1.5 m) using a push-core
- possible methane and CO_2 sensors
- temperature
- salinity (conductivity)
- pH
- dissolved oxygen
- current speed and direction
- particulate matter or similar measure for turbidity.

3.3.2.3 CSIRO Integrated Coring Platform

An integrated coring platform, provided by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) may be used in conjunction with AUV and/or ROV technologies. The platform includes iterative closest point (ICP) and benthic optical, acoustic and grab system (BOAGS) components, consisting of a sediment grab, cameras, scientific echo-sounder and a conductivity/temperature/depth (CTD) profiler to deliver high accuracy, real time visually controlled seabed sampling and collection of water column information with a single deployment. The combined technologies include stereo high resolution digital stills cameras, deep sea power and light LED lighting, front facing low light video camera, grab view video camera, Smith-McIntyre sample grab multi-corer, altimeter, Seabird 37SI CTD and real time video and data feed via fibre optic cable. A 22 kW winch and 6,000 m fibre optic tow cable is used to deploy the system from the vessel to a rated working depth of 3,000 m.

3.3.2.4 Piston/Gravity Corer

Cores will be taken at potential seep sites (identified using previously listed data acquisition methodologies) in water depths between approximately 100 m and up to 1,000 m. Gravity cores will be sampled on board by GA personnel for head-space gas and sediment samples taken for other biophysical studies. Ideally, cores sampled will be 10+ m long. The gravity coring system will ideally have USBL or equivalent location capability and heat flow measurement instrumentation.

3.3.2.5 Rock Dredge

Rock dredging will be used opportunistically in water depths up to 1,000 m to sample scarps and outcrops where identified in potential seepage sites. Pipe dredges (available from GA) will be deployed simultaneously.

3.3.2.6 Smith-McIntyre/Shipek Grabs

Smith-McIntyre/Shipek grabs and a 5 m long vibrocore will be used to collect samples of the seabed and shallow subsurface sediments, respectively. These samples will be collected at representative locations in the study areas to characterise the environments. Priority will be given to sample sites where gas/fluid migration or escape may have occurred in the past. Samples from others areas will also be collected for baseline data to enable comparative analysis. The grab samplers collect a sample of the sea floor using a set of "closable jaws". The jaws close, collecting the sample, after being triggered when the grab contacts the sea floor. The grab collects unconsolidated material (i.e. mud, sand) and each grab is expected to acquire up to 0.14 m^3 of unconsolidated material and will impact on approximately 1 m^2 of seabed.

The Vibrocore is mounted in a 4 m frame that is lowered to the sea floor. The 75 mm diameter core barrel is pushed into the soft sediments by an electrically powered vibration system. The maximum penetration depth of the core barrel is 5 m.

3.3.2.7 Underwater Video and Still Photographs

Underwater video and still photographs will be collected along representative transects over seabed features to characterise the physical habitats and biological communities associated with different seabed environments. Priority will be given to sampling seabed environments that are indicative of gas or fluid migration in the subsurface or escape at the seabed (e.g. pock-marks, ridges). The underwater camera system will operate at approximately 1–2 m above the sea floor in transects of several hundred metres. The system will have USBL or equivalent location technology.

3.3.2.8 CO_2/Hydrocarbon Sensor

A CO_2/hydrocarbon sensor will be used to identify, possible fluid and/or gas escape. Ideally, these samples and sensor will be attached to the preferred underwater camera system (AUV/ROV/BOAGS) and be collected simultaneously with the video transects. The system will have USBL or equivalent location technology.

3.4 Time Frame

The survey timetable is now confirmed for the October – November 2014 period. The survey is proposed to be undertaken in two legs; the first leg would include AUV operations with the possibility of some seabed sampling (cores and grabs); the second leg would include ROV operations and seabed sampling (cores and

grabs). The total time spent within the research area is expected to be 19 days, but may vary within the period according to site conditions.

4.0 ENVIRONMENTAL IMPACTS AND RISKS

4.1 Methodology

The environmental risks associated with the Browse Basin Marine Survey have been assessed using the following steps:

- define the activity and associated environmental aspects
  identify the environmental values at risk within and adjacent to the survey area
- determine the inherent risk of each identified environmental hazard associated with the proposed survey, using the worst-case environmental impact of the hazard
- with controls implemented, establish if the risk is as low as reasonably practicable (ALARP) and acceptable.
- review the activity and consider additional control measures until the residual risk is ALARP and acceptable.

The risks for each potential impact have been assessed using a qualitative assessment process defined by GA, in accordance with the International Organisation for Standardisation (ISO) *31000:2009 – Risk management – Principles and guidelines*, and Standards Australia *Handbook 203:2012 – Managing environment-related risk*.

Within this context a listing of relevant environmental aspects, hazards and possible impacts have been identified which could affect the environment from the survey program. For each hazard, the environmental consequence and the likelihood of occurrence have been assessed.

This Environmental Risk Assessment (ERA) identifies, assesses and prioritises the risks associated with each environmental hazard in accordance with the GA Qualitative Risk Matrix (Table I), using the definitions for Consequence and Likelihood contained in Table G and Table H**.**

The severity of a potential impact is assessed according to the GA “Definition of Consequence” table (Table G). A likelihood rating is allocated to the environmental hazard according to the categories given in the GA “Definition of Likelihood” table (Table H). The ranking of environmental hazards was undertaken using the GA Qualitative Risk Matrix (Table I).

Table F: Definition of Consequence

Consequence		Description
5 Very Serious	S: E: R:	Multiple Fatalities or significant irreversible effects to one or more people Very serious long-term environmental impairment of the ecosystem, significant recovery work over years/decades, Tier 3 Oil Spill Extreme adverse public, political or media outcry resulting in international media coverage critical impact on reputation
4 Serious	S: E: R:	Single Fatality and/or severe irreversible disability to one or more people Serious medium term environmental effects, recovery work over a few months, Tier 2 oil spill Significant impact on reputation and/or national media exposure local community complaint
3 Moderate	S: E: R:	Moderate irreversible disability or impairment to one or more persons. Significant Injury (Lost Time Injury (LTI) or Restricted Work Day Case (RWDC)) Moderate environmental impact with recovery work over a few days/weeks, Tier 1 oil spill, Impact/damage to item of National Environmental Significance (NES) Serious local adverse public media attention or complaints local user concern moderate to small impact on reputation
2 Minor	S: E: R:	Reversible disability requiring hospitalisation or Medical Treatment Injury Minor Impact on biological/physical environment, Negligible remedial/recovery work, <1BBl oil spill Public awareness but no public concern beyond local users Minor impact on reputation
1 Negligible	S: E: R:	Slight Injury (First Aid Treatment) Negligible Impact, Effect contained locally Negligible Impact on Reputation no public or regulator interest

Legend: S: Safety, E: Environment, R: Reputation Impacts

Table G: Definition of Likelihood

Likelihood	Description
E. Very likely	Common occurrence in this type of business
D. Likely	May occur in our business
C. Possible	Possibility of occurring. Has happened in similar businesses
B. Unlikely	Unlikely to occur. A rare event by standards of industry
A. Very Unlikely	Unlikely to happen here or elsewhere. Conceivable under extreme circumstances

Table H: GA Qualitative Risk Matrix

		Likelihood				
		A: Very Unlikely	B: Unlikely	C: Possible	D: Likely	E: Very likely
Consequence	5. Very Serious					
	4. Serious					
	3. Moderate					
	2. Minor					
	1. Negligible					

Category	Description and Response
High	**High Risk:** Considered intolerable. Work cannot proceed as currently planned. Urgent remedy and resources required for immediate risk reduction.
Significant	**Significant Risk:** Undesirable. Upper management decision to accept or reject risk for the operation to continue.
Medium	**Medium Risk:** Risk reduction measures need to be considered to reduce risks to a level which is as low as reasonably practicable. Generally acceptable level of risk where further risk reduction is shown not to be practicable.
Low	**Low Risk:** Risks are sufficiently low to be acceptable (i.e. at ALARP). Manage for continuous improvement by management.

4.2 Acceptability

The risks of adverse environmental impacts associated with the hazards identified within this EP were reduced to ALARP and to a level where the residual risk levels are considered acceptable, on the basis of a systematic process, as summarised below:

1. The environmental aspects of the survey were identified.
2. The credible, potential "consequence" of each hazard was identified.
3. Acceptable levels of risk were defined for each aspect, incorporating:
   a. principles of ecologically sustainable development (ESD)
   b. other requirements (including laws, policies, standards, conventions)
   c. internal context (e.g. consistency with GA policies, culture and company standards)
   d. external context, including:
      i. the environment
      ii. stakeholder expectations.
4. Industry best practice measures were considered.
5. An ALARP process was undertaken to consider further measures to reduce risk.
6. The assessment was reviewed following the inclusion of the additional measures to determine whether the risks and impacts are ALARP, and to determine whether the risks and impacts are acceptable.

GA's senior management reviewed the impacts, risks and management measures described in this EP, in the context of the steps listed above, and are confident that impacts and risks are ALARP and will meet, or be better than, the acceptable levels defined in the EP.

4.3 Risk Assessment and Controls Summary

A summary of the identified risks, their potential environmental impact and the controls applied is provided in Table J.

Table I: Summary of environmental risks, potential impacts and controls

Risk	Potential Impacts	Controls
Routine Operations		
Marine Organisms on vessel hull, niches or equipment	Alteration of marine environment due to Introduced Marine Species (IMS)	Ship hull and niches free of potential IMS prior to mobilisation Hull anti-fouling coating current and in sound condition. Underwater equipment cleaned prior to survey. Pre-survey inspection of confirms vessel and submersible equipment free of marine fouling and marine sediment. Vessel hull and equipment regularly cleaned of fouling organisms as required. National Biofouling Management Guidance for the Petroleum Production and Exploration Industry
Marine Organisms in Ballast Water	Alteration of marine environment due to IMS	Adherence with the Australian Ballast Water Management Requirements No planned ballast water exchanges to take place during the activity. If required ballast water exchange will not occur within 12 nautical miles (NM) of land
Presence of Vessel	Interference with or displacement of recreational, commercial and traditional fishing. Interference with or displacement of commercial shipping.	AMSA, AHO and WA DoT to be advised of the survey prior to mobilisation and following demobilisation for issue of Notice to Mariners All relevant stakeholders notified of the survey prior to mobilisation and following demobilisation. Vessel to maintain appropriate lighting, navigation and communication at all times to inform other users of the position and intentions of the survey vessel, in compliance with the *Navigation Act 2012* and Chapter 5 of the SOLAS Convention. Daily reports to be provided to the AMSA RCC. .
Artificial Lighting	Disruption to behaviour of light sensitive marine fauna.	No unnecessary external lighting during the activity (note that lighting for the purpose of safety, navigation or operational purposes is excluded). Pre-mobilisation audit to identify opportunities to reduce deck light spill to the marine environment.

Risk	Potential Impacts	Controls
Vessel Noise	Disruption of behaviour of noise sensitive marine fauna.	Survey vessel to comply with Section 8 of the EPBC Regs, including: ▪ makes sure the vessel does not drift or approach closer to the cetacean than 50 m for a dolphin and 100 m for a whale. ▪ immediately withdraws from the caution zone (300 m) around the cetacean if it shows signs of being disturbed. ▪ does not exceed a speed of 6 knots within the caution zone of a cetacean (300 m). Report death or injury of a listed species to the Secretary of DotE within seven days. Ensure that the vessel propulsion system is maintained in working order. Bow and stern thrusters to be used as required. An induction training session (start-up meeting) will be provided to all crew members to ensure they are aware and familiar with the environmental sensitivities and survey activity hazards controls to prevent significant impacts to marine fauna and their individual responsibilities throughout the survey.
Oily Water Discharge	Potential localised and temporary acute toxic effects	*Protection of the Sea (Prevention of Pollution from Ships) Act 1983* – No discharge of oily (>15 ppm hydrocarbons) water from the survey vessel during the activity. Oil water separator to be in good working order. No discharge within 12 NM of land or within boundaries of a marine reserve.
Grey Water / Sewage Discharge	Adverse effects on marine biota due to localised increase in turbidity and nutrient concentrations	*Protection of the Sea (Prevention of Pollution from Ships) Act 1983* –Section 26D Prohibition of discharge of sewage into the sea MARPOL 73/78 Annex IV Prevention of Pollution by Sewage from Ships. Biodegradable detergents to be used. Sewage treatment plant to be operations and all sewage treated prior to discharge. All discharges further than 12 NM from land and at a speed of greater than 4 knots. No discharge within the boundaries of a marine reserve.
Putrescible Waste (Food Scraps) Discharge	Adverse effects on marine biota due to localised increase in turbidity and nutrient concentrations	RV *Tangaroa* Garbage Management Plan. *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* – Section 26F Prohibition of disposal of garbage into the sea (all sub-sections) Records detailing the amount, size, type and distance from land to be kept for putrescible waste discharges. No discharge within marine park boundaries or within 12 NM from land.
Greenhouse Gas Emissions	Greenhouse gas emissions to the atmosphere from engines and incinerator	MGO used during the survey to comply with standards outlined in MARPOL 73/78 Annex VI with regards to sulphur content, namely MGO will contain a concentration of sulphur not exceeding 3.5% by mass. Vessel to have a valid IAPP. Propulsion system to be well maintained and in good working order.

Risk	Potential Impacts	Controls
Ozone Depleting Substances	Release of ODS from refrigeration and firefighting equipment.	Adherence with MARPOL 73/78 Annex VI Prevention of Air Pollution from Ships. No release of an ODS during the activity. Register of all ODS to be maintained on board.
Underwater Noise From Multi-Beam and Sub Bottom Profiler	Disruption of behaviour of noise sensitive marine fauna.	Report death or injury of a listed species to the Secretary of DotE within seven days. Soft start procedure for the sub-bottom profiler. An induction training session (start-up meeting) will be provided to all crew members to ensure they are aware and familiar with the environmental sensitivities and survey activity hazards controls to prevent significant impacts to marine fauna and their individual responsibilities throughout the survey. The Sub-bottom profiling sizes to achieve data acquisition objectives for the Browse Basin Marine Survey will be established and the selected equipment sizes will be the minimum to achieve the data acquisition objectives.
Deployment of seabed equipment	Physical disturbance to benthic habitat	Code of Environmental Practice – Environmental Objectives Offshore, Geophysical Surveys and Drilling Operations (APPEA 2008). Locations to be investigated using multi-beam or sub-bottom profiler and underwater video prior to attempting coring. No more than five attempts to collect a successful core will be made at a given sampling location. No coring to be undertaken within the boundaries of a marine protected area.

Risk	Potential Impacts	Controls
Non-Routine Operations		
Vessel Collision Resulting in Hydrocarbon Spill	Acute/chronic toxic effects on marine life from hydrocarbons	Vessel in good condition and suitable for activity Vessel masters qualified and competent in the safe navigation and control of marine vessels to prevent collisions with other vessels. The survey noted in Notice to Mariners. OPEP, vessel SOPEP and the SOPEP Bridging Document (Appendices 5 and 6) testing arrangements implemented MARPOL 73/78 Annex I – Regulations for the Prevention of Pollution by Oil. *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* –Section 9 Prohibition of discharge of oil or oily mixtures into the sea. *Navigation Act 2012* Marine Order 21 (Safety of navigation and emergency procedures) 2012 *Navigation Act 2012* Marine Order 30 (Prevention of collisions) 2009 *Navigation Act 2012* Marine Order 91 (Marine pollution prevention - oil) 2006 Approved SOPEP and the SOPEP Bridging Document on board with suitable crew training Ongoing consultation with stakeholders AMSA, AHO and WA DoT to be advised of the survey prior to mobilisation and following demobilisation for issue of Notice to Mariners All relevant stakeholders notified of the survey prior to mobilisation and following demobilisation. Vessel to maintain appropriate lighting, navigation and communication at all times to inform other users of the position and intentions of the survey vessel, in compliance with the *Navigation Act 2012* and Chapter 5 of the SOLAS Convention. Daily reports to be provided to the AMSA RCC. . Spill response equipment is located in accordance with SOPEP and the SOPEP Bridging Document requirements Routine drills involving spills are undertaken in accordance with the RV *Tangaroa* SOPEP and the SOPEP Bridging Document Drills Matrix A pre-mobilisation emergency response exercise is undertaken to test the Oil Spill Response Arrangements as detailed in EP EP Induction
Vessel Grounding Resulting in Hydrocarbon Spill	Acute/chronic toxic effects on marine life from hydrocarbons	As per *Vessel Collision Resulting in Hydrocarbon Spill* Hazard above, plus: ▪ Vessel not to enter water less than 12 m deep

Risk	Potential Impacts	Controls
Collision with Marine Fauna	Injury or death of marine fauna	Bridge watch to maintain standard watch procedures and avoid cetaceans or other marine fauna where possible EP Induction Survey vessel to comply with Section 8 of the *EPBC Regulations 2000*, including: ▪ makes sure the vessel does not drift or approach closer to the cetacean than 50 m for a dolphin and 100 m for a whale. ▪ immediately withdraws from the caution zone (300 m) around the cetacean if it shows signs of being disturbed. ▪ does not exceed a speed of 6 knots within the caution zone of a cetacean (300 m). ▪ Report death or injury of a listed species to the Secretary of DotE within seven days.
Loss of Solid / Hazardous Waste Overboard	Contamination of marine environment with localised effects.	RV *Tangaroa* Garbage Management Plan. *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* –Sections: ▪ 26AB Prohibition of discharge by jettisoning of harmful substances. ▪ 26F Prohibition of disposal of garbage into the sea.
Oil or Chemical Spill Through Deck Drainage	Contamination of the marine environment with localised acute toxic effects.	MARPOL 73/78 Annex I – Regulations for the Prevention of Pollution by Oil. *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* –Section 9 Prohibition of discharge of oil or oily mixtures into the sea. Chemicals and oils are stored in suitable containers in bunded areas isolated from the deck drainage system. MSDS available to all POB Risk assessment of high risk spill areas Spill kits available Biodegradable detergents used on deck Good housekeeping Vessel/EP inductions Approved SOPEP and the SOPEP Bridging Document Training drills Crew to be trained in implementation of the SOPEP and the SOPEP Bridging Document and use of clean-up equipment.

Risk	Potential Impacts	Controls
Entanglement of Marine Fauna in Equipment	Injury or death of marine fauna.	Bridge watch to maintain standard watch procedures and avoid cetaceans or other marine fauna where possible EP Induction Survey vessel to comply with Section 8 of the *EPBC Regulations 2000*, including: ▪ makes sure the vessel does not drift or approach closer to the cetacean than 50 m for a dolphin and 100 m for a whale. ▪ immediately withdraws from the caution zone (300 m) around the cetacean if it shows signs of being disturbed. ▪ does not exceed a speed of 6 knots within the caution zone of a cetacean (300 m). ▪ Report death or injury of a listed species to the Secretary of DotE within seven days. All entangled marine fauna to be returned to the sea.
Loss of Equipment	Localised disturbance to benthic habitat	GA and RV *Tangaroa* procedures Equipment (bridles and harnesses) are routinely inspected and maintained for wear and tear and prior to deployment Marine notifications in event of loss Towed equipment is fitted with the following equipment: ▪ Buoyancy Devices ▪ Buoys ▪ Secondary retaining devices.
Unexploded Ordnance (UXO)	Localised disturbance to benthic habitat Injury or death of marine fauna	GA and RV *Tangaroa* procedures Multi-beam, sub-bottom and video inspections prior to any physical sample collection No disturbance to UXOs Defence notified of possible UXOs
Responding to an Oil Spill	Increased vessel traffic leading to increased overall risk. Clean up.	Periodic SOPEP drills in accordance with the R RV *Tangaroa* SOPEP drills matrix are undertaken to ensure all crew members are familiar with arrangements. Pre-mobilisation audit confirms availability on-board: ▪ RV *Tangaroa* SOPEP ▪ Port and Emergency Contact details are complete and correct. ▪ Response equipment available and located at locations designated in the SOPEP. All corrective actions are implemented prior to mobilisation. AMSA and GA are notified immediately of the incident Marine spill surveillance and monitoring continues until oil spill termination criteria, in accordance with the Bonn Convention, are achieved.

5.0 MONITORING OF ENVIRONMENTAL PERFORMANCE

5.1 Ongoing Monitoring

The Browse Basin Marine Survey will be managed in compliance with the accepted EP for the activity, all applicable laws and regulations, the Geoscience Australia Environment Policy, and the HSE Management System of the vessel contractor.

The objectives of the EP are to ensure that:

- The proposed activity carried out consistent with the principles of ecologically sustainable development
- The receiving environment is adequately described, such that all values and sensitivities are identified
- The sources of potential impacts from both planned and unplanned activities are identified
- Potential impacts and risks are acceptable and are reduced to as low as reasonably practicable (ALARP).

The implementation strategy for the EP, including for during emergencies or potential emergencies, describes in detail the arrangements in place to allow Geoscience Australia to continually manage the environmental impacts and risks of their activities to acceptable levels and ALARP. It includes:

- details of when the titleholder will report to the Regulator in relation to the titleholder‘s environmental performance
- a description of the environmental management system for the activity, including specific measures to ensure that
  - the environmental impacts and risks of the activity continue to be identified and reduced to a level that is ALARP
  - control measures detailed in the EP are effective in reducing the environmental impacts and risks of the activity to ALARP and an acceptable level
  - environmental performance outcomes and standards set out in the EP are being met
- chain of command, and roles and responsibilities in relation to the implementation, management and review of the EP
- training and competencies, including induction into the EP
- monitoring, recording, audit, management of non-conformance and review of the environmental performance and the implementation strategy, and quantitative records of emissions

GA will maintain a record of environmental performance during the Browse Basin Marine Survey, including an assessment of performance in relation to the environmental performance outcomes and standards detailed within the EP. This record will be documented in the form of a Compliance Register. A report on the environmental performance, including the Compliance Register, will be submitted to NOPSEMA for assessment within two months of completion of the Browse Basin Marine Survey.

The key measures for ensuring ongoing environmental performance include:

- Pre-survey testing of oil spill response arrangements
- a pre-survey audit
- project kick-of meeting
- an audit during the survey
- post –survey review and report on environmental performance

5.2 Review of the EP

If ongoing performance monitoring or consultation with stakeholders identifies any significant new environmental impact or risk, or a significant increase in an existing environmental impact or risk that is not provided for in the EP than Polarcus will submit a proposed revision of the EP, in accordance with regulation 17 of the OPGGS(E)R.

The EP will be reviewed and a proposed revision submitted to the regulator if:

- the activity is changed, significantly modified, or a new stage added, or
- any significant new environmental impact or risk, or a significant increase in an existing environmental impact is identified, or
- if requested by the regulator.

6.0 OIL POLLUTION EMERGENCY PLAN (OPEP) RESPONSE ARRANGEMENTS

The overall objectives in any marine oil pollution event are to:

- Reduce risk to people, property and the environment.
- Effectively respond to minimise the oil impact area and impacts to protection priorities within that area.
- Remove spill and remediate area to agreed spill termination criteria.

The Oil Pollution Emergency Plan (OPEP) for the EP is based on the RV *Tangaroa* Shipboard Oil Pollution Emergency Plan (SOPEP). The OPEP demonstrates:

- provision for the updating of the plan
- adequate arrangements for responding to and monitoring oil pollution
- arrangements for testing the response arrangements in the OPEP
- arrangements for monitoring of impacts to the environment from oil pollution and response activities
- the response arrangements in the OPEP are consistent with the national system for oil pollution preparedness and response

The OPEP integrates the following plans the RV *Tangaroa* SOPEP, the SOPEP Bridging Document, the National Plan for Maritime Environmental Emergencies (NATPLAN) and Western Australian plans.

The first point of contact in the event of an oil spill during the Browse Basin Marine Survey is the Australian Maritime Safety Authority (AMSA). In the event that a hydrocarbon spill associated with the RV *Tangaroa* occurs within port the relevant port authority must be contacted.

Oil spill response arrangements detailed in this section and it's interaction with the RV *Tangaroa* will be tested prior to mobilisation to the Browse Basin Marine Survey area. Outcomes of this testing will be documented and any corrective actions/improvements implemented prior to mobilisation.

6.1 RV *Tangaroa* SOPEP

The RV *Tangaroa*'s SOPEP contains specific actions to contain and mitigate oil spills for identified credible oil spill threats on/from the vessel. This includes the following actions which are assigned to various positions on-board the vessel:

- Operational Spills
  - Bunkering Overflow/Transfer System Leak/Tank Overflow[1]
  - Hull Damage/Leak
  - Equipment in Machinery Space.
- Spills resulting from Casualties
  - Ship Grounding
  - Collision
  - Hull Failure (major cracks in shell plating)
  - Fire and Explosion.

On-site response equipment for the prevention/minimisation of loss of oil to sea during the proposed Browse Basin Marine Survey is the RV *Tangaroa*'s on-board spill response kit equipment. This equipment is stored in dedicated lockers located on the vessel, and identified as spill equipment. All crew are trained in the use of the vessel equipment listed above and the PPE required to appropriately respond to the spill (as contained in MSDSs).

Regular SOPEP drills and exercises are carried out on the RV *Tangaroa* in accordance with the Vessel's SOPEP to maintain the crew's currency in response equipment and incident response procedures. This verifies emergency response efficiency, effectiveness of procedures and detects any failure in equipment. These drills include, but are not limited to, spill response, collision and grounding and fire and explosion. All drills are documented, debriefings held and corrective actions identified (including revisions to SOPEP) and tracked to completion by the Vessel Master.

An audit of the on-board spill response capability of the RV *Tangaroa* against its SOPEP will be made prior to survey mobilisation to ensure appropriate preparedness for the Browse Basin Marine Survey.

6.2 NATPLAN

NATPLAN integrates Commonwealth and State Government response frameworks to facilitate effective response to marine pollution incidents through the Australian Emergency Management Arrangements. The Australian Maritime Safety Authority (AMSA) manages NATPLAN, working with State Governments (who have equivalent state plans which integrate into NATPLAN).

[1] No bunkering of oil will occur at sea during the Browse Basin Marine Survey.

6.3 Western Australian Plans

If a spill occurs in Western Australian waters, the State Emergency Plan for Marine Oil Pollution (WestPlan MOP) and the Western Australia Oil Spill Contingency Plan (WA OSCP) apply.

The Western Australia Department of Transport (DoT) is responsible for the preparedness for marine oil response in Western Australian territorial waters. The Western Australian DoT is the Control Agency, Jurisdictional Authority and the Hazard Management Agency, except if a spill occurs in Port Authority waters. AMSA may request that the Western Australian DoT assume the Control Agency role, even though the spill occurred in Commonwealth waters in situations where oil is likely to impact on the Western Australian shoreline.

Deployment of Western Australian resources outside State waters is coordinated and requested through AMSA.

6.4 Spill Scenarios

Credible spill scenarios identified for the Browse Basin Marine Survey activity are broadly divided into two categories:

- small spill quantities from uncontained deck spills/leaks or in-water equipment leaks to the marine environment

- larger spills resulting from vessel failure (e.g. vessel collision) resulting in the loss of the entire contents of the largest fuel tank on board the RV Tangaroa (63 m^3).

The fuel used on the RV Tangaroa is Marine Gas Oil (MGO). MGO is a common marine fuel used in vessel engines and is a mixture of both volatile and persistent hydrocarbons. On release, MGO is expected to undergo a rapid spreading and evaporative loss with the remainder becoming dispersed in the water column.

MGO slicks tend to break up quickly and evaporative weathering leaves higher concentrations of less volatile, higher molecular weight hydrocarbons. The heavier components have a strong tendency to entrain in the upper water column as oil droplets in the presence of wind/waves but can re-float to the surface if these energies abate.

Response options for MGO spills are as follows:

- Due to the rapid evaporation and dispersion MGO spills are normally monitored and allowed to naturally weather, if no protection priorities are at risk.

- MGO is dispersible, although not recommended because of the high proportion of toxic materials and their persistence and toxicity in the marine environment may increase with dispersant use. Additionally dispersant use on light products which form very thin films of oil or sheens on the water surface, tend to “punch-through” the thin film into the underlying water causing herding of the oil (not to be confused with dispersion). Dispersant may be used in instances where there is an immediate safety hazard, however the rapid spread of this material makes this strategy ineffective.

- Physical agitation by using propeller wash may assist in the evaporation and break up of spilled MGO however the potential exists to emulsify the oil which leads to decreased degradation rates. This response strategy is not recommended for these types of spills.

- The rapid spreading rate of these oils presents problems for containment strategies at sea but if contained diesel is easily recovered with sorbent or oleophilic disc skimmers.

6.5 Spill Response

The immediate response to any spill is to implement the vessel’s SOPEP. The RV *Tangaroa* Vessel Master is responsible for notification and reporting (via POLREP contained in SOPEP) all spills to the marine environment to the AMSA RCC. Once the vessel has transmitted an initial report, further reports will be sent at regular intervals to keep relevant parties (AMSA, GA, NOPSEMA, WA DoT, DMP, etc.) informed.

The on-board GA Survey Leader is responsible for advising the GA Project Manager of the spill incident. The GA CEO is then responsible for notifying NOPSEMA.

The RV *Tangaroa* Incident Management Team (IMT) is responsible for initiating the Incident Action Plan and emergency procedures as detailed in the RV *Tangaroa*’s SOPEP.

6.5.1 Small Spills

A Tier 1 (<400 L (discrete volume) for the Browse Basin Marine Survey) response to a small spill can be handled by on-site or local resources. If a spill occurs from a vessel, the Master will mount the first response to the incident under the Vessel’s SOPEP using the resources immediately available to the vessel (i.e. ship-board equipment). The Master will immediately notify all spills to the Rescue Coordination Centre (AMSA).

The identified Tier 1 spill would have a zone of potential impact (ZPI) which is close to the vessel and would be managed and monitored by the Vessel Master until the spill is effectively dispersed or evaporated, with oversight by, and in close cooperation with, AMSA. The Vessel Master is responsible for providing updated reports to AMSA to inform the spill response strategy (at frequencies determined by AMSA).

AMSA, as Control Agency (CA) for spills in Commonwealth Waters will monitor and continue to assess this level of spill. Note that the Statutory Authority (SA – NOPSEMA) can reassess the response at any time and escalate the response as required.

6.5.2 Large Spills

A Tier 2 (<63 m^3 MGO for the Browse Basin Marine Survey) response is a medium/significant spill which could have serious impacts on the environment and/or cannot be managed by onsite resources. The Vessel Master will notify AMSA who shall be CA for a Tier 2 spill response. The Survey Leader will notify the GA Project Manager who will provide notification to the GA CEO who will notify NOPSEMA.

The Vessel Master, after ensuring safety of crew and fire prevention and notification to AMSA, will implement the SOPEP and consider relevant actions such as tank lightering to reduce the oil volume released to the environment.

AMSA will determine the appropriate response strategies depending upon the protection priorities at risk within the ZPI. AMSA, depending on the location, prevailing weather conditions, available vessel responses (e.g. tank lightering) and volume spilt, will determine the need for oil spill trajectory modelling to confirm protection priorities within the ZPI and possible sea/aerial surveillance to confirm/inform trajectory predictions. All selected response strategies will be in accordance with NATPLAN

The Vessel Master is responsible for providing SITREPs to AMSA to inform the spill response strategy.

6.6 Operational Monitoring (Type 1 Monitoring)

Operational monitoring following a spill may include:

- monitoring and surveillance (e.g. vessel/aerial) of the spill, its weathering and proximity to environmentally sensitive locations

- undertaking oil spill trajectory modelling (as necessary) to predict slick movement

- as required, and after a NEBA assessment, deploy appropriate resources or equipment to protect identified sensitive environmental resources within the zone of potential impact (ZPI).

Onsite resources will continue to provide status updates (SITREPs), at the direction of AMSA, throughout the response activity. AMSA will maintain the response until relevant termination criteria are achieved.[2]

6.7 Scientific Monitoring (Type 2 Monitoring)

6.7.1 Activities

Scientific monitoring activities to be undertaken during a Tier 2 spill event include:

- Water quality;
- Sediment quality;
- Shorelines and coastal habitats – including mangroves, sandy beaches, tidal zones and rocky shores (if shorelines are contacted by the hydrocarbon);
- Seabirds and shorebirds;
- Sea snakes and Marine Turtles.

Table K outlines the operational and scientific response monitoring activities to be undertaken during a Tier 2 spill. Scientific monitoring activities to be undertaken during a Tier 2 spill will be organised and implemented by a GA environmental specialist. Consultation with State Environmental Science Coordinator (ESC) through DoT will be undertaken for any scientific monitoring programs in State waters.

6.7.2 Scientific Response Monitoring Service Providers

During and post-spill scientific response monitoring activities may require resources external to GA and include specialist technical capabilities. GA has arrangements in place with environmental consultant agencies that can be called upon to support scientific response monitoring activities.

[2] For a Tier 2 MGO spill in marine waters it is expected that a criteria of 'no visible sheen' will be adopted by AMSA as the termination criteria.

Table J: OSMP Monitoring Tasks and Responsibility for Implementation

Type	TITLE/DESCRIPTION	KEY RECEPTORS	Implementation
OPERTATIONAL	Oil Spill Movement Prediction, Modelling and Assessment of Resources at Risk	-	AMSA
	Oil spill Surveillance and Reconnaissance (Aerial, Satellite & On-water)	-	AMSA
	Assessment of the Presence, Quantity and Character of Petroleum Hydrocarbons in Water and Marine Sediments	Water and sediments	GA
SCIENTIFIC	Detailed Characterisation of Oil Properties and Eco-toxicological Assessment	Various	GA
	Monitoring for Oil Hydrocarbons in Benthic Sediments	Subtidal and Intertidal Benthos	GA
	Surveys of Shoreline and Intertidal Benthos to Determine Impacts of Oil Spill and Recovery	Invertebrates, Intertidal Corals	GA
	Monitoring of Marine Benthos to Determine Impacts of Oil Spill and Recovery	Corals, Seagrass, Filter-feeders	GA
	Wildlife Surveys to determine Impact of Oil Spill on Seabirds and Shorebird Populations and Recovery	Seabird and Shorebird Populations	GA
	Surveys of Non-Avian Marine Wildlife to Determine Impacts of Oil Spill and Recovery	Sea snakes, Marine Turtles	GA

7.0 DETAILS OF CONSULTATION

7.1 Consultation Already Undertaken

Consultation with the majority of following stakeholders was undertaken between August 2013 and April 2014. An information package was sent to stakeholders, detailing the survey characteristics, locations, duration and proposed activities. Relevant stakeholders, including those potentially involved in oil spill response, were invited to provide comments on the survey. A number of stakeholders did not reply or replied only to acknowledge receipt of the invitation with no further comment.

The stakeholders consulted prior to, and during, the preparation of the EP are listed in Table L along with their objections/claims, an assessment of their merits and Geoscience Australia's response.t

Table K: Pre-survey Consultation

Stakeholder	Summary of Response	Assessment of Merits of Adverse Claim/Objection including response to each
Commonwealth Government		
National Offshore Petroleum Titles Authority (NOPTA)	Email response (31/10/2013): Recommendation that GA should apply for a Greenhouse Gas Research Consent for proposed survey.	GA has submitted an application for a Greenhouse Gas Research Consent
The Department of the Environment	Meeting (17/08/2013) DoE noted that GA should consider Key Ecological Features, the Kimberley Commonwealth Marine Reserve, and whale activity in the area when planning survey timing and location.	Information has been incorporated into EP
	Email response (10/02/2014) Advising shipwrecks in the research area do not require permits and providing guidelines for activities under the EPBC and Historic Shipwreck Acts.	Information has been incorporated into EP.
Commonwealth Marine Reserve Science and Information Management	Email Response (21/11/2013): CMRSIM advised that as a management plan is not yet in place, activities within the Kimberley Commonwealth Marine Reserve are not restricted, but noting the need to consider potential impacts on Matters of National Environmental Significance and requirements for permits to acquire biological samples.	GA to manage potential impacts in on Matters of National Environmental Significance through EP process. Information has been incorporated into EP
Australian Fisheries Management Authority (AFMA)	Email Response (14/03/2014): AFMA advised that in recent year the Northern Prawn Fishery, Western Tuna and Billfish Fishery and North West Slope Trawl Fishery have been active within the research area. AFMA encouraged thorough consultation with fishing industry in relation to this issue.	Consultation activities with relevant sectors of the commercial fishing industry were undertaken (refer Records below). Information has been incorporated into EP.
Australian Marine Safety Authority (AMSA)	Email Response (14/03/2014): Noting that the survey area lies outside major traffic routes but noting that vessel traffic between adjacent oilfields needed to be considered. AMSA request GA advises them and AHS of final survey schedule and exact location 2 weeks prior to the survey.	GA will inform AHS and AMSA RCC of final survey details 2 weeks prior to commencing acquisition.
Department of Defence – Defence Support and Reform Group	Response (05/03/2014): Requesting GA keep AHO informed of survey details and noting UXOs in the proposed research area.	AHO to be notified of final survey details 2 weeks prior to acquisition. Risk relating to UXOs addressed in EP.
Department of Broadband Communication and the Digital Economy (DBCDE)	Response (28/04/2014): the survey area not in the vicinity of any current submarine cable protection zones. Recommend GA contact submarine cable operators to ensure no inadvertent damage is caused to telecommunications cables.	GA has undertaken consultation with relevant parties.

Stakeholder	Summary of Response	Assessment of Merits of Adverse Claim/Objection including response to each
Australian Hydrographic Service (AHO)	Email Response (24/02/2014): AHO requesting notification 2-3 weeks prior to survey with accurate details of the final acquisition plan to issue a notice to mariners.	Information has been incorporated into EP.
Department of Agriculture, Fisheries and Forestry	Phone call response (20/3/2014) noting Indonesian fishermen will be present during survey, but mainly around Scott Reef. Unless acquisition occurs in this area, GA can communicate directly with any vessels they encounter.	Information has been incorporated into EP. If survey sites are identified near Scott Reef, DAFF will engage with Indonesian fishermen on GA's behalf.
National Native Title Tribunal (NNTT)	Email Response (6/03/2014): No relevant Native Title claims in the research area	Not Applicable
Australian Customs and Border Protection Service	Email response (16/4/2014): No comment but request to be kept informed of plans and developments.	GA will provide final survey details 2 weeks prior to acquisition
Oil & Gas		
Apache Energy Ltd	No response	Not Applicable
BHP Billiton Petroleum (Northwest Shelf) P/L	Email response (4/03/2014) acknowledging the receipt of information and noting no comment.	Not Applicable
ConocoPhillips (Browse Basin) P/L	No response	Not Applicable
Moby Oil & Gas Limited	No response	Not Applicable
Santos and subsidiary Coveyork P/L	Email receipt of information (4/3/2014) noting exploration team leader would respond.	Not Applicable
Finder Exploration	Email response received (04/03/2014) noting no issues in Finder operated permits and requesting GA consult Shell regarding operations in one permit.	See below consultation with Shell
Hunt Oil Australia	No response	Not Applicable
INPEX Browse Ltd	Email and phone response (14/03/2014) noting extensive activity in permit areas and arranging for INPEX and GA teams met on 7th April, Perth to discuss operational planning and communication. Meeting outcomes: GA to remain in regular contact with key contacts in INPEX Ichthys project leading up to the survey and provide final acquisition sites >2 weeks prior to commencing survey.	No Objection. If GA final acquisition locations coincide with Ichthys development area or an area of significant vessel traffic due to Ichthys operations, GA and INPEX will liaise to ensure safe operations. Information has been incorporated into EP.
IPM Browse P/L	No response	Not Applicable
Murphy Australia Oil	No response	Not Applicable

Stakeholder	Summary of Response	Assessment of Merits of Adverse Claim/Objection including response to each
Nexus Energy	No response	Not Applicable
PTTEP Australasia	Email (4/4/2014) noting no planned activities in permit area but requesting GA provide updated information regarding timing and location in case PTTEP schedule changes. Also requested data acquired in the lease area be provided to PTTEP. Also notes GA should expect vessel traffic in and out of the Montara field immediately to the northeast through the potential survey area (FPSO located at 667758 MGAE 8599988 MGAN, -12 deg 39" 35.329" S 124deg 32" 41.083" E)	GA will provide PTTEP with final survey location and timing 2-3 weeks prior to acquisition and seek confirmation of no conflicts. Information regarding vessel traffic has been incorporated into EP.
Shell Development (Australia) P/L	Email and phone receipt of information and clarification of process for requesting access to title area 4/03/2014-13/3/2014 and noting they would prepare a written response. Phone discussion indicated that no conflicts are expected, but written response has not been received.	GA will provide Shell with final survey location and timing 2-3 weeks prior to acquisition and seek confirmation of no conflicts.
Total E&P Australia	No response – note that GA is in regular communication with Total regarding other acquisition and has provided several opportunities to communicate potential conflicts.	Not Applicable
Woodside	Response (7/3/2014 -11/3/2014) noting activities in survey area and requesting a meeting. Meeting 19/7/2014 Canberra. Woodside activities likely not to coincide with survey.	GA and Woodside will continue to engage leading up to survey to confirm timing of activities.
Western Australian Government		
Department of Fisheries	Response (24/5/2014) requesting GA consider avoiding spawning times, identify and address fishing industry concerns, and manage fishing related risks and potential impacts in EP.	GA has investigated option to minimise activity in spawning times. However, times provide cover the entire 12 months and therefore cannot be avoided. Scientific information is not available to indicate spatial extent of area for species spawning during the proposed September-October time frame; therefore it is not possible to avoid sensitive locations. Further information has been requested from WAFIC and fishing industry representative organizations. Information has been incorporated into EP.
Department of Mines and Petroleum	Response (12/3/2014) requesting advice on activities in State waters around Scott Reef and requesting engagement with DMP if acquisition is planned for this area.	GA to engage with DMP if acquisition is to occur in State waters, and will provide DMP with details of environmental risks/ management measures and stakeholder consultation in ~May when this is completed for EP.

Stakeholder	Summary of Response	Assessment of Merits of Adverse Claim/Objection including response to each
Department of Transport	No response	Not Applicable
Department of Premier and Cabinet	No response	Not Applicable
Department of Finance – Public Utilities Office	No response	Not Applicable
Fisheries/Fishers		
Commonwealth Fisheries Association	No response on request for feedback on advice received from AFMA on potentially affected fisheries and the recommended industry contacts and engagement method for these.	Not Applicable
Western Australian Fishing Industry Council	Meeting (27/2/2014): WAFIC noted significant fishing activity within the research area and agreed to provide feedback on GA identification of affected fisheries and fishing industry contact lists. WAFIC main concern was clear communication with fishing industry regarding exclusion zones, timing, locations and vessel contact details to allow safe operations.	GA provided WAFIC with a contact list of potentially affected fishing industry associations and businesses for feedback on accuracy and comprehensiveness. GA to place all appropriate notices of activity and also provide final survey location, timing and contact information for the vessel to WAFIC and all interested fishing industry organizations and individuals.
WA Seafood Exporters	No response	Not Applicable
Westmore Seafoods	No response	Not Applicable
TunaWest	No response WAFIC	Not Applicable
Recfishwest	No response	Not Applicable
Northern Wildcatch Seafood Australia	No response	Not Applicable
WA Game Fishing Association	No response	Not Applicable
Australian Council of Prawn Fisheries	No response	Not Applicable
North Coast Shark Fishery	No response WAFIC	Not Applicable
Kimberley Professional Fishermen's Association	No response	Not Applicable
Jamaclan Marine Services	No response	Not Applicable
A. Raptis and Sons	No response	Not Applicable

Stakeholder	Summary of Response	Assessment of Merits of Adverse Claim/Objection including response to each
Australian Recreational Fishing Foundation (ARFF)	No response	Not Applicable
Northern Prawn Fishing Industry Association Pty Ltd	No response	Not Applicable
Australian Southern Bluefin Tuna Industry Association	No response	Not Applicable
Austral Fisheries	No response	Not Applicable
Pearl Producers Association	Requesting additional information and noting, based on location, the PPA have no issues with the planned activity.	Not Applicable
Northern Fishing Companies Association	No response WAFIC	Not Applicable
Western Australian Northern Trawl Owners Association	No response	Not Applicable
Marine Science		
Centre for Whale Research	No significant whale issues to be aware of except Pigmy Blue Whales and requesting access to MMO data if collected.	Not Applicable
Curtin University	No response	Not Applicable
Australian Institute of Marine Science	No response	Not Applicable
Subsea Cables		
Telstra	Email response: survey is outside of the area that is traversed by SMW3. Noting a proposal by Nextgen Pty Ltd to build a cable from Port Hedland to Darwin.	GA provided survey information to Nextgen Pty Ltd seeking feedback.
Nextgen Pty Ltd	Email response: no concern about the planned survey.	Not Applicable

7.2 Ongoing Consultation

Geoscience Australia is committed to ongoing consultation with all relevant stakeholders prior to, during and following the Rosemary 3D MSS Table M presents the identified ongoing consultation requirements for the EP. If additional stakeholders are identified at any time, or existing stakeholders raise any objections or claims, then Geoscience Australia will engage directly with them.

Table L: Ongoing Consultation

Stakeholder	Ongoing communication schedule
Commonwealth Government	
DotE and the Director of National Parks.	Provide final acquisition sites 1 month prior to survey commencement. Confirm if management plan is in place for the Kimberley Commonwealth Marine Reserve
	Acoustic information for wreck sites will be provided to DoE following processing and QC.
AMSA	GA provide final survey location and timing to AMSA RCC 2 weeks prior to commencing acquisition (email). Daily reports to RCC
Department of Defence	GA provide final survey location and timing to Defence 2 weeks prior to acquisition (email). Notify of any potential UXOs
AHO	GA provide final survey location and timing to AHO 2 weeks prior to acquisition . Issue Notice to Mariners
DAFF	If selected sites are close to Scott Reef, GA will contact DAFF one month prior to acquisition to communicate location, timing and vessel contact information to Indonesian fishers (email). DAFF to engage with Indonesian fishers if required
Customs and Border Protection Service	GA to provide final survey location, timing and vessel communication information to Customs and Border Protection contacts 2 weeks prior to acquisition (email).
Oil and Gas	
INPEX Browse Ltd	GA will provide final survey location, timing and vessel communication information to permit holder >1 month prior to acquisition (email). INPEX will provide GA with detailed information regarding planned activities in acquisition areas 2 weeks prior to acquisition (email + phone conference). GA will consult INPEX on identified risks and mitigation strategies, and agree to emergency procedures 2 weeks prior to the survey (email + phone conference). GA and INPEX will agree to a communication schedule to share information on relevant activities during GA acquisition (email + phone conference).
PTTEP Australasia	GA will provide PTTEP with final survey location and timing 2-3 weeks prior to acquisition and seek confirmation of planned activities in permit (email). GA will provide final survey location, timing and vessel communication information to PTTEP >1 month prior to acquisition (email) and seek agreement on communication protocols during the survey (email + phone conference)

Stakeholder	Ongoing communication schedule
Woodside	GA will provide final survey location, timing and vessel communication information to permit holder >1 month prior to acquisition (email). Woodside will provide GA with detailed information regarding planned activities in acquisition areas 2 weeks prior to acquisition (email + phone conference). If acquisition coincides with Woodside activities in permit area, GA will consult Woodside on identified risks and mitigation strategies, and agree to emergency procedures 2 weeks prior to the survey (email + phone conference). If acquisition coincides with Woodside activities in permit area, GA and Woodside will agree to a communication schedule to share information on relevant activities during GA acquisition (email + phone conference).
BHPBP (NWS)	If acquisition is in permit area, GA will provide data to the permit holder following processing and QC (email)
Finder Exploration	
ConocoPhillips (Browse)	GA will provide final survey location, timing and vessel communication information to permit holder 1 month prior to acquisition (email). If acquisition is in permit area, GA will provide data to the permit holder following processing and QC (email)
Moby Oil & Gas	
Santos and Coveyork	
Hunt Oil Australia	
IPM Browse	
Murphy Australia Oil	
Nexus Energy	
Shell Development (Australia)	
Total E&P Australia	
Apache Energy Ltd	
WA Government	
Department of Fisheries	GA to provide final survey details to WA Department of Fisheries prior to commencing acquisition (email).
Department of Mines and Petroleum	GA will provide final survey location, timing and vessel communication information >1 month prior to acquisition (email). If final acquisition locations include State waters, GA will consult with DMP and will provide DMP with details of environmental risks/ management measures and stakeholder consultation in ~May when this is completed for EP.
Department of Transport	GA will provide final survey location, timing and vessel communication information >1 month prior to acquisition (email).
Department of Premier and Cabinet	GA will provide final survey location, timing and vessel communication information >1 month prior to acquisition (email).
Department of Finance – Public Utilities Office	GA will provide final survey location, timing and vessel communication information >1 month prior to acquisition (email).
Fisheries	
Commonwealth Fisheries Association	Final survey location and time will be provided to the Commonwealth fisheries Association 1 month prior to survey for distribution to members.
WAFIC	Final survey location and time will be provided to WAFIC 1 month prior to survey for distribution to members.
Northern Fishing Companies Association	GA will provide above information to State and Commonwealth commercial fishing industry associations for distribution to members 1 month prior to acquisition (email) Final survey information and contact details will be posted at Broome Port during acquisition (flyer) and notice to mariners will be issued by AHO.

Stakeholder	Ongoing communication schedule
North Coast Shark Fishery	GA will provide above information to State and Commonwealth commercial fishing industry associations for distribution to members 1 month prior to acquisition (email)
Recfishwest	GA will provide final survey location, timing, vessel communication and GA 24 hour contact information for the survey timeframe 1 month prior to acquisition (email) Final survey information and contact details will be posted at Broome Port during acquisition (flyer) and notice to mariners will be issued by AHO.
Australian Recreational Fishing Foundation	
WA Seafood Exporters	GA will provide final survey location, timing, vessel communication and GA 24 hour contact information for the survey timeframe 1 month prior to acquisition (email) GA will also provide above information to State and Commonwealth commercial fishing industry associations for distribution to members 1 month prior to acquisition (email) Final survey information and contact details will be posted at Broome Port during acquisition (flyer) and notice to mariners will be issued by AHO.
Westmore Seafoods	
TunaWest	
Northern Wildcatch Seafood Australia	
WA Game Fishing Association	
Kimberley Professional Fishermen's Association	
Australian Council of Prawn Fisheries	
Jamaclan Marine Services	
A. Raptis and Sons	
Northern Prawn Fishing Industry Association	
Southern Bluefin Tuna Industry Association	
Austral Fisheries	
WA Northern Trawl Owners Association	
Research	
Centre for Whale Research	Whale observations will be provided to CWR following the survey.

8.0 DETAILS OF THE TITLEHOLDER'S NOMINATED LIAISON PERSON FOR THE ACTIVITY

Geoscience Australia is the titleholder of a Greenhouse Gas Research Consent under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act).

The details of the titleholder are:

Geoscience Australia (Org. No: 158 585 221)
Cnr Jerrabomberra Avenue and Hindmarsh Drive, Symonston, ACT
GPO Box 378, Canberra ACT 2601

Phone: +61 2 6249 9111
Fax: +61 2 6249 9999
Email: clientservices@ga.gov.au

The titleholder's nominated liaison person is:

Jessica Gurney
Phone: +61 2 6249 9043
Fax: +61 2 6249 9999
Email: jessica.gurney@ga.gov.au

If there are any changes to the titleholder, the titleholder's nominated liaison person or a change in the contact details for either the titleholder or the liaison person, NOPSEMA and the National Offshore Petroleum Titles Administrator (NOPTA) will be notified in writing, within 30 days of the change, using the approved form/s.