

CASWELL MC3D MARINE SEISMIC SURVEY ENVIRONMENT PLAN: PUBLIC SUMMARY

This summary of the Environment Plan for the PGS Caswell MC3D marine seismic survey, which will be acquired in the Browse Basin offshore from Western Australia (WA), has been submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), to comply with Regulations 11(7) and 11(8) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.

INTRODUCTION

The geophysical company Petroleum Geo-Services (PGS) proposes to undertake a multi-client three-dimensional (MC3D) marine seismic survey (Caswell MC3D MSS), in the in the Browse Basin offshore from WA. The Caswell MC3D MSS will be comprised of approximately 14,836 square kilometres (km²) of 3D seismic acquisition in Petroleum Exploration Permits AC/P36, WA-274-P, WA-281-P, WA-285-P, WA-341-P, WA-343-P, WA-344-P, WA-371-P, WA-377-P, WA-408-P, WA-410-P, WA-411-P, WA-431-P, WA-432-P, WA-471-P, Production Licences WA-44-L and WA-50-L, Release Area W12-4 and adjacent open acreage areas. Vessel movements and operations (e.g. line run-ins and run-outs and line turns) will take place in an operational area of 24,723 km² in size that overlaps these exploration permits, production licences and open acreage areas (**Figure 1**).

The Caswell MC3D survey is expected to be acquired in the period between May 2013 and the end of April 2014, with an expected duration of 9-11 months. This period indicated is for acquisition of the entire survey program, in reality the survey will be acquired in phases due to vessel availability and environmental considerations.

The Caswell MC3D MSS was referred to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) in October 2012 (EPBC Reference Number 2012/6594), and was assessed as “not a controlled action if undertaken in a particular manner”—i.e. the action, as proposed, did not require approval under the EPBC Act. Three temporal and spatial restrictions on acquisition have been applied to the proposed survey, as part of particular manner conditions:

- Between 1 July and 31 October, the seismic source must not be discharged in waters less than 200 m in depth, as identified in Areas A and B shown in **Figure 2**.
- Refuelling of the seismic vessel and any support vessels must not be undertaken within a distance of 25 km of any emergent land or shallow water features (20 m or less depth).
- Between 1 January and 28 February, the seismic source must not be discharged within 20 km of Browse Island, as identified in **Figure 2**.

The survey will be carried out in accordance with these specific temporal and spatial restrictions on acquisition, and with the other particular manner conditions specified in the Decision Instrument.

Figure 1: Location map – Caswell Multi Client 3D marine seismic survey

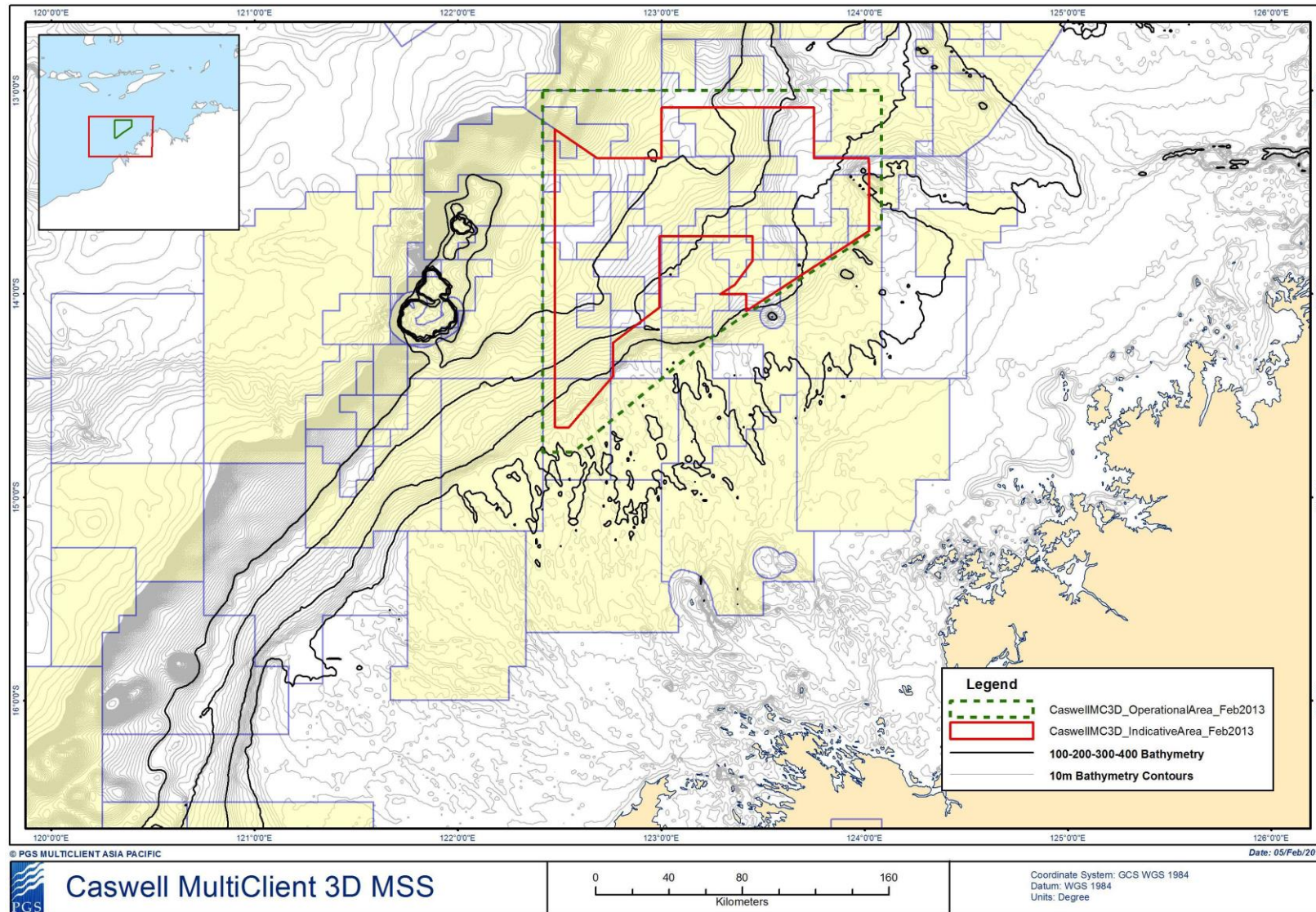
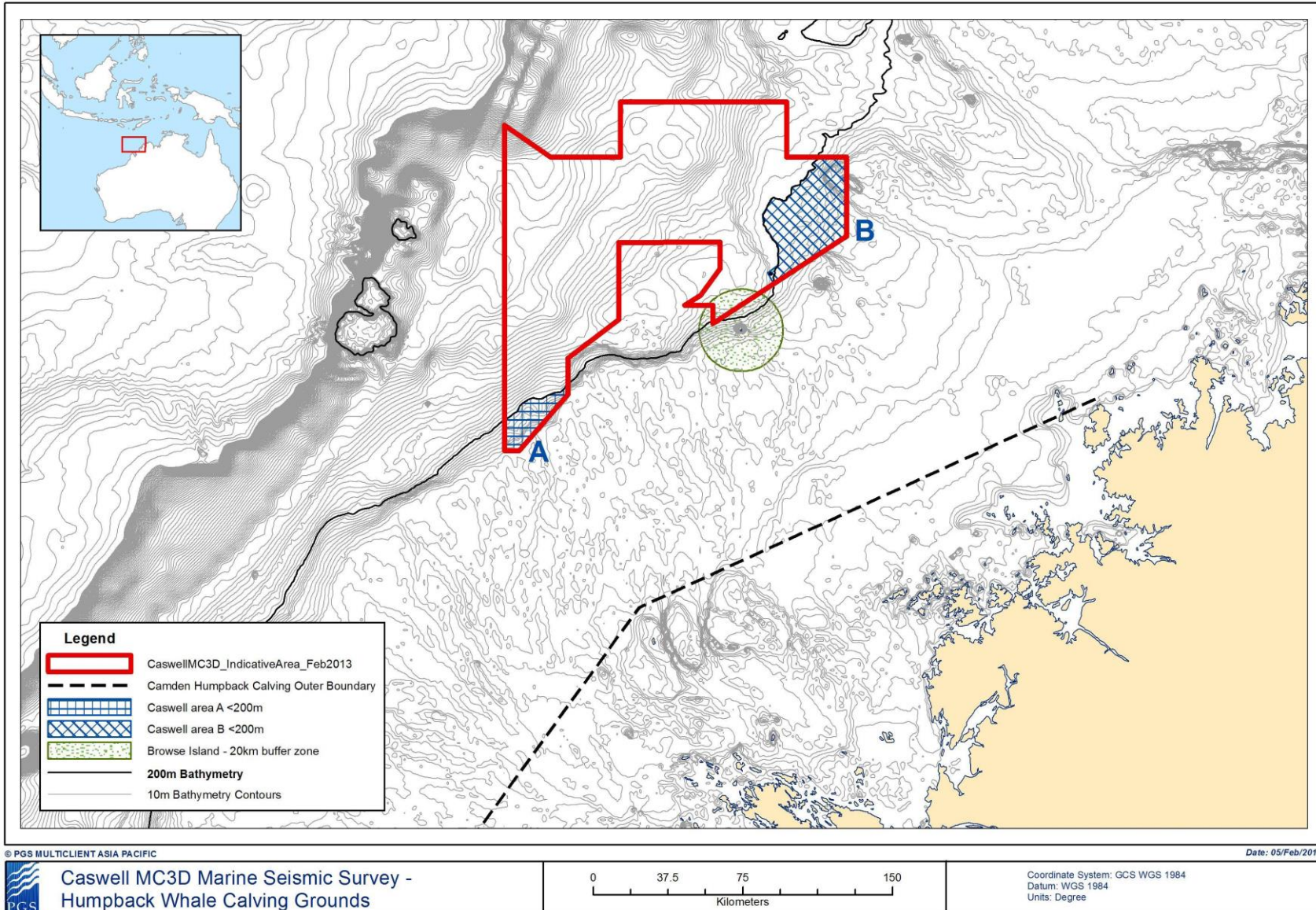


Figure 2: Temporal and spatial restrictions on acquisition applied as particular manner conditions via the EPBC Act approval



COORDINATES OF THE PROPOSED ACTIVITY

Boundary coordinates for the 24,723 km² operational area polygon (**Figure 1**) are provided in **Table 1**.

Table 1: Caswell MC3D MSS operational area

Latitude (S)			Longitude (E)		
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
13	00	00	122	25	01
13	00	00	124	04	59
13	40	01	124	04	59
14	12	45	123	14	43
14	46	43	122	33	54
14	46	43	122	25	01

Datum: WGS84

At the closest point, the south-east boundary of the operational area is located ~160 km from the mainland coastline of the west Kimberley (inshore of Bigge Island), and ~9 km from Browse Island (**Figure 1**). South Scott Reef and Seringapatam Reef are located ~45 km and 40 km to the west of the operational area, respectively. Adele Island is located ~104 km to the south-east of the southern boundary of the operational area. The operational area is located ~125 km north-west of the Maret Islands. The northern boundary of the operational area is located ~50 km and ~80 km south of Cartier Island and Ashmore Reef, respectively.

Water depths in the operational area range from ~13-1,000 m, with the deepest water depths situated in the north-west corner of the operational area. The north-east corner of the survey polygon incorporates Heywood Shoal (**Figure 1**), which has a shallowest water depth of ~13 m.

DESCRIPTION OF THE PROPOSED ACTIVITY

The Caswell MC3D survey is expected to be acquired in the period between May 2013 and the end of April 2014, with an expected duration of 9-11 months. This period indicated is for acquisition of the entire survey program, in reality the survey will be acquired in phases due to vessel availability and environmental considerations.

Timing of commencement is dependent on fair sea state conditions suitable for marine seismic acquisition, the availability of the survey vessel for conducting the survey, and granting of approvals from the appropriate government bodies.

During the proposed activities, the survey vessel will traverse a series of pre-determined sail lines within the operational area at a speed of ~8-9 km/hr. As the vessel travels along the survey lines, a series of noise pulses (every 8-10 seconds) will be directed down through the water column and seabed. The released sound is attenuated and reflected at geological boundaries and the reflected signals are detected using sensitive microphones arranged along a number of hydrophone cables (streamers) towed behind the survey vessel. The reflected sound is then processed to provide information about the structure and composition of geological formations below the seabed in an attempt to identify hydrocarbon reservoirs.

The seismic array will comprise of a maximum of ten solid streamers (PGS's GeoStreamer technology, with pressure and velocity sensors), with a maximum length of 7,100 m. Streamer spacing will be 75-100 m, and line spacing will be 375-500 m. The source (airgun array) tow depth will be 6 m (+/- 1 m) and the streamer tow depth will be 15 m (+/- 1 m). The operating pressure for the airgun array will be approximately 2,000 psi. The airgun array will consist of two sub-arrays, each with a maximum volume of 4,130 cui. These sub-arrays will be fired alternately, with a shotpoint interval of 25.0 m horizontal distance, and will produce at source (i.e. within a few metres of the airguns) sound pulses in the order of 265-275 dB re 1µPa (sound pressure level - SPL), at frequencies extending up to approximately 210 Hz. These sound pulses are

expected to decrease to sound exposure levels (SEL) in the order of 165 to 175 dB re $1\mu\text{Pa}^2\cdot\text{s}$ within 1 km of the source and approximately 160 dB re $1\mu\text{Pa}^2\cdot\text{s}$ within 2 km, dependent on the sound propagation characteristics of the area

PGS proposes to conduct the Caswell MC3D MSS using the purpose-built seismic survey vessel *Ramform Explorer*. The vessel has all necessary certification/registration and is fully compliant with all relevant MARPOL and SOLAS convention requirements for a vessel of this size and purpose, including a Shipboard Oil Pollution Emergency Plan (SOPEP) in accordance with Regulation 37 of Annex I of MARPOL 73/78.

The survey vessel will travel within the operational area at an average speed of 4.5 knots (~ 8.3 km per hour).

A support vessel will accompany the *Ramform Explorer* to maintain a safe distance between the survey array and other vessels, and to manage interactions with shipping and fishing activities, if required. The support vessel that will be utilised during the survey will be the *Nautika Pride*. The support vessel will also re-supply the *Ramform Explorer* with logistical supplies.

During the survey, it is likely that the survey vessel will be refuelled at sea using the support vessel, either within or immediately adjacent to the operational area. At sea refuelling will only take place during daylight hours, and will not take place within a distance of 25 km from any emergent land or shallow water features.

DESCRIPTION OF THE RECEIVING ENVIRONMENT

The proposed Caswell MC3D operational area lies entirely in Commonwealth marine waters in the Kimberley sub-system of the North-west Marine Region (NWMR), which extends from the southern boundary west of Broome to the northern edge of the Exmouth Plateau. Mid-shelf waters (100-500 m water depths) of the Kimberley sub-system consist of submerged reef platforms and mounds that support a diverse array of biological habitats, including coral reefs.

Physical Environment

South-east trade winds are prevalent from April to September, and are usually associated with fine dry weather. They produce a large swell that affects the southern side of most reefs in the area, producing consolidated crustose coralline algae and limestone substrates on the reef slope to depths characteristic of outer reefs or oceanic atolls. During April to September, the predominant direction of the ocean current is west-southwest. In the monsoon season (December to March), when winds come from the north-west or west, the direction of the ocean current reverses, becoming east-northeast. The NWMR's large-scale surface currents are subject to strong seasonal variations, largely due to annual variation in the alongshore pressure gradient that is the main driver of the Region's surface currents. The South Equatorial Current and Eastern Gyral Current intensify during July-September. Similarly, the Leeuwin Current is strongest in autumn, and diminishes during the North-west Monsoon (December-March).

The Kimberley system is also subject to episodic offshore cyclonic activity in the period December to April. Cyclones tend to generate offshore and move south, rarely crossing the coast until they reach the Pilbara region. They can contribute to mixing of water layers as well as play an important role in the dispersal of sediments and species

The seafloor across the NWMR is distinguished by a range of topographic features such as canyons, plateaux, terraces, ridges, reefs, and banks and shoals. The slope is relatively flat, but includes a number of large canyon heads that were probably excavated during and after continental break-up by sediment and water movements. The slope is relatively flat, but includes a number of large canyon heads that were excavated probably during and after continental break-up by sediment and water movements. There a number of reefs and islands in the Kimberley system of the NWMR adjacent to the Caswell MC3D survey area including:

There a number of reefs and islands in the Kimberley system of the NWMR within (Heywood Shoal) and adjacent to the Caswell MC3D operational area including:

- Heywood Shoal, located in the north-east corner of the survey polygon (**Figure 1**), which has a shallowest water depth of ~13 m.
- Echuca Shoal, located ~12.5 km south-east of the operational area boundary, which has a shallowest water depth of ~14 m.
- Scott Reef and Seringapatam Reef, located ~48 km and ~40 km west of the operational area, respectively. These reefs occur on the upper continental slope in water depths of 500–1,500 m. These reefs are listed as Key Ecological Features (KEF) of the NWMR.
- Adele Island, located ~104 km south-east of the operational area. Adele Island is built on a coralline platform reef, and extensive coral reefs surround the island. It is also an important seabird nesting and roosting location.
- Browse Island, located ~9 km south-east of the operational area. Browse Island is an important green turtle and seabird nesting site. It is surrounded by extensive coral reefs. The island is a WA Class 'C' Nature Reserve (No. 22697) vested with the Conservation Commission and managed by the WA Department of Environment and Conservation (DEC), and an IUCN Category 1A protected area.

Biological Environment

Overall, this sub-system is thought to have low productivity, largely due to the influence of the Indonesian Through Flow and hence the chlorophyll maximum is too deep to facilitate high primary production on a regular basis. Productivity would be associated with ephemeral events, such as topographically induced water movement around geomorphic features (i.e. coral reefs, canyon heads), therefore causing some mixing of the water column. It was suggested that eddies may form on the inshore side of the emergent reefs and islands in this sub-system and therefore could be an important mechanism for mixing the water column and thereby stimulating primary production.

Repeating patterns of swirling vortices caused by the unsteady separation of flow around islands (referred to as Van Karman vortex streets) are thought to occur around the islands (on their leeward sides) of this sub-system, and may result in enhanced horizontal and vertical mixing of waters around the islands. These ephemeral but repeating events may support large populations of pelagic fish and seabirds. The islands and reefs are a key biodiversity focal point in this subregion. Associated pelagic communities provide a constant food source for cetaceans, dogtooth tuna, Spanish mackerel and pelagic sharks.

Browse Island, located ~9 km south-east of the operational area, is an important site for bird and turtle communities as well as a site of upwelling. Upwelling around the island is believed to be associated with increased concentrations of tropical krill. These tropical krill aggregations may be important as there have been possible, but unconfirmed, sightings of humpback whales feeding around Browse Island.

Benthic Habitats

Generally, the granitic substrate throughout the Kimberley sub-system is hard and rough due to its erosion resistance and provides a diversity of habitats for benthic flora and fauna. Much of the outer mid-shelf is covered by a relatively featureless, sandy-mud seabed with a sparse covering of sessile organisms dominated by filter-feeding heterotrophs such as gorgonians, sponges, soft corals, echinoderms and detritus-feeding crabs and echinoderms. This is especially true of the non-trawled areas in the deeper water, and the soft-bottomed rises. However, the many limestone banks are likely to be a key ecological feature of this region. They have a harder substrate and are likely to support a more diverse range of sessile benthos such as hard and soft corals, gorgonians, encrusting sponges and macroalgae; and consequently, a more reef-associated fish and elasmobranch fauna. The mid-shelf banks of the NWMR are poorly understood. However, they are likely to support a unique and diverse invertebrate and fish fauna, with communities that change significantly with depth along their slopes.

Protected Marine Fauna

A review of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) database (Protected Matters search tool) held by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) was conducted for the operational area polygon described by the boundary coordinates provided in **Table 1**, with the application of a 1 km buffer zone.

The 10 listed Threatened species that may occur, or relate to, the operational area are:

1. the blue whale;
2. the humpback whale;
3. the short-nosed sea snake;
4. the loggerhead turtle;
5. the green turtle;
6. the leatherback turtle;
7. the hawksbill turtle;
8. the olive ridley turtle;
9. the flatback turtle; and
10. the whale shark.

As indicated by the Protected Matters search two Key Ecological Features (KEF) overlap the operational area for the Caswell MC3D MSS:

1. Ancient coastline at 125 m depth contour.
2. Continental slope demersal fish communities.

The operational area is situated adjacent to two other KEF in the NWMR - Seringapatam Reef and Commonwealth waters in the Scott Reef Complex; and Ashmore Reef and Cartier Island and surrounding Commonwealth waters. There are a number of Biologically Important Areas (BIA) (e.g. breeding, nesting, foraging areas) for EPBC Act-listed species of marine fauna that are in the vicinity of the Caswell MC3D operational area. The only BIA that actually overlap the operational area are:

- breeding areas for the red-footed booby, greater frigatebird and lesser frigatebird; and
- foraging areas for wedge-tailed shearwater and white-tailed tropicbird.

Breeding areas for the red-footed booby, greater frigatebird and lesser frigatebird are confined to the islands within Ashmore Reef, Cartier Island and Adele Island and, as such, would not actually overlap the Caswell MC3D operational area as there are no emergent features within the area.

Whales and Dolphins

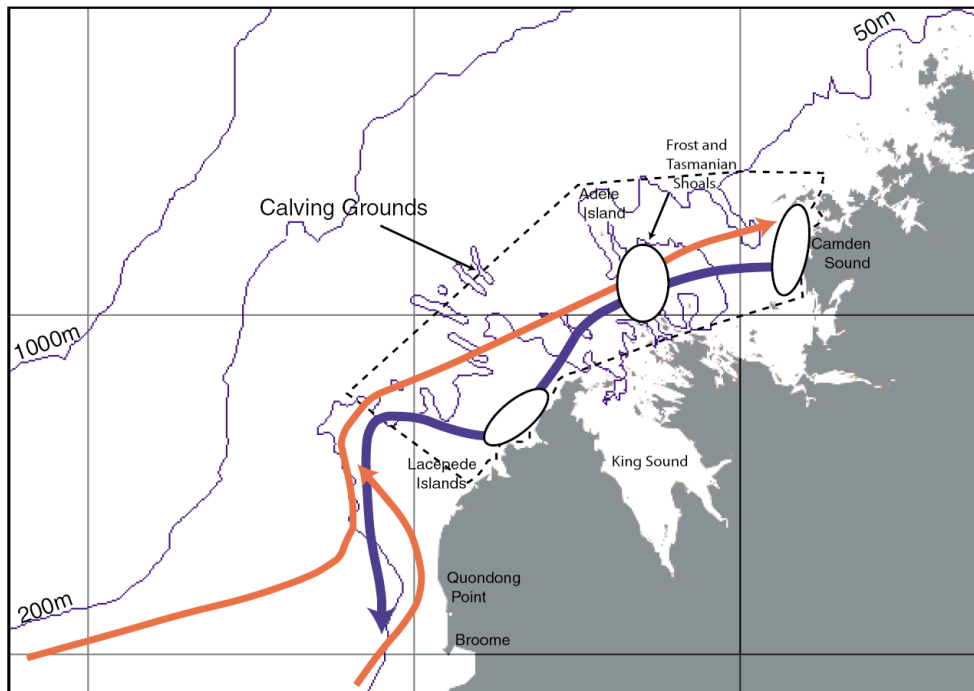
A number of whale species occur in and/or migrate through the NWMR, including the short-finned pilot whale, false killer whale, tropical Bryde's whale, Antarctic minke whale, killer whale, blue whale, sperm whale and humpback whale. The EPBC Act database lists 24 cetacean species that may occur in, and adjacent to, the operational area of the Caswell MC3D MSS, all of which are protected under the Act; one of which is also classified as Endangered, one as Vulnerable and seven as Migratory species.

The humpback whale is the most commonly sighted whale in northern WA waters. The species has been observed seasonally to complete their northern migration in the Camden Sound area of the west Kimberley, after feeding in Antarctic waters during the summer months. It is likely that the whales follow a predictable migratory path and migrate both north and south within the continental shelf boundary (200 m bathymetry). However, on the southbound migration it is likely that most individuals, and particularly cow/calf pairs, will stay closer to the coast than the northern migratory path.

In the Kimberley, humpback whales are seen regularly in coastal waters and out to 50 km offshore from Camden Sound to Joseph Bonaparte Gulf during winter months. As the Group IV humpback whale population continues to recover from whaling, the core calving grounds in the Kimberley (Beagle Bay to Adele Island to Kuri Bay to Montgomery Reef to Cape Leveque - high density areas for calving humpback whales during July-November – **Figure 3**) will continue to expand as animals seek other areas for calving and breeding. The area from Kuri Bay to Cape Londonderry is a recent extension of this core area.

Upwelling around Browse Island, located ~9 km south-east of the operational area, is believed to be associated with increased concentrations of tropical krill. These tropical krill aggregations may be important as there have been possible, but unconfirmed, sightings of humpback whales feeding in waters around the island. The breaking of internal waves on the shelf edge and around significant breaks in slope (e.g. west of Browse Island and around submerged cliffs) may play an important role in nutrient generation and thus enhanced productivity. Waters around Browse Island are believed to support the highest diversity of cetacean species in Western Australia, including large numbers of oceanic dolphins.

Figure 3: Positions of the Group IV humpback whale calving grounds and migratory routes leading to and from the area



Notes: Circled areas have the highest concentrations of whales.

The majority of the Caswell MC3D operational area is located on the upper continental slope in water depths of ~200-1,000 m. Whilst the Browse Cliffs feature (located approximately 75 km west south-west of Browse Island) is located within the operational area, it is situated outside the survey area itself (see **Figures 1 and 2**), and hence outside the area where there will be firing of the full airgun array for the purposed of 3D seismic data acquisition.

At the closest point, the south-west corner of the survey area is located ~100 km from the nominal boundary of the humpback whale calving ground area identified in **Figure 2**. The south-east boundary of the survey area is located at least 160 km from the core areas (e.g. Frost and Tasmanian Shoals, Camden Sound) within the calving grounds that have the highest concentrations of whales (**Figure 3**). The Caswell MC3D survey is expected to be acquired in the period between May 2013 and the end of April 2014, with an expected duration of 9-11 months. The survey will, therefore, overlap the humpback whale calving period on the west Kimberley coastline in 2013.

The blue whale may be present in the operational area and surrounding waters. The blue whale is rarely present in large numbers outside recognised aggregation areas. Blue whales are believed to calve in tropical waters in winter and births peak in May to June, however the exact breeding grounds of this species are unknown. The operational area and adjacent waters does not include any known blue whale feeding, breeding or resting areas. In the NWMR pygmy blue whales migrate along the 500 m to 1,000 m depth contour on the edge of the slope, and are likely to be feeding on ephemeral krill aggregations. The northward component of this migration takes place from May to mid-August, with a peak in July-August, and the southward component occurs from late October to November-December, with a few isolated individuals moving south in January. The migration appears to be centred on the 500 m depth contour.

Consequently, there is the possibility that migrating (and possibly feeding) blue whales may be encountered in the north-west part of the operational area during the proposed period of acquisition for the survey (commencing May 2013).

Other species whose broad distributions cover the region include whales that are infrequently observed usually restricted to cooler or deeper waters (e.g. killer and Bryde's whales) and are unlikely to be encountered in the area during the survey in significant numbers. There are no known breeding, calving or feeding grounds for any listed threatened or migratory whale species within, or in the immediate vicinity of the survey area.

By applying comprehensive cetacean interaction management procedures (including the use of 'Standard Management Measures': soft starts, a 2 km low-power zone and 500 m shut down zone, plus the additional mitigation measure of two dedicated Marine Fauna Observers [MFOs]), direct adverse physiological effects on any whales that may be encountered during the survey are extremely unlikely and any potential disturbance would be minimised.

The MFOs will be aboard the survey vessel for the entire duration of the Caswell MC3D survey.

Marine Reptiles

Six marine turtle species may occur in the operational area - green turtle, leatherback turtle, hawksbill turtle, loggerhead, flatback turtle, and olive ridley turtle. Scott Reef is an important breeding site for two species of marine turtle listed under the EPBC Act. These include a small, genetically distinct, population of the Vulnerable and Migratory green turtle and a population of the Vulnerable and Migratory hawksbill turtle. Adult and juvenile green turtles and hawksbill turtles are also likely to feed in this region.

Browse Island, located ~9 km from the south-east boundary of the operational area (**Figure 1**), is a major rookery for green turtles and flatback turtles also nest on the island. The main nesting season for green turtles in the region is likely to be December to February.

Green turtles feed on macroalgae and are by far the most common turtle seen in nearshore waters. Loggerhead turtles are carnivorous, feeding mainly on molluscs and crustaceans. Hawksbill turtles feed mainly on sponges and are more often found in deeper waters of the NWMR. Green, flatback and loggerhead turtles all breed from September to March, while the hawksbill turtle breeds from July to March. The reefal habitats in the photic zone are key feeding habitats for green and hawksbill turtles. The pinnacle habitats on the mid-shelf may be very important habitats along the migration paths for these species in the sub-region. The leatherback turtle is a pelagic feeder, found in tropical, subtropical and temperate waters throughout the world. Nesting is mainly confined to tropical beaches although some nesting occurs on subtropical beaches. No major nesting has been recorded in Australia, although scattered isolated nesting (1-3 nests per annum) occurs in southern Queensland and the Northern Territory.

It is unlikely that marine turtles will be encountered during the seismic acquisition throughout the operational area, given the water depths (~200-1,000 m) and lack of shallow submerged features (apart from Heywood Shoal in the north-east part of the survey area). It is possible that turtles, particularly green turtles, may be encountered in the vicinity of Browse Island during the peak of the nesting season (December to February), and also in the vicinity of Heywood Shoal, which may represent a feeding habitat for marine turtles.

Other EPBC Act protected marine species that may be present in the operational area include sea snakes. Sea snakes are frequently observed in and around offshore islands and the waters of the shelf generally. There is no information on their frequency of occurrence in deeper offshore waters (except for Scott Reef), though individuals are often observed at the surface.

Sharks and Ray-finned Fishes

The whale shark is listed as Vulnerable and Migratory under the EPBC Act. Although there are no records of whale sharks in the operational area there have been sightings in the region, and they are known to occur in both tropical and temperate waters and are normally oceanic and cosmopolitan in their distribution. The tracks of a whale shark tagged at Ningaloo Reef in 2005 passed through the Browse Basin, just to east of south Scott Reef.

Other EPBC Act protected marine species that may occur within the operational area include various species of pipefishes and seahorses (Family Syngnathidae).

Seabirds and Shorebirds

Five species of seabird may occur in the operational area and surrounding waters – the streaked shearwater, lesser frigatebird, great frigatebird, white-tailed tropicbird and red-footed booby. All of these are listed Migratory species under the EPBC Act. The operational area is located ~160 km from the nearest mainland coastline and there is no information concerning the populations of seabirds utilising the waters of these waters. However, the distributions of many common seabirds overlap the southern Browse Basin and are expected to occur in the operational area and surrounding waters. These include ten species of tern (family Laridae), three species of booby, and the lesser frigatebird.

Browse Island and Adele Island are important seabird nesting sites. Adele Island (located ~104 km south-east of the operational area) has significant rookeries of the lesser frigatebird, brown booby, red-footed booby, and masked booby.

Migratory shorebirds are likely to be present in the region between July and October and again between March and April as the operational area is located within the East Asian-Australasian Flyway. Migratory shorebirds are listed as Migratory and Marine species under the EPBC Act and all are also listed under the Convention on Migratory Species (CMS). Additionally, some species are listed on the China-Australia Migratory Bird Agreement (CAMBA), the Japan-Australia Migratory Bird Agreement (JAMBA), or the Republic Of Korea Australia Migratory Bird Agreement (ROKAMBA).

Socio-Economic Environment

Commercial Fisheries

The principal commercial fisheries in the NWMR focus on tropical fin fish, particularly the high-value emperors, snappers and cods which are taken by the Northern Demersal trap fisheries. The typical catch is in the order of 3,000 tonnes annually, making these fisheries, at an estimated annual value of around \$12 million, the most valuable fin fish sector in the state. The NWMR has a number of small, limited-entry trawl fisheries for prawns, producing about 700 tonnes annually, valued at around \$10 million. There are also significant fisheries for Spanish mackerel, barramundi/threadfin salmon and shark, and a developing fishery for blue swimmer crabs. However, the bioregion is increasingly coming under threat from international poaching, particularly for sharks. A number of fin fish activities, including offshore demersal line fishing and near-shore beach seining and gillnetting, also occur in the region.

Commercial fisheries that can operate in the region include:

- the Northern Demersal Scalefish Managed Fishery (NDSF);
- the North Coast Shark Fishery;
- the Mackerel Managed Fishery (MMF);
- the North West Slope Trawl Fishery (NWSTF);
- the Western Skipjack Fishery;
- the Southern Bluefin Tuna Fishery; and
- the Western Tuna and Billfish Fishery.

These are generally small, non-intensive fisheries that have very limited activity in the southern Browse Basin and are unlikely to be impacted by the proposed survey, with the exception of the NDSF.

The NDSF divided into two fishing areas, an inshore sector (Area 1) and an offshore sector (Area 2). Under a voluntary industry agreement, the offshore sector (Area 2) has been further divided into three zones – A, B and C. Zone B comprises the area of historical fishing activity and exploitation, while Zone A is an inshore developmental area and Zone C is an offshore deep-slope developmental area representing waters deeper than 200 m. Access to the offshore sector (Area 2) of the NDSF is currently limited to 11 licences under an individually transferable effort system. During 2011, seven vessels (trap fishing only) collectively held and operated the effort individually assigned to the 11 licences.

The NDSF principally targets red emperor and goldband snapper, with a number of species of snappers (Lutjanidae), cods (Serranidae) and emperors (Lethrinidae) comprising the remainder of the catch. It is possible that some vessels active in this fishery within Zones A and B will target areas in and around the Caswell MC3D MSS operational area. The eastern edge of the operational area is located within Zone A of

the offshore sector (Area 2). At present, the majority of the activity (and consequently catch levels of key target species) in the NDSF occurs in Zone B of the offshore sector, which is located further offshore.

Fishers in the NDSF don't usually operate in water depths greater than 100 m, and very rarely in water depths greater than 200 m. Therefore, it is unlikely that any vessels fishing in Area 2 Zone C of the NDSF will be operating in most of the waters covered by the Caswell MC3D survey area, which covers water depths of ~200-1,000 m.

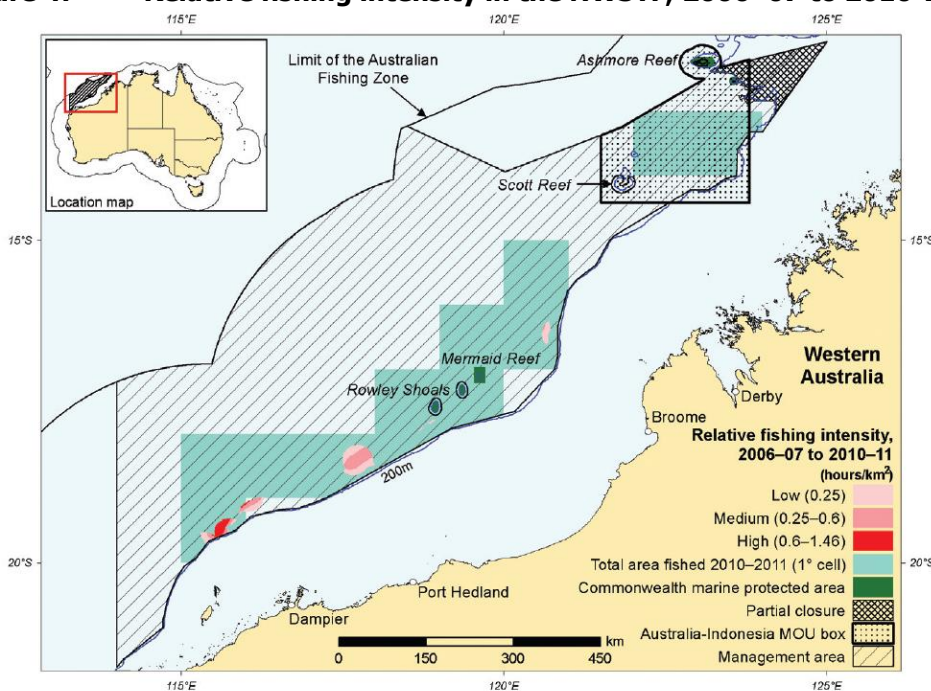
Shark fishing is licensed in the area encompassing the Caswell MC3D operational area (in the WA Department of Fisheries managed WA North Coast Shark Fishery – WANCSF), but activity is expected to be limited. There were two active licenses in the northern WANCSF during 2008/09, but there was no reported fishing activity in the northern shark fisheries during 2009/10 or 2010/11.

The MMF 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*, *Grammatocygnus* and *Acanthocybium* also contributing to commercial catches. Permit holders may only fish for mackerel by trolling or handline. The Caswell MC3D operational area is located within Area 1 of the MMF - Kimberley. There are currently 23 permits in the Area 1 of the fishery with the combined quota allocations being consolidated onto four vessels. The majority of the catch is taken in the Kimberley Area, reflecting the tropical distribution of mackerel species.

The NWSTF operates off north-western Australia from 114°E to 125°E, roughly between the 200 m isobath and the outer boundary of the Australian Fishing Zone. The NWSTF has traditionally targeted scampi and deepwater prawns. However, in recent years, Australian scampi has been the main target of the fishery. Demersal trawl gear is used in the NWSTF. Fishing for scampi occurs over soft, muddy sediments or sandy habitats, typically at depths of 350–600 m on the continental slope. Whilst there are seven fishing permits in the NWSTF only one vessel was active in the fishery in 2010-2011, with Australian scampi being the main target. Recent effort in the fishery has been dominated by a small number of vessels based in WA.

Whilst the Caswell MC3D operational area is located within the overall management area for the NWSTF (see **Figure 4**), it is apparent that in recent years (2006-2011) most of the effort and catch within the fishery has occurred in shallower, upper slope waters (350-600 m) to the south-west and north-east of the Rowley Shoals. Some fishing activity in 2010-2011 has also occurred to the north-east of Scott Reef (**Figure 4**), overlapping a large part of the Caswell MC3D operational area.

Figure 4: Relative fishing intensity in the NWSTF, 2006–07 to 2010-2011



Traditional Fisheries

Indonesian fishermen have visited the north-western Australian coast and around the islands and reefs of this coastline for almost three centuries, focusing their fishing effort on a range of species, including:

- beche-de-mer (trepang or sea cucumber);
- various molluscs, particularly trochus shell and clams;
- seabirds (particularly frigate birds) and eggs;
- sharks; and
- marine turtles.

In November 1974, traditional Indonesian fishing practices - referring exclusively to non-motorised sailing craft, were permitted in the region and formalised under a Memorandum of Understanding (MOU) between the Governments of Australia and Indonesia. This MOU covers Scott Reef, Seringapatam Reef, Browse Island, Ashmore Reef and Cartier Island (the MOU 74 Box). The MOU 74 Box is an area of approximately 50,000 km² within the Australian Fishing Zone where Indonesian traditional fishermen are allowed to fish under the provision of the MOU that recognised the long history of traditional Indonesian fishers, enabling them to continue their customary practices and target species such as trepang, trochus, abalone and sponges. As a result, Indonesian fishing vessels may move through waters adjacent to the operational area, although traditional fishing is predominantly around the shoals. Fishing effort is difficult to estimate.

The majority of the Caswell MC3D operational area is located within the MOU 74 Box. There are portions of the eastern and southern parts of the operational area that extend out beyond the boundary of the MOU 74 Box.

Petroleum Exploration and Production

The southern Browse Basin has been the target of significant petroleum exploration activity stretching back over the past 40 years. There have been a large number of both 2D and 3D seismic surveys conducted in the region, plus the drilling of both exploration and appraisal wells. At least 30 exploration wells have previously been drilled within the Caswell MC3D operational area. At present, there are no petroleum production facilities located within or adjacent to the operational area, but the area overlaps a number of previously-discovered gas and oil fields.

Shipping

No defined commercial shipping lanes exist in the operational area for the Caswell 3D MC3D survey, or in adjacent waters. The major commercial shipping route through the region passes well to the west of Scott Reef.

Tourism

Due to the deepwater location of the operational area and distance to coastal areas of the Kimberley there are no recreational activities undertaken in the area.

Cultural Heritage

There are no known indigenous cultural heritage values or issues for the waters and seabed within and immediately adjacent to the Caswell MC3D operational area. Similarly, there are no current or pending Native Title Determinations for the waters and seabed within and immediately adjacent to the operational area.

There are a large number of listed historic shipwrecks in the region, located mainly around Browse Island and south Scott Reef. There are nine listed historic shipwrecks around Browse Island, including one which is listed on the Register of the National Estate (Browse Island (East) Wreck).

National Heritage

There are no places listed on the Commonwealth Heritage List or the Register of National Estate within or immediately adjacent to the Caswell MC3D operational area. There are three places listed on the Commonwealth Heritage List or the Register of National Estate within the southern Browse Basin region:

- “Scott Reef and Surrounds”.
- “Seringapatam Reef and Surrounds”.
- “Adele Island and Reefs”.

Ashmore Reef National Nature Reserve is listed the Register of the National Estate. “The West Kimberley” is a Listed Place on the National Heritage List; and “Browse Island (East) Wreck” is listed on the Register of the National Estate.

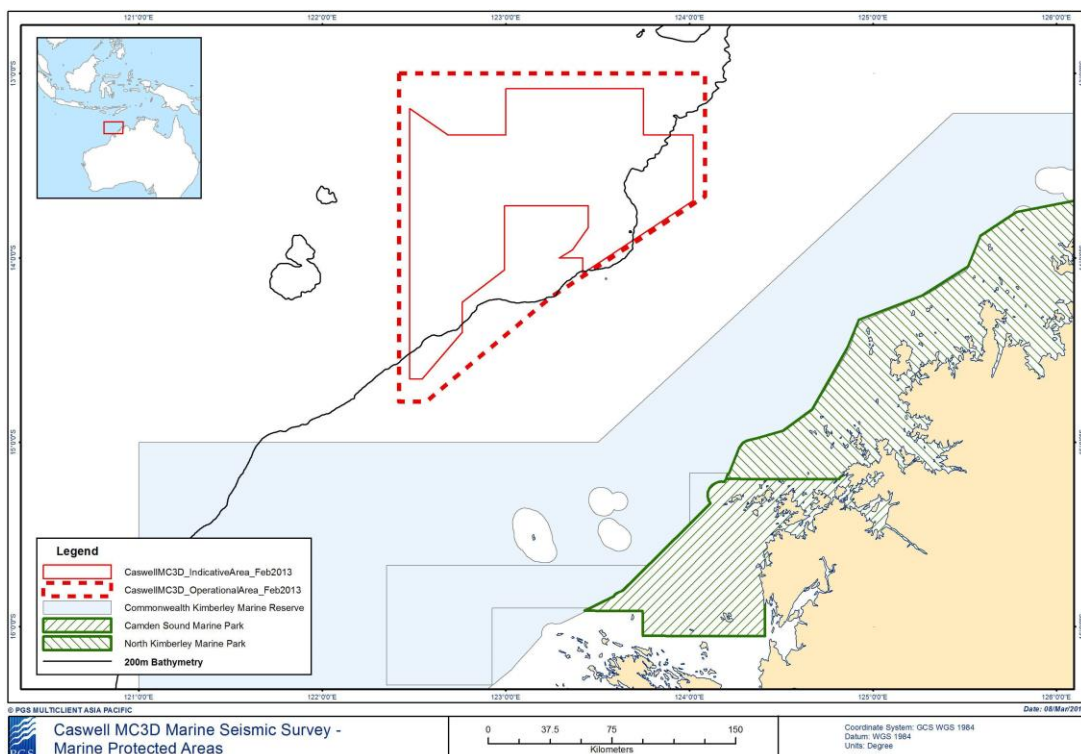
South Scott Reef is located ~45 km west of the Caswell MC3D operational area; Seringapatam Reef is located ~40 km west of the operational area; Adele Island is located ~104 km south-east of the operational area; Ashmore Reef is located ~80 km north of the operational area; and Browse Island is located ~9 km south-east of the operational area. At the closest point, the west Kimberley coastline is located ~160 km from the operational area.

Marine Parks and Reserves

At the closest point, the Caswell MC3D operational area is located ~147 km from the boundary of the newly declared Camden Sound Marine Park, which is situated in WA State waters to the south-east of the operational area. At the closest point, the operational area is located ~118 km north-west of the boundary of the newly declared North Kimberley Marine Park, also in WA State waters (**Figure 5**).

At the closest point, the southern boundary of the operational area is situated ~25 km to the north of the boundary of the Commonwealth Kimberley Marine Reserve (**Figure 5**).

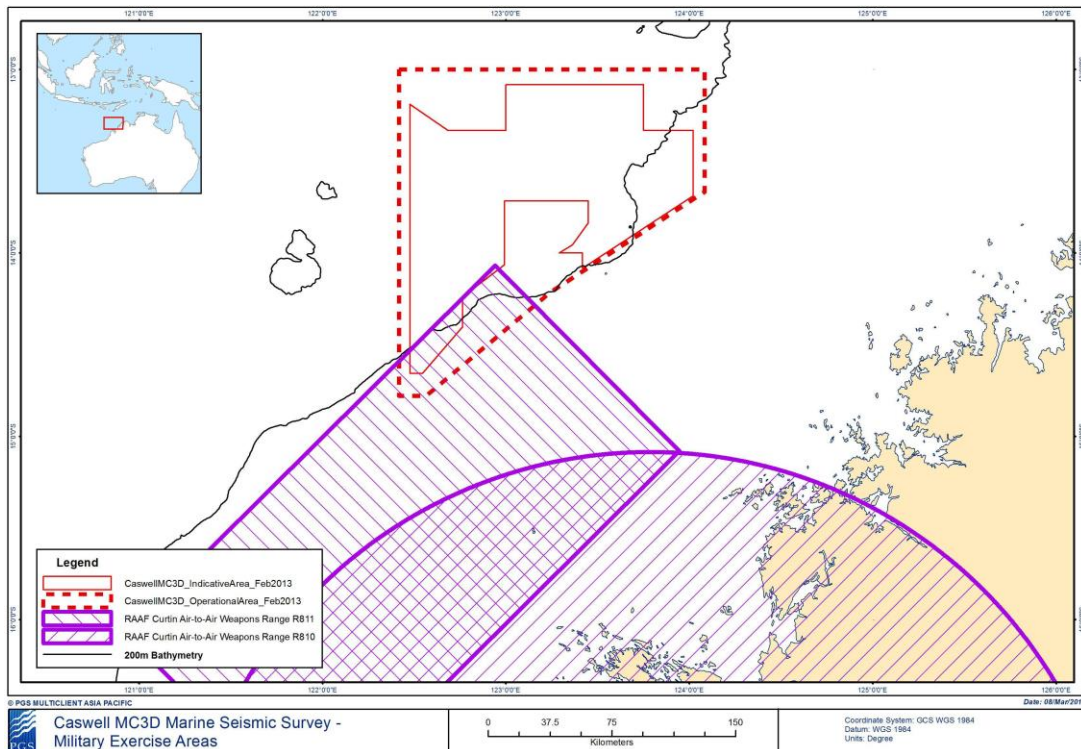
Figure 5: Marine protected areas in the Browse Basin region



Defence Activities

The southernmost part of the Caswell MC3D operational area is located within the northern component of a military exercise area, the RAAF Curtin Air-to-Air Weapons Range R811 (**Figure 6**). When activated by a Notice to Airmen (NOTAM), the restricted airspace can operate down to sea level.

Figure 6: Restricted airspace in the Browse Basin region



MAJOR ENVIRONMENTAL HAZARDS AND CONTROLS

An Environmental Risk Assessment (ERA) has been undertaken to understand and manage the environmental risks associated with the Caswell MC3D MSS to a level that minimises impacts on the environment and meets the objectives of the survey. The ERA methodology applied is consistent with the Australian/New Zealand Standard *AS/NZS ISO 31000:2009 Risk management—Principles and guidelines*, Handbook *HB 203:2012 Managing environment-related risk*, and Handbook *HB 89:2012 Risk management - Guidelines on risk assessment techniques*.

The risk assessment has been undertaken to identify the sources of risk (aspects) and potential environmental impacts associated with the activity and to assign a level of significance or risk to each impact. This subsequently assists in prioritising mitigation measures to ensure that the environmental impacts are managed to As Low As Reasonably Practicable (ALARP).

A summary of the key sources of environmental risk (aspects) for the proposed activity include:

- discharge of underwater seismic pulses;
- light generation from vessels;
- interactions of vessels with marine fauna;
- anchoring of vessels used for the activity;
- dragging or loss of streamers and associated equipment;
- emissions to atmosphere from vessels;
- discharge of ballast water and vessel biological fouling (biofouling);
- routine discharge of wastewater and waste to the ocean from survey and support vessels;
- accidental discharge of hydrocarbons and chemicals to the ocean from survey and support vessels;

- interactions with commercial fishing, shipping and defence activities; and
- operation of the survey and support vessels within, or in the vicinity of, protected areas and heritage places.

A summary of the potential environmental impacts associated with the above sources of environmental risk include:

- disturbance to marine fauna including cetaceans, whale sharks, turtles and fish;
- disturbance to the seabed and benthic habitats and communities;
- reduced air quality from atmospheric emissions as a result of operation of machinery and use of internal combustion engines;
- introduction of invasive marine species as a result of ballast water discharge and vessel biological fouling;
- marine pollution from routine discharges including sewage water, bilge water and other solid wastes;
- marine pollution from accidental discharges including hydrocarbon spills and hazardous materials;
- disturbance to social and community values due to interactions with commercial fishing vessels, shipping and military aircraft; and
- disturbance to heritage and conservation values.

The environmental aspects of the Caswell MC3D MSS that have the potential to cause significant environmental effects have been determined through an evaluation of the proposed activity, the surrounding environment including specific sensitivities and values, and legislative requirements. These environmental aspects are:

- accidental discharge of hazardous materials;
- accidental fuel and oil spills from the survey vessel; and
- vessel collisions resulting in fuel and oil spills.

Implemented control measures documented in **Table 2** ensures that the environmental risks associated with these impacts are maintained at ALARP levels, while maintaining economic viability for the proposed activity. These control measures are taken into consideration in calculating the residual risk associated with the activity of impact.

MANAGEMENT APPROACH

The design and execution of the proposed Caswell MC3D MSS will be conducted under the framework of the PGS Environment Policy, HSE&Q Management System and the survey vessel operator (Wilhelmsen Ship Management - WSM) HSE Management System. The program will be supported by Emergency Response Plans (ERPs), a Project Plan (that incorporates HSE elements), and an HSE-MS Bridging Matrix between PGS and WSM HSE management systems. To ensure PGS's environmental standards and performance objectives are achieved, the seismic contractor (WSM) will be required to comply with all relevant requirements of PGS's HSE&Q systems/policies and standards.

PGS and its contractor will apply a tiered approach to optimising the environmental performance of the project and ensuring that PGS's environmental management standards and performance objectives are achieved. The approach involves identification of local and regional environmental sensitivities, prioritisation of risks, determination of appropriate practices and procedures to reduce those risks, and clear designation of roles and responsibilities for implementation. A series of specific systems, practices and procedures will be used for the Caswell MC3D MSS to ensure that the environmental impacts and risks associated with the activity are continuously reduced to ALARP. The systems, practices and procedures are documented within corporate systems/manuals developed by PGS as well as documents written specifically for the Caswell MC3D MSS. Many of the procedures apply to all vessels in the PGS fleet, however some are vessel specific.

PGS is responsible for ensuring that the proposed Caswell MC3D MSS is managed in accordance with the Implementation Strategy and the PGS Environment Policy and HSE&Q Management System. Given the control measures that will be implemented for all environmental aspects of the survey, the risk of significant

adverse environmental effects from the proposed Caswell MC3D MSS has been assessed as low for all aspects, apart from discharge of hazardous materials, fuel and oil spills and vessel collisions, which have been assessed as medium.

The implementation of specific whale monitoring and encounter procedures will be used to minimise the potential for any adverse effects to whales. These procedures comply fully with the Australian Commonwealth Government Guidelines: *EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales* (September 2008). Two dedicated, expert Marine Fauna Observers (MFOs) will be aboard the survey vessel for duration of the Caswell MC3D survey. The key role of the MFOs will be to monitor the waters around the survey vessel for the presence of cetaceans, whale sharks and turtles during daylight hours. The MFOs will be responsible for ensuring that the interaction procedures are implemented and followed correctly during survey activities. The MFOs will also be responsible for recording any cetacean sightings during the survey on the appropriate sightings forms, using the DSEWPaC CSA software.

The survey will be conducted in water depths of ~200-1,000 m and in an area that is located at least 9 km away from any beaches and adjacent shallow waters that are important for turtle nesting, hatching and breeding (e.g. Browse Island). Whilst the survey area does include one feature that may represent feeding areas for green turtles (i.e. Heywood Shoal), the density of animals in this area is likely to be low, and as such the probability of adverse fauna interactions is also low. During the peak of the nesting season for green turtles in the region (between 1 January and 28 February 2014), there will be no seismic acquisition within 20 km of Browse Island.

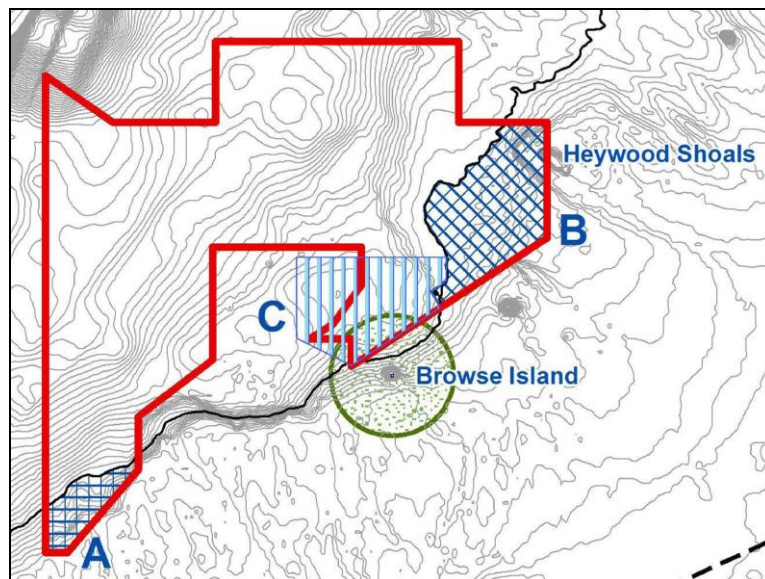
The operational area is not located close to any locations important for seabird or shorebird breeding or feeding. The survey is unlikely to have any significant effects on benthic communities due to the water depths across the operational area.

Acquisition lines in the vicinity of Heywood Shoal will be deviated around the shoal to ensure that the all lines are located in water depths >30 m. This will mean that the vessel and towed array will not be passing over the shallower waters on the top of the shoal, and there be a minimum separation distance of ~1 km between the nearest line and the shallowest part of the shoal. This will minimise the potential for contact between the towed streamer array and substrates of Heywood Shoal, and consequently will minimise the potential for localized physical disturbance of benthic habitats and communities. Anchoring of the survey or support vessel will only occur in emergency circumstances and both vessels are fitted with highly sophisticated position fixing equipment.

At sea refuelling of the survey vessel will only take place during daylight hours, and will not take place within a distance of 25 km from any emergent land or shallow water features.

The spill risk assessment, which was conducted as part of the evaluation of environmental impacts and risks for the proposed survey, indicated that the probability of entrained diesel contacting inshore waters and shorelines of Browse Island is significantly lower during the period September to February (3-7%) than during March to August (21%). Accordingly, acquisition of survey components within a distance of ~40 km of Browse Island will occur in the period September 2013 to February 2014 (Area C in **Figure 7**). This management/mitigation measure will be implemented in conjunction with the application of a 20 km buffer zone around Browse Island during the peak of the nesting season for green turtles in the region - between 1 January and 28 February 2014 (see **Figures 2 and 7**).

Figure 7: Caswell MC3D Area C – acquisition between September 2013 and February 2014



CONSULTATION PLAN

Consultation with stakeholder groups concerning PGS’s proposed Caswell MC3D MSS has taken place, primarily within the commercial fishing industry, during the preparation of the Environment Plan, and prior to the commencement of the survey. The following organisations have been contacted and informed of the proposed operations:

- A Raptis and Sons
- Austral Fisheries
- Australian Fisheries Management Authority
- Australian Hydrographic Service
- Australian Maritime Safety Authority
- Australian Southern Bluefin Tuna Industry Association
- Border Protection Command
- Centre for Whale Research
- Coastwatch
- Commonwealth Fisheries Association
- Department of Defence
- Department of Sustainability, Environment, Water, Population and Communities
- Geoscience Australia
- Jamaclan Marine Services
- Kimberley Professional Fishermen’s Association
- MG Kailis
- Northern Fishing Companies Association
- Northern Wildcatch Seafood Australia
- Recfishwest
- TunaWest
- WA Department of Fisheries
- WA Department of Mines and Petroleum
- WA Department of Transport
- WA Fishing Industry Council
- WA Seafood Exporters
- WestMore Seafoods

Consultation with all of the stakeholders listed above, plus any others identified during the consultation process, will continue during and after the survey, if necessary.

Table 2: Summary of environmental risks and management approach for key aspects of the Caswell MC3D MSS

Impact category	Potential impacts	Control and mitigation measures	Residual risk level
Disturbance to marine fauna	<p>Cetaceans - behavioural reactions (avoidance, diving, increased dive times)</p> <p>Disturbance to marine turtles, whale sharks, fish communities, and seabirds</p>	<ul style="list-style-type: none"> • Adherence to EPBC Act Policy Statement 2.1 and the following additional mitigation measures: <ul style="list-style-type: none"> ➢ precaution zones (observation zone: 3 km+; low power zone: 2 km; and shutdown zone: 500 m) ➢ two dedicated MFOs on survey vessel ➢ application of vessel-marine fauna interaction procedures for non-acoustic energy source operations • Application of precautionary 500 m shut-down zone for whale sharks and turtles • Between 1 July and 31 October 2013, there will be no seismic acquisition in waters <200 m in depth • Detailed reports of all cetacean sightings will be recorded using the DSEWPaC CSA • External lighting of vessels will be minimized to that required for navigation, vessel safety and safety of deck operations, except in the case of emergency • Application of 20 km exclusion zone around Browse Island 1 January to 28 February 2014 • Acquisition lines in the vicinity of Heywood Shoal will be deviated around the shoal to ensure a minimum separation distance of ~1 km from the shallowest part of the shoal • Use of streamer tail buoys fitted with appropriate turtle guards • Operational area is not located close to any locations important for seabird or shorebird breeding or feeding • Survey will not be operating over critical habitat for feeding, spawning, breeding or migrating fish populations 	Low
Disturbance to benthic habitats	Small localised disturbance to epibiota in event of loss of equipment	<ul style="list-style-type: none"> • Majority of survey will be conducted in water depths of ~200-1,000 m away from any shallow water areas • Anchoring in shallower waters near reefs, islands or west Kimberley coastline will only occur in an emergency. All measures will be taken to avoid sensitive habitats – corals, seagrasses, macroalgal beds • Acquisition lines in the vicinity of Heywood Shoal will be deviated around the shoal to ensure that all lines are located in water depths >30 m and at a minimum distance of ~1 km from the shallowest part of the shoal • All reasonable efforts taken to retrieve lost equipment • Recording and reporting of all items lost overboard 	Low
Introduction of invasive marine species	Introduction and establishment of invasive marine species with consequent impacts on benthic communities, fisheries etc.	<ul style="list-style-type: none"> • Vessels required for the proposed activity will not discharge ballast water • Adherence the Australian Ballast Water Management Requirements, if necessary • Both the survey and support vessels have all the necessary AQIS clearances to operate unrestricted anywhere in Australian waters 	Low

Impact category	Potential impacts	Control and mitigation measures	Residual risk level
Marine pollution from routine discharges	Localised temporary decrease in ambient water quality from discharge of sewage, grey water, putrescible wastes and bilge water	<ul style="list-style-type: none"> All sewage and putrescible wastes will be handled and disposed of in accordance with MARPOL Annex IV Discharge of sewage and putrescibles waste will be of short duration with high dispersion and biodegradability Sewage and putrescible wastes macerated where possible prior to disposal All sewage and putrescible waste treatment systems and holding tanks are to be fully operational prior to survey commencement Relevant discharge requirements for treated and untreated sewage are adhered to (>3 nm from land for treated sewage; >12 nm from land for untreated sewage) Bilge water treated and disposed of in accordance with MARPOL Annex I requirements 	Low
Marine pollution from accidental discharges	Acute toxicity effects on marine fauna, such as marine turtles, fishes and seabirds, from accidental discharges of hazardous materials	<ul style="list-style-type: none"> Harmful Packaged Substances handled and disposed of in accordance with MARPOL Annex V Garbage handled and disposed of in accordance with MARPOL Annex V requirements No discharge of plastics or plastic products of any kind from vessels All solid, liquid and hazardous wastes (other than sewage, grey water and putrescible wastes) will be incinerated or compacted (if possible) and stored in designated areas and sent ashore for recycling, disposal or treatment Correct segregation of solid and hazardous wastes Incinerators used are compliant with MARPOL and IMO requirements All storage facilities and handling equipment will be in good working order and designed in such a way as to prevent and contain any spillage as far as practicable 	Medium
	Acute toxicity effects on marine fauna from fuel and oil spills	<ul style="list-style-type: none"> Survey vessel will comply with MARPOL Annex I requirements to prevent oil pollution (e.g. SOPEP implemented and tested) Spill response bins/kits located in close proximity to hydrocarbon storage areas and replenished if required Identified personnel trained in the use of the equipment Hydrocarbons located above deck will be stored with some form of secondary containment to contain leaks or spills Refuelling at sea subject to PGS Marine Operations Offshore Bunkering Procedures Application of 25 km exclusion zone from emergent land or shallow water features (20 m or less depth) for at sea refuelling operations Acquisition of survey components within a distance of ~40 km of Browse Island (Area C) will occur in the period September 2013 to February 2014 	Medium
Interaction with commercial fisheries, shipping and defence activities	Disruption to commercial fishing vessels, shipping and military aircraft operating within or near the operational area and surrounding waters	<ul style="list-style-type: none"> Notification of activity details as required to relevant commercial fisheries management agencies, fishing industry bodies and individual companies Consultation with AMSA prior to the survey commencing Consultation with Department of Defence prior to the survey commencing Use of a support vessel to manage vessel interactions 	Low

Impact category	Potential impacts	Control and mitigation measures	Residual risk level
	<p>Potential direct and indirect noise impacts on target species</p> <p>Restriction of access to fishing grounds, loss or damage to fishing gear</p> <p>Recreational take of finfish species from survey vessel</p>	<ul style="list-style-type: none"> • Use of standard maritime safety procedures (Notice To Mariners (NTM) via the Australian Hydrographic Service; radio contact, display of appropriate navigational beacons and lights) • Compliance with AMSA administered marine safety regulations and marine notification requirements • Strict adherence to equipment handling and acquisition procedures • Fishermen and other mariners alerted of vessels presence and extent of towed array • Establishment of a vessel exclusion zone around the survey vessel • Where possible in-water equipment lost will be recovered • Detailed records of equipment lost overboard will be maintained 	
Operation of survey vessel within protected and heritage areas	Disturbance to heritage and conservation values	<ul style="list-style-type: none"> • Survey and support vessels will not enter waters adjacent (<3 nm) to Browse Island, South Scott Reef, or of any other protected areas or heritage places, except in an emergency • All PGS and contractor personnel made aware of, and comply with, requirements of accepted EP 	Low

FURTHER DETAILS

For further information about the proposed PGS Caswell MC3D MSS in the Browse Basin offshore from WA, please contact:

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