GRAVIS MULTI CLIENT 3D MARINE SEISMIC SURVEY

ENVIRONMENT PLAN - PUBLIC SUMMARY

CGG Services (Australia) Pty Ltd

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Rev 0

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1. INTRODUCTION

The geophysical company CGG Services (Australia) Pty Ltd (CGG) proposes to acquire a multi-client three-dimensional (MC3D) marine seismic surveys (Gravis MC3D MSS), in the Browse and Bonaparte Basin offshore from Western Australia (WA) (**Figure 1.1**). The Gravis MC3D MSS will comprise of the acquisition of approximately (~) 23,891 square kilometres (km^2) of 3D seismic data in Petroleum Exploration Permits, Release Areas, and adjacent open acreage areas (**Figure 1.1**).

This Environment Plan (EP) for the Gravis MC3D MSS has the objective of covering multi-client MSS over the specific petroleum titles and adjacent vacant acreage (identified above) within the Browse and Bonaparte basins over a period of up to two years.

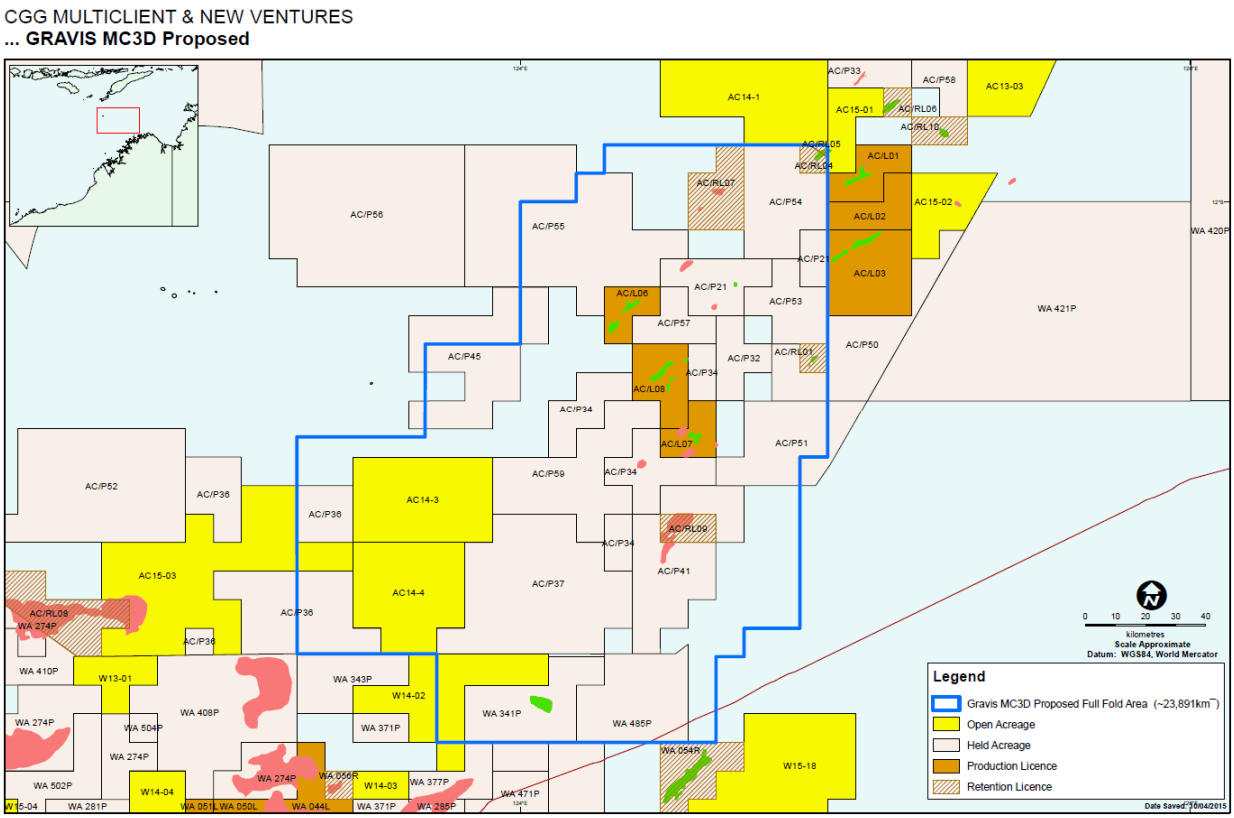


Figure 1.1 - Location map - Gravis MC3D MSS polygon

1.1. LOCATION OF THE ACTIVITY

The Gravis MC3D MSS polygon lies entirely in Commonwealth waters within the North-west Marine Region (NWMR) and will be comprised of the acquisition of ~23,891 km^2 of 3D seismic data in Petroleum Exploration Permits AC/P 21, AC/P 32, AC/P 34, AC/P 36, AC/P 37, AC/P 41, AC/P 45, AC/P 50, AC/P 51, AC/P 53, AC/P 54, AC/P 55, AC/P 57, AC/P 59, WA-341-P, WA-343-P, WA-377-P, WA-408-P, WA-485-P, Production Licences AC/L1, AC/L2, AC/L3, AC/L6, AC/L7, AC/L 8, Retention Leases AC/RL1, AC/RL4, AC/RL5, AC/RL7, AC/RL 9, WA-54-R, Release Areas AC 14-1, AC 14-3, AC 14-4, W 14-2, and adjacent open acreage areas (see **Figure 1.1**).

Table 1.1 - Gravis MC3D polygon - boundary coordinates

Latitude (S)	Longitude (E)
Decimal degrees	Decimal degrees
-11.9153	124.8346
-12.6653	124.8346
-12.6653	124.7512
-13.1653	124.7512
-13.1653	124.5846
-13.2486	124.5846
-13.2486	124.5012
-13.4986	124.5012
-13.4986	123.8346
-13.2486	123.8346
-13.2486	123.4179
-12.4986	123.4179
-12.4986	123.6679
-12.4986	124.0846
-12.0819	124.0846
-12.0819	124.2512
-11.9986	124.2512
-11.9986	124.3346
-11.9153	124.3346

Datum: WGS84

The Gravis MC3D MSS polygon is located ~132 km from the mainland coastline (at the closest point) of the west Kimberley coastline (Cape Voltaire), and ~44 km southeast of Ashmore Reef Commonwealth Marine Reserve (see **Figure 1.1**). Browse Island is located ~63 km to the southwest of the polygon.

Water depths across the polygon are ~10 to 525 m. In shallow waters steamers will be towed at a depth that will not allow them to be closer than 10 m from the seabed, as per the CGG Standard Operating Procedure (SOP) - Close Approach Of A Natural Obstacle document (MAR SEO PRC 010E). There will be no seismic data acquisition (i.e. shotpoints) in water depths shallower than 50 m across all of the Gravis MC3D MSS polygon.

1.2. TIMING OF THE ACTIVITY

The commencement date of the proposed activity is yet to be finalised. CGG plans to commence individual surveys within the Gravis MC3D MSS polygon no earlier than Q2, 2015; however this is subject to availability of the survey vessel for conducting the survey, client data requirements, fair sea state conditions suitable for marine seismic acquisition, and granting of approvals from the appropriate government bodies. Although the Gravis MC3D MSS is expected to have an actual acquisition period of no more than 12 months, the individual surveys may be conducted in phases over a period of two (2) years.

2. DESCRIPTION OF THE RECEIVING ENVIRONMENT

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

2.1. PHYSICAL SETTING

The Gravis MC MSS polygon lies entirely within Commonwealth marine waters of the North-west Marine Region (NWMR) which extends from offshore Kalbarri in Western Australia (WA) to the Western Australia / Northern Territory (NT) border.

The region is generally characterised by two seasons: winter (May to August) and summer (September to April). The Kimberley system is subject to episodic offshore cyclonic activity. On average, two to three tropical cyclones occur during each tropical cyclone season, primarily in the December to April period, though cyclones have been recorded as late as June (BoM, 2014).

Depth is the primary driver in the differences between inshore and offshore waters. Overall, the NWMR is relatively shallow with more than 50% of the region at depths <500 m; therefore, surface currents exert a strong influence over the region's biophysical and ecological processes (DEWHA, 2008a). Oceanographic processes are also a key driver, particularly the composition of each water mass, such as its physical and chemical composition and temperature. Currents are the agents for movements of the differing water masses and therefore provide the link between systems.

2.2. BIOLOGICAL ENVIRONMENT

2.2.1. BIOLOGICAL COMMUNITIES

Most of the NWMR species are tropical and are also found in other parts of the Indian and western Pacific oceans. The NWMR has high species diversity said to be associated with the diversity of habitats available. These include hard seafloor areas (e.g., limestone pavements on the NWS), submerged cliffs and coral reefs of the Kimberley, and atolls and reefs on the edge of the shelf. These habitats support a high diversity of benthic filter feeders and producers. Fish spawning in summer/autumn in the Kimberley is thought to correspond with peaks in production and current movements. There is a strong delineation in demersal slope fish communities in the Kimberley in comparison to systems further south.

The NWMR supports internationally important breeding and feeding grounds for a number of threatened and migratory marine species that transit through the bioregion, including humpback whales. Significant turtle rookeries are found on coastal beaches and offshore islands and the surrounding waters provide important resting and internesting (i.e. in between egg laying periods) habitats (DEWHA, 2007; DEWHA, 2008a).

There are a number of islands, reefs, and shallow shoals in the Kimberley system of the NWMR within and adjacent to the Gravis MC3D MSS polygon. These oceanic banks and shoals form a region of unique topography. They are part of a large area referred to as the Oceanic Shoals (OSS) meso-scale region within the 'Integrated Marine and Coastal Regionalization of Australia' (IMCRA) classification (Heyward *et al.*, 2010). Those located within the polygon include:

- Vulcan Shoal - minimum depth ~9.5 m, located within the polygon, ~60 km to the west of the eastern boundary;
- Goeree Shoal - minimum depth ~18.8 m, located within the polygon, ~54 km to the west of the eastern boundary;

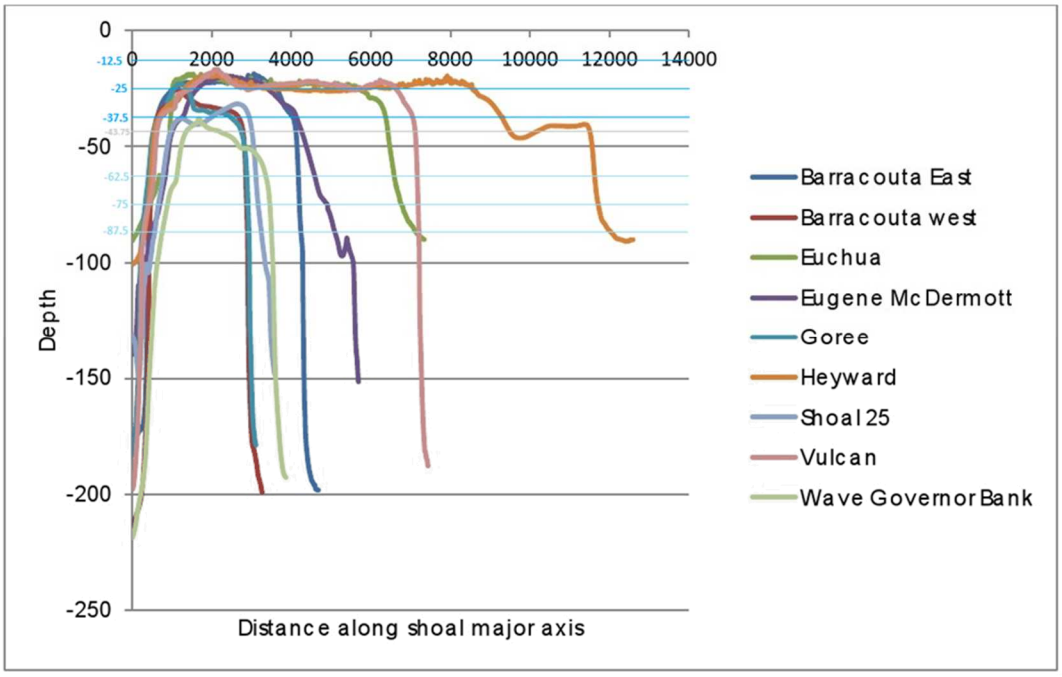
- Eugene McDermott Shoal - minimum depth ~11 m, located within the polygon, ~27 km to the west of the eastern boundary;
- Barracouta Shoal - minimum depth ~10.2 m, located ~20 km south of the north western boundary; and
- Heywood Shoal - minimum depth ~13 m, located ~11 km north of the southern boundary.

Features such as shoals provide topographic structure and habitat for sessile megabenthos, including hard and soft corals, filter feeders, seagrass and macroalgae. These shoals all have the potential to support photosynthetic organisms and primary production due to water clarity and adequate light penetration at the depths of the shoal plateaus (Heyward *et al.*, 2011a). Such habitats provide shelter and food for a diverse range of primary and secondary consumers, such as schooling fish (e.g. herring and damsel fish), parrot fish etc., which then support higher order consumers such as trevally, dolphin fish and emperors etc. (Brewer et al., 2007).

Although typical shoal biota includes algae, corals and seagrass, there can be significant diversity within and between shoal ecologies (Heyward *et al.*, 2011a). Reviews indicate that fish communities on tropical shelves can be structured by biogeography, regional sources of upwelling and runoff, thermoclines, mud content of sediments, topographic complexity, depth, latitude, ontogenetic migrations and species replacements through effects of fishing (Weinberg et al., 2010).

Light, depth, aspect and substrate type appear to be the biggest influence on substrate types. Hard corals need light, whereas gorgonian and many soft corals do not and so are more abundant in deeper waters. Studies on the Big Bank Shoals confirmed that coral growth is limited to depths less than 50 m as the quality of light changes rapidly with depth, both in intensity and composition.

The results of an AIMS study (Heyward *et al.* 2012) indicated that there is high fish abundance and richness around the shoal rims which are ~40 m deep and on top of the plateaux. They found that the 60 m contour typically occurred just below the upper shoal rims as the substrate curved rapidly from the more horizontal shoals plateau regions in the 20-45 m depth range to steeply sloping shoal sides (**Figure 2.1**). The study indicated that the majority of the habitat around the edges out to the 60 m contour are "sparse mixed biota", while the hard corals are dominant towards the centre of the shoals, often associated with hard limestone.



Source: Modified from Heyward *et al.,* (2012)

Figure 2.1- Cross Section shoal depth profiles derived from a multibeam transect across the long axis of each shoal

Based on studies conducted by AIMS at Seringapatam Reef, Ashmore Reef and Cartier Island (Heyward *et al.* 2011b) coral spawning on the six shoals within the Gravis MC3D MSS polygon can be predicted to occur according to the same timelines that apply for other reefs in the region (e.g. Scott Reef) – i.e. a primary spawning event in March/April; and a secondary spawning event in October/November. Spawning in March usually occurs 7-10 nights after the full moon, and spawning also occurs in the first week of April after the preceding full moon (Heyward *et al.* 2011). A similar pattern applies for the secondary Oct/Nov spawning event.

The NWMR is thought to contain a high diversity of crustaceans with dominant species groups including copepods, prawns, scampi and crabs. The North West Slope Trawl Fishery (NWSTF) targets scampi in the NWMR. Data from the fishery suggests that muddy sediments support significant populations of crustaceans (Fletcher and Santoro, 2014).

2.2.2. PROTECTED MARINE FAUNA

The Protected Matters Search Tool (PMST) from the DoE was used to determine whether matters of national environmental significance (NES) or other matters protected by the EPBC Act were likely to occur in the Gravis MC MSS polygon. Thirteen (13) listed Threatened species may occur, or relate to, the Gravis MC MSS polygon:

1. the Australian lesser noddy;
2. the blue whale;
3. the humpback whale;
4. the short-nosed seasnake;
5. the leaf-scaled seasnake;
6. the loggerhead turtle;
7. the green turtle;
8. the leatherback turtle;
9. the hawksbill turtle;
10. the olive ridley turtle;
11. the flatback turtle;
12. the great white shark; and
13. the whale shark.

The Gravis MC 3D MSS polygon is not considered a habitat that is critical to the survival of any listed species. Similarly, there are no EPBC Act-listed threatened ecological communities (TEC) or critical habitats within the vicinity of the Gravis MC 3D MSS polygon.

The PMST report identified two Key Ecological Features (KEF) within or adjacent to the Gravis MC 3D MSS-Reduced Scope Polygon:

- Ancient Coastline at 125 m isobath
- Ashmore Reef and Cartier Island and surrounding Commonwealth waters
- Continental Slope Demersal Fish Communities

The BIA that overlap the Gravis MC 3D MSS polygon are as follows:

- migration area for the pygmy blue whale;
- nesting area and internesting buffer for the green turtle;
- foraging area for the whale shark; and
- breeding and foraging area for the white-tailed tropicbird, brown booby, greater frigatebird, greater frigatebird, red-footed booby, and wedge-tailed shearwater.

The BIA for particular marine species are presented in **Appendix 1**.

2.2.2.1. CETACEANS

The EPBC Act database (DoE, 2015a) lists 25 cetacean species that may occur within the Gravis MC 3D MSS polygon, all of which are protected under the Act; one of which is also classified as Endangered (blue whale), one as Vulnerable (humpback whale) and nine as Migratory.

2.2.2.1.1. Pygmy blue whales

The western boundary of the polygon overlaps at most ~24 km^2 of the eastern edge of the pygmy blue whale BIA. The Gravis MC3D MSS polygon does not include any known blue whale feeding, breeding or resting areas. Consequently, there is the possibility that migrating blue whales may be encountered in the deeper waters of the Gravis MC3D MSS polygon, due to maximum water depths in the polygon (~525 m), However, it is unlikely that significant numbers of individuals will be encountered as the majority of animals will be moving north/south to the west of the polygon, as supported by the satellite tracking data. Appropriate mitigation including soft starts and use of MFO will be utilised throughout the survey.

2.2.2.1.2. Humpback whales

The humpback whale is the most commonly sighted whale in WA waters.

Given that the Gravis MC 3D MSS is located more than 100 km from the identified humpback whale migration and calving BIA, and the water depths over the polygon (>120m), it is unlikely that significant numbers of humpback whales will be encountered. Nevertheless, adaptive management of impacts from seismic acoustic emissions on humpback whales have been considered and adopted.

2.2.2.1.3. Dugongs

The Ashmore Reef Commonwealth Marine Reserve (ARCMR) lagoonal habitats support a small population of dugong (less than 50 individuals) and their range more than likely extends to Cartier Island and other submerged shoals in the region such as Vulcan Shoals (DNP, 2014; DEH, 2002). The Ashmore and Cartier Reefs seagrass beds are a known feeding ground and critical habitat for this population of dugong. Consequently, it is possible that dugongs may be encountered within the Gravis MC3D MSS polygon, as they travel between feeding grounds on the reefs and shoals in the region.

2.2.2.1.4. Marine Reptiles

The PMST identified six (6) species that may occur within or in the waters surrounding the Gravis MC 3D MSS polygon; the green, hawksbill and flatback turtles (all listed as Vulnerable and Migratory); and the loggerhead, olive ridley and leatherback turtles (listed as Endangered, and Migratory).

The green turtle nesting area and internesting buffer overlaps the western edge of the Gravis MC3D MSS polygon. Ashmore Reef (~44 km from the polygon) and Cartier Island are the closest turtle nesting areas to the polygon and support large significant populations of turtles, feeding turtles are present on the reef throughout the year (DEH, 2002). Green turtles and to a lesser extent, hawksbill turtles both use these areas as nesting, internesting and foraging sites (DoE, 2014g; DoE, 2014f).

2.2.2.1.5. Sea Snakes

There are seventeen (17) protected species of sea snakes listed as marine species under the EPBC Act that may occur within the Gravis MC3D MSS polygon (see Table 4.1). The short-nosed sea snake and leaf-scaled seasnake are listed as Critically Endangered under the EPBC Act and may be present in the polygon as they have been identified as being present in the region. Given the water depths within the polygon (~10 to ~525 m) it is possible they may be encountered in the Gravis MC3D MSS polygon.

The ARCMR is an internationally significant area for sea snakes, it is estimated that there are ~40,000 sea snakes from at least thirteen (13) different species found in the reserve, nowhere else in the world can compare to this record

Sharks and Ray-finned Fishes

EPBC Act protected marine species that may occur within the Gravis MC 3D MSS polygon and surrounding waters include the great white shark, giant manta ray and various species of pipefishes and seahorses (Family Syngnathidae). Information regarding the habitat, species numbers or life cycles of species from this family on the NWS is limited (DSEWPaC, 2012); however, it is understood most syngnathid species prefer complex shallow water habitats including seagrass and reefs.

2.2.2.1.6. Whale Shark

The whale shark is listed as Vulnerable and Migratory under the EPBC Act and is also classified as Vulnerable on the World Conservation Union's Red List of Threatened Species (IUCN, 2015). In WA, they are known to aggregate in

the reef front waters of Ningaloo Reef from March to July, and northward of the Ningaloo Marine Park along the 200 m contour from July to November. However, the timing is variable and individual whale sharks have been recorded at other times of the year, (Wilson *et al.,* 2001).

The Gravis MC3D MSS polygon does not represent any critically important areas (migration, feeding, breeding areas) for the whale shark. A BIA (foraging area) for the whale shark overlaps the Gravis MC3D MSS polygon and is shown in the maps in **Appendix A**. Therefore, it is possible that whale sharks may be encountered in the polygon, although significant numbers of individuals are unlikely and those that are encountered are likely to be transient.

2.2.2.1.7. *Seabirds*

Seven (7) species of seabird may occur in the Gravis MC3D MSS polygon and surrounding waters - Australian lesser noddy, brown booby, great frigatebird, lesser frigatebird, red-footed booby, streaked shearwater and the white-tailed tropicbird. BIA breeding and foraging areas for the brown booby, greater frigatebird, lesser frigatebird, red-footed booby, wedge-tailed shearwater, and white-tailed tropicbird overlap the Gravis MC3D MSS polygon. Foraging, resting and breeding areas for the greater frigatebird, lesser frigatebird, red-footed booby, roseate tern and little tern are in the vicinity of the polygon.

Ashmore Reef (~54 km northwest of the polygon) is recognised as regionally important for seabirds, with 16 species known to breed on the islands within the reef. Seven (7) species of migratory shorebirds have been reported to occur at Ashmore Reef in numbers that exceed 1% of their total estimated East Asian - Australasian Flyway population (Clarke, 2010). Such numbers are significant as they identify Ashmore Reef as a wetland of international importance (declared Ramsar site) for these species.

2.3. SOCIO-ECOMOMIC ENVIRONMENT

2.3.1. COMMERCIAL FISHERIES

The Gravis MC 3D MSS has the potential to interact with Commonwealth and State-managed fisheries. The following section details the commercial fisheries that may be operating within, or adjacent to, the operational area.

State fisheries administered by DoF that can operate in the Gravis MC3D MSS polygon include:

- the Kimberley Prawn Managed Fishery;**
- the Mackerel Managed Fishery (MMF);
- the Marine Aquarium Fishery (MAF);**
- the JA Northern Shark Fishery (JANSF);*
- the WA North Coast Shark Fishery (WANCSF);*
- the Northern Demersal Scalefish Managed Fishery (NDSF);
- the Pearl Oyster Managed Fishery (POMF);**
- the Specimen Shell Fishery; and
- the West Coast Deep Sea Crustacean Managed Fishery (WCDSCF).

The Commonwealth fisheries administered by AFMA that can operate in the Gravis MC3D MSS polygon include:

- the North West Slope Trawl Fishery (NWSTF);
- the Western Skipjack Fishery (WSF);
- the Western Tuna and Billfish Fishery (WTBF); and
- the Southern Bluefin Tuna Fishery (SBTF).

**Note: There has been no reported fishing activity in the northern shark fisheries since 2008/09 (Fletcher and Santoro eds., 2013).*

***Note: Fisheries have not been described below as the current fishing effort does not overlap the Gravis MC3D MSS polygon (Fletcher and Santoro eds., 2013).*

2.3.2. 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. The Gravis MC3D MSS polygon overlaps the eastern edge of the MOU 74 Box, therefore traditional fishers may be encountered. However, as the traditional fishers tend to "island hop" from Ashmore Reef to Seringapatam Reef, to Scott Reef, it is unlikely that vessels will be encountered.

2.3.3. PETROLEUM EXPLORATION AND PRODUCTION

The Gravis MC 3D MSS overlaps numerous Exploration Permits and adjacent open acreage areas. At present, there is one production facility located within the Gravis MC3D MSS polygon:

- the *Montara Venture* FPSO, producing oil from the Montara field.

The survey and support vessel(s) will not enter the Petroleum Safety Zone (PSZ) of 500 m, as per Section 616(2) of the OPGGS Act.

2.3.4. COMMERCIAL SHIPPING

The Gravis MC3D MSS polygon overlaps the Osborne Passage and the charted "Preferred Route" commercial shipping lanes. The Australian Maritime Safety Authority (AMSA) was identified as a stakeholder and contacted regarding the proposed Gravis MC 3D MSS and subsequently supplied details of the location of shipping fairways that overlap and are adjacent to the polygon. Consultation with AMSA will be ongoing prior to, and throughout the duration of the survey.

2.3.5. TOURISM AND RECREATION

Due to the location of the Gravis MC3D MSS polygon, deep water depths of the majority of the polygon (>100 m) and distance to coastal areas of northern WA (~132 km) there are minimal recreational activities undertaken in the area, visitors are limited by the remote location, difficulty and expense involved in accessing the area. Commercial tour operators visit the Ashmore and Cartier Reef region intermittently, primarily for scuba diving and bird watching as the reserves provide opportunities for these activities (DEH, 2002). All visitors to the region arrive by boat, and mainly on yachts that are en route to other locations.

2.3.6. CULTURAL HERITAGE

There are no known indigenous cultural heritage values or issues for the waters and seabed within and immediately adjacent to the Gravis MC3D MSS polygon. Similarly, there are no current or pending Native Title Determinations for the waters and seabed within and immediately adjacent to the polygon. Under the *Historic Shipwrecks Act 1976* (Commonwealth), all wrecks older than 75 years are protected. A search of the National Shipwrecks Database indicates that there are a large number of listed historic shipwrecks in the region, but none are within the Gravis 3D MC polygon.

2.3.7. NATIONAL HERITAGE

There are no places listed on the Commonwealth Heritage List or the Register of National Estate within the Gravis MC3D polygon. There is only one place listed on the Commonwealth Heritage List or the Register of National Estate adjacent to the Gravis MC3D MSS polygon:

- Ashmore Reef National Nature Reserve - listed on the Commonwealth Heritage List (Place ID 105218, Place File No 9/04/001/0002), and also listed on the Register of the National Estate (Place ID 14689).

2.3.8. MARINE PARKS AND RESERVES

The Gravis MC 3D MSS polygon is adjacent to the following Commonwealth Marine Reserve (CMR) and WA State marine parks:

- Ashmore Reef Commonwealth Marine Reserve (ARCMR) and

- Cartier Island Commonwealth Marine Reserve (CICMR)

The reserves are designated IUCN category Ia - strict nature reserves, they are protected areas managed mainly for scientific research or environmental monitoring. The CICMR is located ~17 km north of the Gravis MC3D MSS polygon and the ARCMR is located ~44 km northwest of the polygon. As such activities are planned to have minimal impact of sensitive environments

2.3.9. COMMONWEALTH MARINE RESERVES

The Gravis MC3D MSS polygon is in the vicinity of the following proposed Commonwealth Marine Reserves:
Oceanic Shoals Commonwealth Marine Reserve (Multiple Use Zone - IUCN Category VI - 71,744 km^2), which is ~124 km away from the survey polygon.

2.3.10. OTHER PROTECTED AREA

There are no listed World Heritage Properties within, or adjacent to, the Gravis MC3D MSS polygon.

There is one listed Ramsar Wetland of International Importance in the vicinity of the polygon - Ashmore Reef, which is located ~44 km to the northwest of the polygon. It was designated as a Ramsar wetland in 2003 due to the importance of its islands as resting locations for migratory shorebirds, and as they support large seabird breeding colonies.

2.3.11. DEFENCE ACTIVITIES

There are no defence activities overlapping the Gravis MC 3D MSS polygon (AMSIS, 2015)

3. DESCRIPTION OF ACTIVITY

3.1. SURVEY PARAMETERS

The marine seismic surveys proposed will be a typical 3D survey similar to most others conducted in Australian marine waters (in terms of technical methods and procedures). No unique or unusual equipment or operations are proposed. The activity will be conducted using a purpose-built seismic survey vessel.

For individual surveys within the Gravis MC3D MSS polygon, CGG will be using BroadSource, a multi-level source and variable-depth streamer acquisition technique. The airgun array consists of two sub-arrays, each comprised of three strings of airguns. With BroadSource, the three airgun strings are configured with some airguns at 6 m depth below the surface, and the remainder at 9 m depth. Firing of the guns at different levels are synchronized to defocus both source ghosts. Based on variable gun depth geometry inside the three airgun strings in each sub-array, this multi-level source allows the flip-flop mode for 3D acquisition. The sub-arrays will be fired alternately, with a shotpoint interval of either 18.75 or 37.5 m horizontal distance. For BroadSource, a variable streamer tow depth is used, which in this case will be up to 50 m.

During the proposed activities, the survey vessel will traverse a series of pre-determined sail lines within the polygon at a speed of ~ 8 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 operating pressure for the airgun array will be ~ 2,000 psi. The airgun array will consist of two sub-arrays, each with a maximum volume of 4,433 cui. These sub-arrays will be fired alternately, with a shotpoint interval of either 18.75 or 37.5 m horizontal distance, and will produce at source (i.e. within a few metres of the airguns) sound pulses in the order of 242 dB re 1 µPa-m $_{pk-pk}$ (sound pressure level - SPL), at frequencies extending up to ~200 Hz.

The seismic array will comprise of up to 14 solid streamers, with a maximum length of up to 10,000 m. Streamer spacing will be from 50 to 150 m, and line spacing will be from 75 to 150 m. The source (airgun array) tow depth will be 5 m and 9 m (BroadSource) and the streamer tow depth will be 6 m at the head of the streamers and 50 m at the tail. In shallow waters, steamers will be towed at a depth that will not permit them to be closer than 10 m from the seabed, as per the CGG Standard Operating Procedure (SOP) - Close Approach Of A Natural Obstacle document (MAR SEO PRC 010E).

For Phase I, CGG anticipate undertaking the Gravis acquisition using a racetrack formation in northwest-southeast orientation to minimise interaction with shoals within the area. Due to the deep tow cable streamer configuration (7-50 m) and ~1 km wide acquisition spread, by default, the sound source will come no closer than ~500 m from the 50 m contour around all the banks.

A volume of 4,433 cui has been nominated as the maximum volume based on previous surveys in the Browse and Bonaparte basins, but seismic source modelling software is used on a survey by survey basis to determine the ideal array volume to be used

3.2. ACOUSTIC MODELLING

Source modelling was used to calculate sound levels within the water column, both vertically and up to several kilometres away from the source, using the sound exposure level (SEL) and sound pressure level (SPL) units of measurement suggested by Southall *et al.* (2007) (and further refined by NOAA (2013) and Popper *et al.* (2014) to evaluate the effect of seismic noise on the receiving environment.

Sound levels have been calculated within the water column over a grid of locations around the array up to 20 km distance from the seismic source at a depth of 10 m below the sea surface. The calculations of SEL and SPL have been made according to the methods suggested by Southall *et al.* (2007) to calculate the sound field emitted by the seismic source.

For a 4,433 cui airgun array, modelling indicates that the maximum pk-pk output will be ~261 dB re 1 µPa-m $_{pk-pk}$, which equates to a maximum source level SPL of 242 dB re 1 µPa-m $_{pk-pk}$. Modelling indicates that sound levels will reduce to SPL of ~210-215 dB re 1 µPa-m$_{pk-pk}$ @ 50 Hz at the far-field point ~250-300 m vertically below the array. For a 4,433 cui airgun array, modelling indicates that the SPL value from a single shot at a distance of 1 km horizontally from the source (at 1 m depth below the surface) is likely to be <150 dB re 1 µPa/Hz.

These results are in line with empirical measurements from a number of seismic airgun sources in western and southern Australian waters (Dr Rob McCauley, CMST Curtin University, pers. comm., June 2009), in which a 4,000 in^3 airgun array is expected to decrease to SEL in the order of 165 to 175 dB re 1µPa^2.s within 1 km of the source.

On this basis, and as required by the EPBC Policy Statement 2.1, the following precaution zones will be applied for the Gravis MC 3D MSS – Reduced Scope Polygon:

- Observation zone: 3+ km horizontal radius from the acoustic source.
- Low power zone: 2 km horizontal radius from the acoustic source.
- Shut-down zone: 500 m horizontal radius from the acoustic source.

An interference effect at the sea surface means that a seismic pulse will cancel itself out. This results in a 'dipole' radiation pattern and an animal at or near the surface will experience much lower sound levels than one at depth (Geoscience Australia, 2002). Modelling undertaken clearly show that a 'ghost shadow' zone underneath the sea-surface has a significant effect on the source amplitude. Thus a 200-500 m separation from the reef will result in ~ 30-67 dB reduction in the energy from the seismic sources impinging on the shallow part of the reef (6-31 m).

3.3. SEISMIC SURVEY VESSELS

CGG proposes to conduct individual surveys within the Gravis MC3D MSS using a purpose-built seismic survey vessel, similar to the M/V *Geo Caspian* (see **Figure 3.7**), which is owned by Volstad Maritime AS and operated by CGG. 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. The vessel will travel within the survey polygon at an average speed of 4.5 knots (~8.3 km per hour).

3.3.1. SUPPORT / GUARD VESSEL(S)

One or more support vessel(s) will accompany the seismic survey vessel to maintain a safe distance between the survey array and other vessels, and also to manage interactions with shipping and fishing activities if required. The support vessel, which have a crew of ~15 personnel, will also re-supply the survey vessel with fuel and other logistical supplies. If required (i.e. for vessels over 400 GRT) the support vessel will have an implemented and tested Shipboard Oil Pollution Emergency Plan (SOPEP).

The Gravis MC3D MSS is expected to have an acquisition period of 12 months, however individual surveys within the survey polygon will be acquired in phases, over a period of 2 years. It is likely that the survey vessel will be refuelled at sea using the support vessel either within or immediately adjacent to the polygon. 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 (<20 m water depth).

4. DETAILS OF ENVIRONMENTAL IMPACTS AND RISKS

4.1. ENVIRONMENTAL RISK ASSESSMENT METHODOLOGY

An Environmental Risk Assessment (ERA) of the proposed Gravis MC 3D MSS has been undertaken to understand and manage the environmental risks associated with the activity to a level that minimises impacts on the environment and meets the objectives of the proposed 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 ALARP.

The environmental risks associated with the proposed marine seismic survey have been assessed by a methodology that:

- identifies the activities and the environmental aspects associated with them;
- identifies the values/attributes at risk within and adjacent to the polygon;
- defines the potential environmental effects of the activities;
- identifies the likelihood of occurrence and potential consequences; and
- determines overall environmental risk levels using a likelihood and consequence matrix.

The Environmental Risk Assessment process identified, assessed and ranked the risks associated with each environmental hazard in accordance with the environmental risk matrix.

Table 4.1 – General environmental risk assessment matrix

	LIKELIHOOD				
CONSEQUENCE	**Unlikely**	**Possible**	**Likely**	**Highly Likely**	**Routine**
Catastrophic	**High**	**High**	**High**	**High**	**High**
Severe	**Medium**	**Medium**	**Medium**	**High**	**High**
Moderate	**Medium**	**Medium**	**Medium**	**Medium**	**Medium**
Minor	**Low**	**Low**	**Medium**	**Medium**	**Medium**
Slight	**Low**	**Low**	**Low**	**Low**	**Low**

High Risk Level: Apply strict precautionary principle, and industry best practice to reduce to ALARP.

Medium Risk level: Apply standard cost-benefit approach to reduce risk to ALARP.

Low Risk level: Apply normal business management practice to avoid impact.

4.2. RISK EVALUATION

Environmental risks cover a wider range of issues, multiple species, persistence, reversibility, resilience, cumulative effects and variability in severity. The degree of environmental risk and the corresponding threshold for acceptability has been adapted to include principles of ecological sustainability (given as an objective in the Environment Regulations and defined in the EPBC Act), the Precautionary Principle and the corresponding environmental risk threshold decision-making principles used to determine acceptability.

4.2.1. DEMONSTRATION OF ALARP

Impacts and risks are reduced to ALARP where:

- The residual risk is **LOW**:
  - good industry practice or comparable standards have been applied to control the risk, because any further effort towards risk reduction is not reasonably practicable without sacrifices grossly disproportionate to the benefit gained.
- The residual risk is **MEDIUM** or **HIGH**:
  - good industry practice is applied for the situation/ risk; or
  - alternatives have been identified and the control measures selected to reduce the impacts and risks to ALARP. This may require assessment of Company and industry benchmarking, review of local and international codes and standards, consultation with stakeholders etc.

4.2.2. DEMONSTRATION OF ACCEPTABILITY

The following process has been applied to demonstrate acceptability.

- **LOW** residual risks are 'Broadly Acceptable', if they meet legislative requirements, industry codes and standards, regulator expectations, Dolphin's HSE Policy and industry guidelines.
- **MEDIUM** and **HIGH** residual risks are 'Broadly Acceptable' if ALARP can be demonstrated using good industry practice, risk based analysis, if societal concerns are accounted for and the alternative control measures are disproportionate to the benefit gained.
- **SEVERE** residual risks are 'Intolerable' and therefore 'Unacceptable'. Risks will require further investigation and mitigation to reduce the risk to a lower and more acceptable level. If after further investigation the risk remains in the severe category, the risk requires appropriate business sign-off to accept the risk.

4.3. IDENTIFICATION OF RISKS AND IMPACTS

The risks identified during the ERA process (including Decision Type, residual risk level and acceptability of residual risk) have been divided into two broad categories: Planned (routine and non-routine); and Unplanned (accidents or incidents) activities. Both of these categories have then been further divided into impact assessment groupings based on stressor type e.g. noise, equipment loss etc.

4.3.1. ENVIRONMENTAL ASPECTS

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 and grounding 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 vessel(s);
- accidental discharge of hydrocarbons and chemicals to the ocean from survey and support vessel(s);
- interactions with commercial fishing and shipping activities; and

4.3.2. ENVIRONMENTAL IMPACTS

A summary of the potential environmental impacts associated with the sources of environmental risk listed above 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, and shipping; and

4.4. ASSESSMENT OF ENVIRONMENTAL IMPACTS AND RISKS

This section briefly describes the potential risks and impacts that could occur as a result of the proposed activity. **Section 4** details the risk assessment and **Section 6** summarises the control measures that will be implemented to minimise impacts to receptors described herein.

4.4.1. UNDERWATER NOISE EMISSIONS FROM DISCHARGE OF AIRGUN ARRAY

Studies relating to the environmental effect of marine seismic surveys have largely focused on the potential effects to fish stocks and marine mammals from the sound waves associated with the seismic energy source. Concerns have included:

- pathological effects (lethal and sub-lethal injuries) - immediate and delayed mortality and physiological effects to nearby marine organisms;
- behavioural change to populations;
- disruptions to feeding, mating, breeding or nursery activities of marine organisms in such a way as to affect the vitality or abundance of populations;
- disruptions to the abundance and behaviour of prey species for marine mammals, seabirds and fish; and

- changed behaviour or breeding patterns of commercially targeted marine species, either directly, or indirectly, in such a way that commercial or recreational fishing activities are compromised.

In relation to cumulative noise levels, an environmental review recently published by the Bureau of Ocean Energy Management (BOEM 2014) indicated a typical radius for a 160-dB threshold for a large airgun array was no more than 10 km (BOEM, 2014). Consequently, the implementation of a 40 km geographic spacing between survey vessels working simultaneously is a very conservative approach, as this would leave a potential 20 km 'corridor' between vessels, rather than the 10 km 'corridor' as stated in the BOEM environmental review (BOEM, 2014).

Disturbance to Benthic Invertebrates

Few marine invertebrates have sensory organs that can perceive sound pressure, but many have organs or elaborate arrays of tactile 'hairs' that are sensitive to hydro-acoustic disturbances (McCauley, 1994). These sensory hairs or organs are collectively known as mechanoreceptors, and crustaceans are particularly well endowed with them. Close to a seismic source, the mechano-sensory system of many benthic crustaceans will perceive the 'sound' of airgun pulses, but for most species such stimulation would only occur within the near-field or closer, perhaps within distances of several metres from the source (McCauley, 1994).

A summary of impacts of seismic airguns on marine invertebrates based on literature reviews concludes that "very limited numbers of experiments were scientifically and reasonably conducted" but the results of nine quantitative studies showed five cases of immediate (lethal or physical) impacts of seismic airguns on invertebrate species and four cases of no impacts. One study showed physiological impacts and another showed no physiological impact. Three cases showed behavioural impacts and one study showed no impact on behaviour.

Disturbance to Bivalve Molluscs

A review of studies (Parry *et al.* 2002) suggested that molluscs are at risk of damage from seismic airgun noise only when they are closer than 1-2 m. However, previous studies have also suggested that most effects on invertebrates without gas-filled cavities are likely to be too subtle to be measured in the field. It would appear that significant impacts on bivalve molluscs, such as the pearl oyster, from airgun noise emissions will only occur within very short distances from the source. A conservative estimate for a minimum distance beyond which significant effects are unlikely, is approximately 10 m, but this will depend on the source dynamics and propagation characteristics of the area.

Disturbance to Planktonic Organisms

Except for fish eggs, larvae and other minute planktonic organisms within a few meters of an airgun, no planktonic organisms are likely to be affected significantly by airgun array discharges (McCauley, 1994). Sound exposure guidelines published by Popper *et al.* in 2014 have indicated that for eggs and larvae, SEL (cum) levels >210 dB or peak > 207 dB may incur mortality or potential mortal injury while animals near have a moderate risk of recoverable injury or TTS. These predictions are based on work by Bolle *et al*. (2012) as cited in Popper *et al* 2014) on pile driving signals.

Disturbance to Coral Spawn

Considering the coral spawn physiology, it would be very unlikely that coral spawn would be susceptible to low frequency noise due to a relatively uniform density throughout (e.g. absence of any gas capsules). As a conservative approach in the absence of data, it would be considered that coral spawn mortality may occur within 5 m of an acoustic pulse. In consideration of the extremely low proportion of coral larvae that may be exposed, and that any impacts will be widely distributed over the survey area, it is unlikely that seismic acquisition during a coral spawning event within the Gravis MC3D MSS polygon will have a significant impact on coral recruitment and settlement for any of the shallow shoals within the polygon, and any impacts at the population level would be negligible and undetectable.

Disturbance to Fish

Potential impacts on fish species related to the operation of survey airgun arrays include behavioural avoidance of seismic sound sources, temporary threshold shifts (TTS) and pathological trauma or mortality. Indirect effects may include reduced catches resulting from changes in feeding behaviour and vertical/horizontal distribution (Skalski *et al.* 1992).

Behavioural responses to sounds are variable but include:

- avoidance;
- startle/alarm response;
- changes in swimming patterns (including change in swimming speed and direction); and
- changes in vertical distribution.

These effects are expected to be short-lived, with duration of effect less than or equal to the duration of exposure, are expected to vary between species and individuals, and be dependent on the properties of received sound (DFO 2004). The ecological significance of such effects is expected to be low, except where they influence reproductive activity.

Based on existing information, impacts on fish populations (as opposed to individuals) resulting from seismic survey noise are likely to be restricted to the following:

- short ranges and high sound intensities (i.e. <200 m range from source);
- populations that cannot move away from operating arrays (e.g. site-attached reef species);
- surveys that take place over protracted periods close to areas important for the purposes of feeding, spawning or breeding; and
- surveys that take place over protracted periods close to areas that constitute narrow, restricted migratory paths.

Due to the deep tow cable configuration (7-50 m) associated with BroadSource and ~1 km wide acquisition spread, the sound sources by necessity will come no closer than ~500 m from the 50 m contour around all the banks, ostensibly creating an exclusion zone around each shoal. Due to the very steep slopes of the shoal banks, this means that the majority of acquisition will be in waters > 100 m deep (shallowest being ~ 70 m), and ~ 500m from sensitive environments associated with the upper regions of the shoals (waters <50 m).

Exposure guidelines for fishes and turtles exposed to seismic airgun noise are presented in Popper *et al* (2014), with a summary provided below. These levels were developed through an extensive review of available literature and scientific papers on the effects of anthropogenic noise on various marine fauna.

Table 4.2 – Exposure guidelines sound levels for mortality and impairment in fishes and turtles

Type of animal	Mortality or potential mortal injury	Impairment	
		Recoverable injury	TTS
Fish: no swim bladder	>219 dB SEL_{cum} or >213 dB_{peak}	>216 dB SEL_{cum} or >213 dB_{peak}	>186 dB SEL_{cum}
Fish: swim bladder but not involved in hearing	>210 dB SEL_{cum} or >207 dB_{peak}	>203 dB SEL_{cum} or >207 dB_{peak}	>186 dB SEL_{cum}
Fish: swim bladder involved in hearing	>207 dB SEL_{cum} or >207 dB_{peak}	>203 dB SEL_{cum} or >207 dB_{peak}	>186 dB SEL_{cum}
Sea turtles	>210 dB SEL_{cum} or >207 dB_{peak}	-	-
Eggs and larvae	>210 dB SEL_{cum} or >207 dB_{peak}	-	-

Using the equation SEL_{cum} = SELss+10log10(N), where N equals the number of shots, it is possible to calculate the number of shots it would take to exceed the SEL_{cum} exposure guidelines provided in **Table 4.2** if a sound source was stationary above a fixed point on the seabed. At 70 m of water this equates to 4 to 9 shots. This however does not take into account a moving vessel with a shotpoint interval of ~ 18.75m, and hours to days between adjacent lines.

Therefore, it is highly unlikely that any of the SEL_{cum} exposure guidelines in Popper *et al*. (2014) would be exceeded with use of 4,433 cui array in water depths >70 m (worst case scenario Eugene McDermott Shoal northern aspect) within the Gravis MC3D MSS polygon.

Based on the racetrack formation that CGG will use, the closest that the sound source will be to the 50 m contour as it deviates either side of a shoal is ~500m, with the separation distance generally much greater around most of the shoal.

There will be very limited suitable habitats for site attached fish species as communities are likely to be limited to water depths much shallower within the Gravis MC3D MSS polygon, for the following reasons:

- water depths >50 m are below the photic zone where photosynthesising corals and calcareous algae occur;
- any hard substrates in the deeper waters of the upper slope region will be overlain by unconsolidated sandy sediments; and
- minimum hard substrates in water depths >50 m and hence a lack of suitable conditions for sessile epibenthic fauna.

CGG conclude that by discharging the acoustic source only in waters not less than ~500m from the shoals within the polygon, the source will **NOT** be discharged on:

- the shoal tops
- the shoal edges (25 - 40 m)
- areas of predicted high fish abundance
- areas of predicted high species richness and
- areas of predicted sensitive habitats

Disturbance to Sharks and Whale Sharks

The available evidence indicates sharks will generally avoid seismic sources and the likely impacts on whale sharks are therefore, expected to be limited to short-term behavioural responses, possibly including avoidance of the operating airgun array. These behavioural responses are unlikely to be significant at a population level, particularly as the waters of the Gravis MC3D MSS polygon do not represent critical habitat for whale sharks. Any whale sharks in the area are likely to be transient, i.e. moving through the polygon and adjacent waters during migratory movements, to and from the Ningaloo Reef area.

It is unlikely that the underwater noise emissions from the airgun array would cause any pathological effects (lethal and sub-lethal injuries), resulting in immediate and delayed mortality and physiological effects, on whale sharks.

Whilst the proposed survey activities may overlap the period when whale sharks are transiting the area to feed in the waters off Ningaloo Reef, any whale sharks encountered in the Gravis MC3D MSS polygon are likely to be transient.

Disturbance to Marine Turtles

Electro-physical studies have indicated that the best hearing range for marine turtles is in the range 100 to 700 Hz, which overlaps with the frequency range of maximum energy in the horizontally propagating component of a seismic array 'shot' (McCauley, 1994). Studies indicate that marine turtles may begin to show behavioural responses to an approaching seismic array at received sound levels of 166 dB re 1 µPa (rms), and avoidance at around 175 dB re 1 µPa (rms; McCauley *et al.,* 2003). This corresponds to behavioural changes at approximately two kilometres, and avoidance from approximately one (1) km.

Popper *et al*. (2014) provide exposure guidelines for marine turtles exposed to seismic airgun noise, with threshold criteria of >210 dB re 1 $\mu Pa^2.s$ SEL_{cum} and >207 dB re 1 $\mu Pa^2.s$ SEL_{peak} for mortality and potential mortal injury. These levels would be exceeded only within a distance of ~13 m vertically below the 4,433 cui array (largest array size proposed for surveys within the Gravis MC3D MSS polygon), and at shorter ranges (i.e. <10 m) horizontally out from the array.

The green turtle BIA overlapped by the survey is for the internesting BIA and not nesting BIA which is very small and discrete. The internesting BIA's are conservative and as such numbers anticipated at this distance from the nesting BIA (being the waters immediately surrounding Cartier Island) are not anticipated to be high. Furthermore, breeding in the Ashmore/ Cartier stock is year round and so cannot be avoided unless the polygon was reduced. If this was to occur, client data requirements could not be met.

Based on the work of McCauley *et al* (2003), behavioural changes could occur at ~166dB which equates to ~ 2km distance. Based on modelling undertaken by CGG, 2 km is an overly conservative distance as modelling indicates that levels of 160dB will be attained at only 1km.

Although some turtles could be encountered, it is unlikely they will be in significant numbers and with the application of the management measures (including temporal and spatial limitations exclusion on seismic acquisition within the BIA for nesting turtles), potential impacts are unlikely.

During the peak nesting season (1 October to 28 February) for green turtles, no survey acquisition with take place within the internesting BIA. Consequently, it is unlikely that significant numbers of turtles will be encountered during individual surveys within the Gravis MC3D MSS polygon.

Disturbance to Sea Snakes

Little information is available about the effects of seismic surveys on sea snakes. In the absence of observations of sea snake exposed to air gun noise, either of captive animals or in the field, it is assumed that they will respond in a similar way to turtles such as exhibiting behavioural change to an approaching sound source. One of the findings of the research and monitoring programme conducted at Scott Reef to study the effects of Woodside's Maxima 3D survey in 2007 on marine life was that the survey did not cause any observed physiological effects or mortality in marine fauna, including sea snakes.

Disturbance to Baleen whales (Mysticetes)

Physical damage to the auditory system of cetaceans may occur at noise levels of about 230 to 240 dB re 1µPa (Gausland, 2000), which is equivalent to a distance of about 1-2 m from the energy source. Because of the good swimming abilities of marine mammals and their avoidance of either the vessel or the airgun array, it is highly unlikely that any marine mammals will be exposed to levels likely to cause pathological damage (McCauley, 1994).

Noise associated with airguns used during seismic surveys can cause significant behavioural changes in whales. With regards to avoidance behaviour by baleen whales, it is known that baleen whales will avoid operating seismic vessels and the distance over which the avoidance occurs seems to be highly variable between species and even within species. It is considered that this avoidance behaviour represents only a minor effect on either the individual or the species unless avoidance results in displacement of whales from nursery, resting or feeding areas, at an important period for the species.

The western boundary of the polygon overlaps at most ~24 km^2 of the eastern edge of the pygmy blue whale BIA, however the BIA is over 120 km wide in this area and so is not, therefore, a "narrow migratory corridor". Consequently, there is the possibility that migrating blue whales may be encountered in the western portion of the Gravis MC3D MSS polygon. CGG conducted an assessment of whether the activity could result in significant impacts on pygmy blue whales (listed as Endangered and Migratory under the EPBC Act) using the DoE's Matters of National Environmental Significance (NES) guidelines (DoE, 2014f). It was determined that with the implementation of various mitigation measures, risks and impacts are ALARP and acceptable and as such there is no "real chance or possibility" that surveys acquired within the Gravis MC3D MSS polygon will result in any significant impact outcomes to pygmy blue whales.

Disturbance to Toothed Whales (Odontocetes)

The frequency range of toothed whale sounds excluding echo location clicks are mostly <20 kHz with most of the energy typically around 10 kHz, although some calls may be as low as 100 to 900 Hz. Source levels range from 100 to 180 dB re 1 µPa (Richardson et al., 1995).

There is little systematic data on the behavioural response of toothed whales to seismic surveys. Richardson et al., (1995) reports that sperm whales appeared to react by moving away from surveys and ceasing to call even at great distances from a survey. However, in a 2003 study supported by the US Minerals Management Service (Jochens and Biggs, 2003), two controlled exposure experiments were carried out (including one with three simultaneously tagged whales) to monitor the response of sperm whales to seismic source. The whales were exposed to a maximum received level of 148 dB re 1µPa. There was no indication that the whales showed horizontal avoidance of the seismic vessel nor was there any detected change in feeding rates of the tagged sperm whales.

The southeast corner of the polygon is located at least 125 km from the edge of the humpback whale BIA at Camden Sound, the closest 'core' location within the humpback whale calving grounds off the west Kimberley coastline. The separation distance from the calving grounds means that any underwater noise originating from the airgun array is extremely unlikely to exceed SEL levels that could cause behavioural impacts in humpback whale mothers and calves.

4.4.2. LIGHT GENERATION

Lighting on both the survey and support vessel(s), is required for safe navigation and work practices at night, and has the potential to create light pollution. This may subsequently affect some marine species, primarily seabirds and turtles.

The potential for lighting from the survey vessel to disorientate or attract turtle hatchlings during the Gravis MC3D MSS is likely to be minimal given the management measures (buffer/exclusion zone from nesting areas during peak nesting periods) that are being applied to the survey. Additionally, the vessel is likely to be moving continually, albeit at a low speed, and consequently the effects of artificial lighting are likely to be less than for a stationary source, such as a drill rig, or FPSO facility.

It is possible that seabirds may fly over the polygon. However, it is not anticipated that the seismic survey will have any impact on any species of seabird, due to their mobility and distance of the polygon to any nesting sites for seabirds (~54 km from Ashmore Reef).

4.4.3. VESSEL AND TOWED EQUIPMENT INTERACTIONS WITH MARINE FAUNA

The survey and support / guard vessel(s) may present a potential physical hazard (e.g. animal displacement or vessel strike) to marine fauna including cetaceans, turtles and whale sharks. Additionally, the tail buoys that are attached to the end of seismic streamers can represent an entanglement risk for turtles. The impact from vessel interactions with marine fauna can be as minimal as behavioural changes by the marine fauna to severe impacts such as mortality resulting from vessel strikes. Support vessel-marine fauna interaction procedures have been prepared to ensure any interactions between the support vessel and cetaceans, whale sharks and turtles are managed in accordance with EPBC Regulations 2000. Given the slow operating speed of the survey and support / guard vessel(s) (unless in an emergency) and the low likelihood of large numbers of animals being present, the potential for vessel strike to impact significantly on cetacean, whale shark or turtle populations in the polygon is assessed to be low.

4.4.4. DISTURBANCE TO BENTHIC HABITATS

The accidental dragging or loss of seismic streamer equipment, anchoring or vessel grounding has the potential to cause minor physical damage to benthic habitats and biological communities. Soft sediment benthic areas relatively devoid of sensitive habitats (i.e. coral reefs, seagrass meadows) and consisting of sandy /silt substrate is the predominant benthic receiving environment within, and adjacent to, the polygon.

Anchoring will not occur during the Gravis survey. Anchoring outside the polygon would only occur in emergency circumstances and the seismic and support vessel(s) are fitted with highly sophisticated position fixing equipment.

There are a number of shallow water features (<20 m water depth) within and adjacent to the polygon. However, the survey vessel will not be operating with towed streamers in water depths less than 50 m. The *Geo Caspian* has

a draft of 5.9 m, and the support vessel is expected to have a shallower draft than this. Therefore, the possibility that either vessel could run aground on any of the shallow shoals in the region, which have a minimum water depth ~9.5 m, is low.

Dragging of streamers along the seabed may result in localized physical disturbance of substrates, benthic habitats and communities. However, given the water depth range in which the survey vessel will be operating with towed streamers within the Gravis MC3D MSS polygon (>50 to 525 m), and the absence of any emergent features within or immediately adjacent to the area, the risk of significant impacts resulting from equipment dragging or loss is considered to be low.

4.4.5. Reduced Air Quality from Atmospheric Emissions

Atmospheric emissions from the proposed survey will occur as a result of engine use, power generation equipment and incinerators.

Potential environmental effects from these atmospheric emissions are a contribution to GHG emissions (albeit very minor) that may potentially influence climate change, and a localised reduction in air quality. Atmospheric emissions generated during the survey will result in a localised, temporary reduction in air quality. Incineration of oily sludges is not expected to generate any significant atmospheric emissions, due to the infrequent nature of the activity and the small volumes of material being burnt during each disposal episode. The vessels shall comply with all MARPOL requirements associated with preventing air pollution and use of incinerators.

4.4.6. Introduction of Invasive Marine Species

Invasive Marine Species (IMS) are marine plants or animals that have been introduced into a region beyond their natural range and have the ability to survive, reproduce and establish founder populations. In the case of CGG's proposed activities, the key vectors requiring management attention include:

- biofouling on vessel hulls and other external niches (e.g. propulsion units, steering gear and thruster tunnels);
- biofouling of vessel internal niches (e.g. sea chests, strainers, seawater pipe work, anchor cable lockers and bilge spaces etc.);
- biofouling on equipment that routinely becomes immersed in water; and
- discharge of high risk ballast water taken up at international or domestic sources.

Once introduced IMS can cause serious environmental, social and economic impacts through predation or displacement of native species. These direct or indirect impacts have the potential to threaten a range of sectors including commercial fisheries and aquaculture, the tourism industry, human health, shipping and infrastructure

Ballast Water

The Department of Agriculture (DoA) has introduced the mandatory Australian Ballast Water Management Requirements (DoA, 2008) that are enforced under the *Quarantine Act 1908*. Under these arrangements all vessels that have travelled from international waters are obligated to assess and manage their ballast water in accordance with the AQIS requirements. These arrangements prohibit the discharge of high-risk ballast water within Australian territorial seas (within 12 nautical miles of Australian territories) including Australian ports. It is also recommended by AQIS that ballast exchanges be conducted as far as possible away from shore and in water at least 200 m deep.

Biofouling

Under the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia, 2009) a risk assessment approach is recommended to manage biofouling. Any vessels contracted for the Gravis MC 3D MSS will be required to meet the biosecurity standards of the DoF and the DoA.

Any vessel or marine infrastructure destined for WA waters is required to meet the aquatic biosecurity standards set out under the *Fisheries Resources Management Act 1994*, including a Marine Biosecurity Inspection for the presence of known and potential IMS to ensure compliance with Regulation 176. Vessels will be coated in an appropriate antifouling system that is considered suitable for both coastal and deep sea vessels and is compliant with the International Convention on the Control of Harmful Anti-Fouling Systems on Ships (IMO document AFS/CONF/26).

4.4.7. Sewage, Grey Water and Putrescible Wastes

Routine discharge of wastewater to the ocean will cause a negligible and localised increase in nutrient concentrations. The total nutrient loading from vessel operations during the Gravis MC3D MSS will be insignificant in comparison to the natural daily nutrient flux that occurs within the region. All discharges will be in accordance with the requirements of the MARPOL 73/78 Convention (as implemented in Commonwealth waters by the PSPPS Act).

4.4.8. Bilge Water

The survey and support vessel(s) may need to discharge bilge water during the survey. Bilge water can contain water, oil, dispersants, detergents, solvents, chemicals, particles and other liquids, solids or chemicals. This can cause a localised reduction in water quality if not treated prior to discharge. All discharges will be in accordance with the requirements of the MARPOL 73/78 Convention (as implemented in Commonwealth waters by the PSPPS Act).

4.4.9. Other Wastes

The vessels will also produce a variety of other solid and liquid wastes, including packaging and domestic wastes, such as aluminium cans, bottles, paper and cardboard. These materials could potentially impact the marine environment if accidentally released in significant quantities resulting in a reduction in water quality and physical impacts on marine fauna, for example marine fauna can become entangled in waste plastics. Garbage Management Plan shall be implemented and all discharges will be in accordance with the requirements of the MARPOL 73/78 Convention (as implemented in Commonwealth waters by the PSPPS Act).

4.4.10. Marine Pollution from Accidental Discharges

The survey and support vessel(s) will store and use fuel and a variety of hazardous materials such as lubricating oils and cleaning chemicals. During the survey, the survey vessel will be refuelled at sea using the support vessel either within or immediately adjacent to the polygon. At sea refuelling will only take place during daylight hours and will not take place within a distance of 25 km of any emergent land or shallow water features (20 m or less depth).

Hazardous Materials

These materials have the potential to adversely impact the marine environment if accidentally released in significant quantities. Chemicals e.g. solvents and detergents will typically be stored in small containers of 5-25 L capacity and stored / used in internal areas where any leak or spill would be retained on board and cleaned up in accordance with the Shipboard Oil Pollution Emergency Plan (SOPEP) and associated spill clean-up procedures. The realistic worst case volume would be 25 L.

Fuel and oil Spills

The hazards associated with fuel and oil spills during the Gravis MC3D MSS (that are considered most credible) are:

- on-deck leak or spill of small quantities (up to 50 litres) of hydraulic oil or lubricating oil;
- loss of up to 125 litres of diesel during refuelling operations, as a result of hose failure;
- larger volume (up to 410 m^3) loss of diesel from a ruptured fuel storage tank, resulting from vessel collision or grounding.

The accidental discharge of fuel and oil has the potential to cause toxic effects on marine fauna and flora and a localised reduction in water quality. Potentially affected biota includes seabirds, cetaceans turtles and whale

sharks that may come into contact with a surface hydrocarbon slicks. In the event a loss to sea does occur, impacts to the marine environment would be minimal, due to the small potential volumes released, and the fact that spilt hydrocarbons will rapidly evaporate, disperse and weather.

4.4.11. HYDROCARBON RELEASE CAUSED BY VESSEL COLLISION OR AT-SEA REFUELLING

The hazards associated with hydrocarbon spills during the Gravis MC 3D MSS (that are considered most credible) are:

- on-deck leak or spill of small quantities (up to 50 litres) of hydraulic oil or lubricating oil;
- loss of up to 125 litres of diesel during refuelling operations, as a result of hose failure;
- larger volume (up to 410 m^3) loss of diesel from a ruptured fuel storage tank, resulting from vessel collision or grounding.

The accidental discharge of diesel has the potential to cause toxic effects on marine fauna and flora and a localised reduction in water quality. Potentially affected biota includes seabirds, cetaceans, turtles and whale sharks that may come into contact with a surface hydrocarbon slicks. If surface slicks or entrained diesel were to contact shallow waters or emergent features adjacent to the survey polygon, then a range of benthic habitats and communities could be at risk of impacts. Commercial fishing activities and shipping in the area could also be impacted in the event of a major diesel spill.

The fuel that will be used by the *Geo Caspian* is Marine Gas Oil (MGO) (marine diesel). The largest diesel oil tanks have a maximum capacity of 268.5 m^3. However, the vessel to be used for the surveys has not yet been finalised and may be one of the other vessels in the fleet. Therefore, when commissioning the stochastic oil spill modelling for the Gravis MC3D MSS polygon CGG have used the largest fuel tank in the CGG fleet, from the MV *Oceanic Phoenix*, which has a maximum storage capacity of 410 m^3. Modelling was undertaken for all times of the year and results indicate the following:

- In the dry season, 100% of a slick may disperse and evaporate within about 16 hours of the spill, based on a wind speed of 8 m/sec, current speed of 0.3 m/sec and mean water temperature of 29ºC. On this basis a surface slick is calculated to travel a maximum distance of 31.1 km within 16 hrs. Therefore, the ZPI for a 410 m^3 occurring within the Gravis MC3D MSS polygon in the dry season is 31 km.

- In the wet season, 100% of a slick may disperse and evaporate within about 30 hours of the spill, based on a wind speed of 6 m/sec, current speed of 0.2 m/sec and mean water temperature of 31ºC. On this basis a surface slick is calculated to travel a maximum distance of 41.0 km within 30 hrs. Therefore, the ZPI for a 410 m^3 occurring within the Gravis MC3D MSS polygon in the wet season is 41 km.

As can be expected for a large release of diesel at a location ~17.5 km west (site 1) and ~17.5 km to the south (site 2) of Cartier Island, the results of the modelling indicate potential exposure to hydrocarbon concentrations above defined thresholds for the island. The main findings for the Dissolved 96 Hour Dose are summarised below.

- There is the potential for a low level of exposure to dispersed hydrocarbons within the Cartier Island Commonwealth Marine Reserve (CICMR)(site 1 and 2), and a low level of exposure on the eastern and southern boundaries of the Ashmore Reef Commonwealth Marine Reserve (ARCMR) due to a spill at Site 1.
- There is a 25-50% likelihood that a spill at Site 1 will result in a low exposure across the CICMR.
- There is a 1-5% likelihood that a spill at Site 2 will result in a low exposure across the CICMR.
- There is a 1-5% likelihood that a spill at Site 1 or Site 2 will result in a low exposure at the southern edge of the ARCMR

These ZPI have been used to establish exclusion zones around Cartier Island within which no close proximity procedures (bunkering, supply or equipment transfer) using the support vessel can occur in either the dry or wet seasons, to reduce the likelihood of floating, dispersed or dissolved hydrocarbons contacting any sensitivities and values, in the highly unlikely event of a large diesel spill occurring due to vessel collision.

Sensitivities and values at risk within and adjacent to the Gravis MC3D MSS polygon in the scenario of an accidental release of marine diesel resulting from a vessel collision with the survey vessel are: protected marine fauna such as seabirds, cetaceans, whale sharks, turtles, sea snakes; shorelines, benthic habitats, corals, coral spawn and commercial fisheries.

4.4.12. VESSEL COLLISIONS

The potential environmental impact as a result of a significant vessel collision could cause localised chronic/acute toxicity effects on marine organisms from a hydrocarbon spill (see previous section for full description of impacts). However, it is highly unlikely that such a collision would occur during the Gravis MC3D MSS, as the survey and support vessel(s) will be required to adhere to standard maritime safety and navigational procedures, such as use of lights, beacons, notification of vessel presence via NTM, radio contact and through use of the support vessel.

4.4.13. DISTURBANCE TO SOCIAL AND COMMUNITY VALUES

Commercial Fisheries

Disruption to fisheries in the area could result from:

- direct effects of underwater noise disturbance on target fish populations;
- indirect effects of underwater noise disturbance on fish prey species;
- restriction of access to fishing grounds due to vessel movements and operations;
- seismic equipment loss and subsequent interference with fishing gear (entanglement);
- loss of fishing gear e.g. buoyed fish traps, cray pots; and
- recreational take of finfish species from the survey vessel and support / guard vessel(s).

Fishing companies and individual licence holders operating in the NDSF, MMF, WCDSCF, WANCSF and POMF have been contacted on four occasions by CGG directly and via the appropriate peak fishing industry organisations, and informed of the location and timing of the survey.

In the period 28th May 2013 to 9th April 2015, six (6) responses were received from fisheries stakeholders - Department of Fisheries WA (DoF), Austral Fisheries, MG Kailis, Northern Wildcatch, PPA, and Recfishwest. At this point in time there are no outstanding issues with respect to potential impacts of the proposed survey on any commercial fisheries. CGG will continue to provide information and respond to any concerns raised by the DoF throughout the duration of the Gravis MC3D MSS.

The risk of potential impacts to commercial fisheries in or adjacent to the Gravis MC3D MSS polygon is considered to be minimal, due to the distance to the mainland coastline (~132 km) and given the small number of fishing vessels operating in the area:

- NDSF fishers don't usually operate in water depths greater than 100 m, and very rarely in water depths greater than 200 m.
- WCDSCF fishers operate in deep offshore waters between 500 and 800 m water depths.
- WANCSF has not reported any fishing activity in the northern shark fisheries since 2008/09.
- MMF fishers' majority of catch is taken from the Kimberley Area.
- POMF is a dive fishery operating in shallow coastal waters, there are no pearl culture activities occurring on Cartier Island, confirmed by the PPA.

Shipping

Shipping activity in the polygon and surrounding waters is low. The survey vessel and towed array represent a potential navigational hazard and other vessels will need to avoid the seismic vessel to prevent collisions, entanglement of streamers, and other incidents. Any vessels contracted by CGG are required to comply with

MARPOL requirements and other applicable maritime laws and will need to operate strictly in accordance with SOP for marine operations. Loss of equipment may interfere with shipping activity.

4.4.14. HERITAGE AND CONSERVATION VALUES

It is highly unlikely that the proposed Gravis MC3D MSS will impact on the heritage and conservation values of any protected areas or heritage listed places, given the location of the polygon in offshore waters of the mid-shelf. There are no protected areas or heritage places within or immediately adjacent to the polygon.

The closest heritage place is the Cartier Island Commonwealth Marine Reserve, located ~10 km north and west of the polygon. Sound propagation modelling for the 4,433 cui array indicates that received SEL at a range of 10 km horizontally out from the array would be <120 dB re 1 μPa^2.s. Therefore, received SEL within the reserve will be <120 dB re 1 μPa^2.s, which is well below the levels likely to result in avoidance and other significant behavioural responses in turtles. Received SEL of <120 dB re 1 μPa^2.s are also well below the levels (SEL >140 dB re 1 μPa^2.s) that have the potential to cause short-term, low level behavioural effects (e.g. avoidance) in pelagic fish species and the more nomadic demersal species of fish. SEL <120 dB re 1 μPa^2.s are ~60 dB lower than the levels that may cause high level behavioural effects in site-attached fishes (>180 dB re 1 μPa^2.s), and also well below the exposure guideline for the TTS in fishes (>186 dB re 1 μPa^2.s – Popper *et al*., 2014).

4.5. SUMMARY OF ENVIRONMENTAL RISK ASSESSMENT RESULTS

The risk assessment indicates that the potential impacts arising from the proposed Gravis MC3D MSS can be categorised as having Low to Medium risk levels. No risks were assessed as High. **Table 6.11** presents a summary of the assessed level of residual (post-mitigation) environmental risk associated with the proposed seismic survey. The environmental aspects of the survey that have the potential to cause significant environmental effects (Medium or High risk levels) 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.
- Vessel collisions resulting in fuel and oil spills.

Table 4.3 -Summary of Environment Risk Assessment for Gravis MC 3D MSS

Hazard	Environmental aspect	Potential environmental impacts	Risk		
			Consequence of impact	Likelihood	Residual risk level
Disturbance to marine fauna	Discharge of underwater seismic pulses	Behavioural and physiological effects on cetaceans, whale sharks, turtles and fish	Slight	Possible	**Low**
		Physiological effects on benthic invertebrates and plankton	Slight	Possible	**Low**
	Light generation from vessels	Behavioural effects on dolphins, turtles, fish and seabirds	Slight	Possible	**Low**
	Vessel and towed equipment interactions	Behavioural and physical effects on cetaceans, whale sharks and turtles	Minor	Possible	**Low**
Disturbance to benthic habitats	Deployment and retrieval of anchors	Localised physical damage to benthic habitats	Slight	Possible	**Low**
	Vessel grounding		Minor	Unlikely	**Low**
	Equipment damage, dragging or loss		Slight	Possible	**Low**
Atmospheric emissions	Operation of machinery and vessels powered by internal combustion engines	Localised reduction air quality Greenhouse gas emissions	Slight	Likely	**Low**
Invasive marine species	Discharge of ballast water from vessels	Introduction and establishment of IMS and displacement of native marine species	Minor	Possible	**Low**
	Biofouling of vessel hulls, other niches and submersible equipment		Minor	Possible	**Low**
Marine pollution from routine discharges	Discharge of sewage, grey water and putrescible wastes	Localised reduction in water quality due to nutrient enrichment	Slight	Routine	**Low**
	Discharge of bilge water	Acute toxicity effects on marine fauna and flora Localised reduction in water quality	Slight	Possible	**Low**
	Discharge of other wastes i.e. garbage	Localised reduction in water quality Physical impacts on marine fauna i.e. from plastics	Minor	Possible	**Low**
Marine pollution from accidental discharges	Hazardous materials	Toxic effects on marine fauna and flora Localised reduction in water quality Indirect effects on commercial fisheries	Moderate	Possible	**Medium**
	Fuel and oil spills		Moderate	Possible	**Medium**
	Vessel collisions		Moderate	Unlikely	**Medium**
Disturbance to social and community values	Interaction with commercial fisheries	Disruption to commercial fishing vessels Potential direct and indirect noise impacts on target species Restriction of access to fishing grounds, loss/damage to gear Recreational take of finfish species	Minor	Possible	**Low**
	Interaction with shipping	Disruption to shipping activities	Slight	Possible	**Low**
	Operation of vessels within protected areas and heritage places	Disturbance to heritage and conservation values	Slight	Possible	**Low**

5. SUMMARY OF THE CONTROL MEASURES

Table 5.1 - Summary of the Controls and Mitigation Measures

Environmental Aspect	Environment Performance Outcome	Primary Mitigation Measures
• Discharge of underwater seismic pulses. • Light generation from vessels. • Vessel and towed equipment interactions.	• Prevent adverse noise impacts on whales, whale sharks, turtles and fish and fisheries from underwater seismic pulses. • Prevent excessive light spill from survey and support vessel to surrounding sea surface.	• Adherence to EPBC Act Policy Statement 2.1, with application of 2 km low power zone and use of two MFO for entire duration of survey. • Adherence to specific Part B Additional Management Measures of the EPBC Act policy Statement 2.1): - Implemented for individual surveys undertaken within the pygmy blue whale BIA, during migration periods, from the 1 June to 31 July and 15 September to 15 November: o Increased pre-start visual observation of 45 mins and complete shutdown of the acoustic source if a blue whale is observed within 2 km of the seismic source. - Temporal and spatial limitations to acquisition during peak nesting periods for marine turtles: o Seismic operations must not occur within the BIA for the green turtle, during the peak nesting period, from 1October to 28 February (**Appendix E**). - Implementation of the precautionary 500 m shutdown zone for whale sharks 1 July to 30 November. • Survey personnel (marine and seismic) provided with pre-survey induction • the source shall not operate closer than ~500 m from the 50 m contour. • Use of the smallest possible airgun array size (total capacity of each sub-array 4,433 cui). • a minimum separation distance of 50 km between their survey vessel and the *Geo Caspian.* • Survey and support vessel(s) will not enter waters of the Ashmore Reef and Cartier Island Commonwealth Marine Reserves, except in an emergency. • External lighting of vessels is minimised to that required for safe navigation, vessel safety, safety of deck operations, except in the case of an emergency. • Surveys will be conducted in water depths of >50 to ~525 m and away from any shallow water BIA during peak nesting times that may be important for marine turtle nesting and foraging • Application of support vessel-marine fauna interaction procedures modified from the Australian National Guidelines for Whale and Dolphin Watching. • Application of applicable guidelines described in AMSA Marine Notice 12/2011 (Minimising the risk of ships colliding with cetaceans). • Use of streamer tail buoys fitted with appropriate turtle guards, if required. • Adherence to specific Part B Additional Management Procedures: - Implemented for individual surveys undertaken within the pygmy blue whale BIA, during migration periods, from the 1 June to 31 July and 15 September to 15 November:

Environmental Aspect	Environment Performance Outcome	Primary Mitigation Measures
		○ Increased pre-start visual observation of 45 mins and complete shutdown of the acoustic source if a blue whale is observed within 2 km of the seismic source. - Temporal and spatial limitations to acquisition during peak nesting periods for marine turtles: ○ Seismic operations must not occur within the BIA for the green turtle, during the peak nesting period, from 1 October to 28 February (**Appendix E**). - Implementation of the precautionary 500 m shutdown zone for whale sharks 1 July to 30 November.
• Deployment and retrieval of anchors. • Vessel grounding. • Equipment damage, dragging or loss.	• Prevent physical damage to benthic habitats from vessel anchoring. • Prevent physical damage to benthic habitats from vessel grounding. • Prevent physical damage to benthic habitats from equipment damage, dragging or loss	• Anchoring in polygon will not be undertaken unless in an emergency situation. All measures will be taken to avoid sensitive benthic habitats (corals, seagrasses, and macroalgal beds). • Survey and support vessel(s) equipped with approved electronic navigation systems and radar. • Use of approved navigation systems and depth sounders. • Adherence to standard maritime safety / navigation procedures • The support vessel will scout ahead confirming water depth prior to survey vessel passing. • In shallow waters, streamers will be towed at a depth that will not allow streamers to be closer than 10 m from the seabed. • Vessels with experienced operators and crew will be used to minimise the risk of equipment dragging or loss • In-water equipment lost will be recovered - if irretrievable, detailed records of the circumstances that prohibited the equipment from being recovered.
• Operation of machinery and vessels powered by internal combustion engines	• Reduce emissions of GHG, NOx, SOx, CO and particulate matter during the survey.	• Adherence to Marine Orders - Part 97 and MARPOL VI in particular: - Implementation of Planned Maintenance System (PMS) aboard survey vessel. - Use of low sulphur diesel fuel. • Vessel combustion equipment (including incinerator) compliant with MARPOL 73/78 Annex VI requirement. • Incinerator to be IMO approved. • Implementation of Ship Energy Efficiency Management Plan (SEEMP).
• Discharge of ballast water from survey and support vessel(s). • Biofouling of vessel hulls, other niches and submersible equipment (towed seismic equipment).	• Prevent introduction of IMS from ballast water discharge during the survey.	• Adherence to Marine Orders - Part 98. • No routine discharge of ballast water from survey and support vessel(s), without prior authorisation from DoA Biosecurity. • Adherence to Australian Ballast Water Management Requirements.
• vessel hulls, other niches and submersible equipment.	• Prevent introduction of IMS from biofouling of survey and	• Recent dry-dock, hull inspection/cleaning and AF coating application for survey and support vessel(s). • survey vessel must operate in accordance with the "Approval to Berth" issued by DoA, and submitted a Quarantine Pre-

Environmental Aspect	Environment Performance Outcome	Primary Mitigation Measures
	support	arrival Report (QPAR). • Compliance with WA *Fish Resources Management Act 1994*; and Fish Resources Management Regulations 1995): • AF coating meets IMO 2001 Convention requirements. • Application of guidelines detailed in the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry
• Discharge of sewage, grey water and putrescible wastes. • Discharge of bilge water. • Discharge of other wastes i.e. garbage.	• Sewage and putrescible wastes will be disposed of in accordance with legal (MARPOL) limits during the survey. • Bilge water will be discharged only within legal (MARPOL) limits during the survey. • Any bilge water contaminated with chemicals will be assessed for potential toxicity prior to discharge. • No other solid or liquid wastes will be discharged overboard during the survey.	• Adherence to Marine Orders - Part 96, 96. • All sewage and putrescible wastes handled and disposed of in accordance with MARPOL 73/78 Annex IV requirements • Survey and support vessel equipped with grinder/comminuter for maceration of sewage and putrescible wastes. • Survey and support vessel equipped with IMO approved / MARPOL compliant sewage treatment system (including biological reduction and disinfection prior to discharge). • Provision of appropriate segregation facilities on survey vessel including tanks for storage of grey and black water. • If vessels are unable to treat/store grey water (i.e. wastewater from sinks and showers) only biodegradable soaps and detergents will be used • Bilge water treated and disposed of in accordance with MARPOL Annex I requirements. • Garbage handled and disposed of in accordance with MARPOL 73/78 Annex V requirements. • Survey vessel Garbage Management Plan in place detailing wastes generated and disposal requirements • Provision of appropriate segregation facilities on survey and support vessel including integral waste oil tank for oils and sludge
• Hazardous materials • Fuel and oil spills • Vessel collisions	• Prevent accidental discharges of hazardous materials during the survey. • Prevent accidental discharges of fuel and oil during the survey. • Prevent loss of containment during at sea refuelling. • Prevent contact from large diesel spills to Cartier Island	• Adherence to Marine Orders - Part 94. Part 21, Part 30, Part 59, Part 91, and COLREGS. • All chemical and hazardous wastes will be segregated into clearly marked containers prior to onshore disposal. • Shipboard Oil Pollution Emergency Plan (SOPEP) implemented and tested (including notification of relevant agencies and operational monitoring tasks) for the survey vessel, and copies kept aboard. • All hazardous substances will have an MSDS in place that is readily available aboard the survey and support vessel(s). • No close proximity procedures between the survey and support vessel (bunkering, supply / equipment transfer, crew change) will take place within the Gravis MC3D MSS polygon within a distance of 31 km of Cartier Island at the Lowest Astronomical Tide (LAT) during the dry season (April to September). • No close proximity procedures between the survey and support vessel (bunkering, supply / equipment transfer, crew change) will take place within the Gravis MC3D MSS polygon within a distance of 41 km of Cartier Island at the Lowest Astronomical Tide (LAT) during the wet season (October to March).

Environmental Aspect	Environment Performance Outcome	Primary Mitigation Measures
	and Ashmore Reef. • Prevent contact from large diesel spills to protected marine species and sensitive benthic habitats on a seasonal basis.	• Issuing of appropriate NTM by the AHS, and AMSA RCC coastal warnings and NAVAREA X via Inmarsat SafetyNET. • AMSA notified (via phone call) prior to the commencement of all bunkering operations. • When a fuel/oil spill to sea occurs the vessel Master will inform the RCC Australia using POLREP. RCC Australia, in turn, notify AMSA • Type I Operational Monitoring implemented for spill surveillance and tracking. • Type II Scientific Monitoring implemented for spill scientific monitoring. • Hydrocarbons located above deck will be stored with some form of secondary containment to contain leaks or spills e.g. bund, containment pallet, transport packs etc.
	• Implementation of SOPEP / OPEP for all spills of hydrocarbons to sea during the survey.	
• Interaction with commercial fisheries. • Interaction with shipping. • Operation of vessels within protected and heritage areas.	• No incidents of interference and negative interactions with commercial fishing occur during the survey	• Adherence to Marine Orders - Part 21, Part 30, Part 59, and COLREGS. • Notification of activity details to relevant stakeholders three weeks prior to each survey commencing • NTM issued by AHS prior to individual survey commencement. • MSI (coastal warnings and NAVAREA X) via Inmarsat SafetyNET issued by AMSA RCC prior to survey commencement. • Use of a support vessel to manage vessel interactions. • Compliance with AMSA administered marine safety regulations and marine notification requirements. • Other mariners alerted of vessels presence and extent of towed array. • Establishment of a vessel exclusion zone (SNA) around the survey vessel (likely ~ 12. 1 km radius) • In-water equipment lost will be recovered - if irretrievable, detailed records of the circumstances that prohibited the equipment from being recovered. • Recreational fishing from survey and support vessels is prohibited. • At sea refuelling must not take place within or adjacent to the Osborne Passage. • Compliance with statutory safety exclusion zones around the Montara Venture FPSO • Other mariners alerted of vessels presence and extent of towed array. • All CGG and contractor personnel made aware of, and comply with, requirements of accepted EP.
	• No incidents of interference and negative interactions with shipping occur during the survey.	
	• No incidents of disturbance to heritage and conservation values occur during the survey.	

6. EMERGENCY RESPONSE ARRANGEMENTS

Survey-specific ER procedures for the Gravis MC3D MSS are included in the Project HSE Plan and contains instructions for vessel emergency, medical emergency, search and rescue, reportable incidents, incident notification and contact information. In the event of an emergency of any type the survey vessel Master will assume overall onsite command and act as the Emergency Response Coordinator (ERC). All persons aboard the vessel/s will be required to act under the ERC's directions. The survey vessel will maintain communications with the Vessel Director and Technical Operations Manager and/or other emergency services in the event of an emergency. Emergency response support can be provided by CGG if requested by the ERC.

The survey and support vessel(s) will have equipment aboard for responding to emergencies, including but not limited to medical equipment, firefighting equipment and oil spill equipment.

6.1. OIL POLLUTION EMERGENCY PLAN

The Oil Pollution Emergency Plan (OPEP) for seismic surveys undertaken within the Gravis MC3D MSS polygon, taking into account the nature and scale of the activity and the potential spill risks involved, comprises components of the survey vessel SOPEP that manage the environmental impacts of a spill, supported as required by applicable established, statutory OPEPs. As such, the following plans are in place as a contingency in the unlikely event of an oil spill, which as a whole, represent the OPEP for this activity:

- Survey vessel SOPEP - deals with spills which are either contained on the vessel or which can be dealt with from / by the vessel.
- National Plan for Maritime Emergencies (NATPLAN): Australian Maritime Safety Authority (AMSA) - is the Jurisdictional Authority (JA) and Control Agency (CA) for spills from vessel which affect Commonwealth waters, i.e. outside of 3 nm from the coast (AMSA, 2014).

6.2. VESSEL SOPEP

The survey vessel SOPEP, which has been prepared in accordance with the IMO guidelines for the development of shipboard oil pollution emergency plans (resolution MEPC.54(32) as amended by resolution MEPC.86(44)), includes emergency response arrangements and provisions for testing the OPEP (oil pollution emergency drills), as required under Regulations 14(8), 14(8AA), 14(8A) to 14(8E) of the Environment Regulations.

6.2.1. DRILLS AND TRAINING

A drill test of the oil spill emergency response arrangements will be conducted during the mobilisation phase prior to commencement of operations within the Gravis MC3D MSS polygon and then at three (3) monthly intervals (which is a standard operating procedure [SOP] for CGG vessels) during the course of a survey.

All drill tests will be reported as per MARPOL Annex I (Regulation 15) requirements and reviewed after each drill as part of the ongoing monitoring and improvement of emergency control measures. Identified improvements or recommendations shall be addressed via revisions of the SOPEP. The objective of testing is to ensure that the vessel SOPEP is current and applicable (including contact details) for dealing with a spill specific to the nature and location associated with an individual survey conducted within the Gravis MC3D MSS polygon. Testing will include CGG's arrangements for notifying relevant agencies (e.g. AMSA) and operational monitoring tasks. If response arrangements are significantly amended, testing of the updated response arrangements shall occur.

As described above, the SOPEP is subject to four (4) scheduled drills per annum; therefore, at least one drill will be conducted during the course of a survey. In compliance with Regulations 14(4) and 14(5) a designated Oil

Protection Team (OPT) will be trained to ensure they are familiar with their tasks and the equipment in the event of an oil spill.

6.2.2. INITIAL ACTIONS

The survey vessel Master will initiate the vessel SOPEP and first strike actions as outlined within it.

Due to the nature and scale of the activity, credible spill scenarios and characteristics of diesel, and the location of the Gravis MC3D MSS polygon, the initial response to any spill will be to monitor and evaluate. The preferred strategy for diesel spills will be to allow small spills to disperse and evaporate naturally, and monitor the position and trajectory of any surface slicks. Physical break up (using prop wash from the support vessel) by repeated transits through the slick may be considered for larger slicks (following consultation with the Combat Agency – AMSA).

Priority actions in the event of a fuel or oil spill are to make the area safe and to stop the leak and ensure that further spillage is not possible. All deck spills aboard vessel will be cleaned-up immediately, using appropriate equipment from the on board spill response kits (e.g., absorbent materials etc.) to minimise any likelihood of discharge of spilt hydrocarbons or chemicals to the sea. A planned maintenance system (PMS) will be implemented on the survey vessel, to ensure that all equipment used during operations is in full working order, and does not represent a hydrocarbon spill risk.

For Commonwealth waters, initial actions will be undertaken by the survey vessel(s) with subsequent actions determined in consultation with the regulatory authorities (AMSA) under NATPLAN, having regard to the potential impacts posed by the spill.

6.2.3. TYPE 1 OPERATIONAL MONITORING

In the event of an accidental event that resulted in a diesel spill to the waters surrounding the survey or support vessel(s), CGG would be responsible for undertaking Type I “Operational Monitoring” that would have the primary objective of spill surveillance and tracking, as well as providing information on possible environmental impacts. This monitoring will be implemented to:

- determine the extent and character of a spill;
- track the movement and trajectory of surface diesel slicks;
- identify areas/ resources potentially affected by surface slicks; and
- determine sea conditions/ other constraints.

This monitoring will enable the Vessel Master to provide the necessary information to the relevant Combat Agency (AMSA), via a POLREP form, to determine and plan appropriate response actions under NATPLAN (if this plan is actually activated). Operational monitoring and observation in the event of a spill will inform an adaptive spill response and scientific monitoring of relevant key sensitive receptors.

This Type I monitoring will be restricted to daylight hours only, when surface slicks will be visible from the vessel(s), (or via aerial surveillance if available). The information gathered from this monitoring will be passed on to AMSA, via the POLREP form, but also via ongoing SITREP reports following the initial spill notification to RCC Australia. Dolphin believe that the arrangements in place are ALARP and acceptable.

6.2.4. TYPE II SCIENTIFIC MONITORING

The stochastic modelling output indicates Low levels of exposure from a large MGO spill at Site 1 and Site 2 contacting inshore waters and shorelines of Cartier Island and Ashmore Reef during the wet and dry seasons.

Given this level of risk, if a large diesel spill occurs from the survey or support vessel within the Gravis MC3D MSS polygon and this incident results in surface slicks entering the waters of the CICMR, CGG will work with the

relevant stakeholders to develop and implement appropriate Type II "Scientific Monitoring" to understand the effects of the spill and any response activities on the marine environment. This scientific monitoring will have a focus on relevant environmental and social values and sensitive receptors.

For development of a Type II scientific monitoring plan that would be applied in the event of a large diesel spill from an individual survey within the Gravis MC3D MSS polygon, the relevant stakeholders would be (but not necessarily be limited to):

- the Combat Agency (AMSA);
- the Department of the Environment (DoE);
- the Australian Fisheries Management Authority (AFMA);
- the WA Department of Fisheries (DoF);
- appropriate marine research and monitoring organisations, such as:
  - the WA Marine Science Institution (WAMSI);
  - the Australian Institute of Marine Science (AIMS); and
  - environmental consultancy companies with appropriate expertise and experience in hydrocarbon spill monitoring
- marine contractors able to provide appropriate vessels for inshore/shallow water work at Cartier Island; and
- key marine users of the CICMR, such as the Department of Defence.

This scientific monitoring in the CICMR will focus on the following key environmental and social values and sensitive receptors, as described in the current Management Plan for the ARCMR and CICMR (DEH, 2002)

CGG has insurance policies in place that would cover the costs of any Type I operational monitoring and Type II scientific monitoring required in the event of a large hydrocarbon spill resulting from its' activities, or required to cover the costs of any clean-up or remediation activities following a spill. These policies cover activities in Australian Commonwealth waters, including individual surveys within the Gravis MC3D MSS polygon.

Any fuel or oil spills aboard either the survey or support vessel(s) must be reported to CGG via the CGG Event Reporting Management (GRP HSE GEI 17E). In the event of spillage of any oil or diesel spills to the sea, AMSA will be notified immediately (via RCC Australia using a POLREP form) to ensure prompt and appropriate mobilisation of relevant response plans. Any significant spills (greater than 80 L) will be reported to NOPSEMA as reportable incidents

7. SUMMARY OF THE ARRANGEMENTS FOR ONGOING MONITORING OF THE TITLEHOLDERS PERFORMANCE

Environmental performance of the Gravis MC3D MSS is reviewed in a number of ways. These reviews are undertaken to:

- ensure all significant environmental aspects of the activity are covered in the EP;
- ensure that environmental management measures to achieve EPO and EPS are being implemented, reviewed and where necessary amended;
- identify potential non-conformances and opportunities for continuous improvement;
- ensure that all EPO and EPS have been met before completing the activity: and
- ensure that all environmental commitments contained in the Environmental Commitments Register (ECR) have been fulfilled.

The following arrangements will be established to review environmental performance of the activity:

- An inspection(s) of the vessels will be carried out before or during each survey to ensure that procedures and equipment for managing routine discharges and emissions are in place to enable compliance with the EP.
- A summary of the key information, commitments, EPO, EPS and MC for the activity (ECR) will be distributed aboard the survey vessel, and implementation of the EPO and commitments will be monitored on a regular basis by the Client Site Representative via mechanisms such as audits and inspections during the activity.
- A test of the oil spill emergency response arrangements will be conducted during the mobilisation phase of each survey to ensure the survey vessel SOPEP is current and applicable.
- An inspection(s) of the vessels will be carried out before or during each survey to ensure that procedures and equipment for managing routine discharges and emissions are in place to ensure compliance with the EP.

These audits/inspections, combined with MC shall ensure that EPO and EPS are met and that lessons learned can be incorporated to ensure risks are being continuously managed to ALARP during the activity.

The collection of data from audits, inspections and response tests will form the basis of demonstration that the EPO and EPS are being met, that specified mitigation measures are in place to manage environmental risks, and that they remain working, and contribute to continually reducing risks and impacts to ALARP.

CGG will review environmental performance upon completion of each survey. The results of the review and any identified improvements or recommendations will be incorporated into processes and procedures for future surveys to help facilitate continuous improvement

8. DETAILS OF CONSULTATION ALREADY UNDERTAKEN, AND PLANS FOR ONGOING CONSULTATION

Consultation with stakeholder groups, primarily within the commercial fishing industry, concerning the proposed Gravis MC3D MSS has taken place prior to, and during the preparation of this EP. The stakeholder consultation will be undertaken in phases as described below:

- Phase 1: Preparatory Consultation:
  - Stakeholders notified of the proposed Gravis MC3D MSS.
- Phase 2: Ongoing Consultation:
  - Includes complying with requests from stakeholders for survey updates, etc.
- Phase 3: Post-survey Notifications:
  - Includes complying with requests from stakeholders for notification of the completion of individual surveys.

8.1. PHASE 1 – PREPARATORY CONSULTATION

The following fisheries bodies and organisations were originally informed of the survey, via letters or emails sent on 28/5/2013 as part of Phase 1: Preparatory Consultation.

- A Raptis and Sons;
- Austral Fisheries;
- Australian Southern Bluefin Tuna Industry Association (ASBTIA);
- Commonwealth Fisheries Association (CFA);
- Kimberley Professional Fishermen's Association (KPFA);
- MG Kailis;
- Northern Fishing Companies Association (NFCA);
- Northern Wildcatch Seafood Australia (NWSA);
- Pearl Producers Association (PPA);
- Recfishwest;
- WA Fishing Industry Council (WAFIC);
- WA Seafood Exporters; and
- WestMore Seafoods.

CGG obtained extracts from the Public Register held by the WA Department of Fisheries (DoF) for the three WA State-managed fisheries that can operate in the waters overlapped by the proposed Gravis MC3D MSS polygon (see **Sections 4.4.1** and **6.7.1**). These extracts showed that the following number of individuals or entities currently hold licences (one or more) that enable them to operate in the NDSF, MMF and WCDSCF:

- NDSF - 15;
- MMF - 34; and
- WCDSCF - 7.

The following Commonwealth and WA State government departments and agencies were informed of the proposed activities:

- Australian Fisheries Management Authority (AFMA);
- Australian Hydrographic Service (AHS);
- Australian Maritime Safety Authority (AMSA);

- Border Protection Command (BPC);
- Coastwatch;
- Department of Sustainability, Environment, Water, Population and Communities (now DoE);
- WA Department of Fisheries, (DoF - Perth, Hillarys and Broome offices); and
- WA Department of Mines and Petroleum (DMP - Environment).

Also included in the consultation process was the International Fund for Animal Welfare (IFAW). IFAW have requested to be included as a stakeholder for all future CGG projects.

Due to changes in the Gravis MC3D MSS polygon, timing and duration, a second round of stakeholder consultation was undertaken on 6th November 2013, third round of consultation on the 12th of May 2014, a fourth round of consultation on the 30th October 2014, and a fifth round of consultation on 14-15th May 2015.

Note that it is not possible to obtain a list of licence holders in the Pearl Oyster Managed Fishery (POMF) from DoF as this fishery is administered under the WA *Pearling Act 1990*, rather than under the WA *Fish Resources Management Act 1994*. DoF advised that the best way to contact individual licence holders in the POMF was via the peak industry body for this fishery - the Pearl Producers Association (PPA).

8.1.1. PHASE 1 – FIRST ROUND OF STAKEHOLDER CONSULTATION

Six responses were received from the first round of stakeholder consultation: Australian Customs and Border Protection; AMSA (Nautical Advice); Department of Defence (AHS); Department of Environment (Offshore Petroleum Section); PPA; and Recfishwest. Both the PPA and Recfishwest indicated that they had no issues with the proposed seismic survey. No responses/submissions were received from organisations representing fishers in the NDSF, MMF and WANCSF, or from individual licence holders in these fisheries.

1. *Australian Customs and Border Protection Service*
   Australian Customs (via email 30/05/2013) acknowledged receipt of the stakeholder notification, and indicated that it had been forwarded to the appropriate Customs work area for action.

2. *AMSA (Nautical Advice)*
   AMSA (via email 20/06/2013) acknowledged receipt of the stakeholder notification and noted that for all offshore exploration related activities, correspondence should be sent through to the generic Nautical Advice email: NauticalAdvice@amsa.gov.au to ensure that information gets to the nautical and regulation section of AMSA. AMSA advised that local vessel traffic will be encountered within the proposed Gravis polygon. *CGG will comply with this request.*

3. *Department of Defence (AHS)*
   DoD (via email 20/06/2013) acknowledged receipt of the stakeholder notification and requested that the AHS be notified 2-3 weeks prior to the survey commencing so a Notice to Mariners (NTM) can be issued for relevant nautical products. *CGG will comply with this request*.

4. *Department of the Environment (Offshore Petroleum Section)*
   DoE (via email 01/07/2013) acknowledged receipt of the stakeholder notification and informed CGG of its obligations under the EPBC Act - that is, to refer actions it considers likely to have a significant impact on a matter of NES. CGG responded (via letter 16/07/2013) outlining the reason for not referring the proposed Gravis MC3D MSS to DoE.

   DoE (via email 31/07/2013) acknowledged receipt of CGG email and noted that without an assessment via the referral process DoE is not in a position to comment on whether the proposed Gravis MC3D MSS will have or is likely to have a significant impact on a matter(s) of NES.

5. *Pearl Producers Association (PPA)*

The PPA (via email 28/05/2013) acknowledged receipt of the stakeholder notification and indicated that they have no issues with the Gravis MC3D MSS polygon. *No further action required.*

6. *Recfishwest*
   Recfishwest (via email 29/05/2013) confirmed that, given the distance from the polygon to shore, they do not anticipate any issues of conflict with recreational fishers. *No further action required.*

8.1.2. PHASE 1 – SECOND ROUND OF STAKEHOLDER CONSULTATION

The second round of stakeholder consultation occurred on the 6th November 2013. To date, (3rd December 2013) responses have been received from seven stakeholders: AMSA (Nautical Advice); Austral Fisheries; Border Protection Command; MG Kailis; and Pearl Producers Association (PPA).

7. *AMSA (Nautical Advice)*
   AMSA (Nautical Advice) (via email 15/11/2013) acknowledged receipt of the stakeholder notification. AMSA noted the significant expansion of the initial Gravis MC3D MSS polygon and provided a vessel track plot indicating that commercial shipping traffic would appear to be relatively contained (AHV/support craft notwithstanding), yet extra caution must be taken as the polygon overlaps the Osborne Passage. The stated guard vessel (support vessel) must be used effectively to alert shipping to the 8,500 m streamer array positions.

   AMSA also indicated that bunkering offshore must not be conducted near any area or lane commonly used for shipping, and to refer to AMSA Marine Order 8/2012 for further related information and reporting requirements. AMSA also advised that CGG needs to ensure that both AMSA RCC and the AHS are advised before operations commence, for both Auscoast warning and NTM promulgation, respectively. *CGG will comply with this request*.

8. *Austral Fisheries*
   Austral Fisheries (via email 13/11/2013) acknowledged receipt of the stakeholder notification and indicated that they were grateful for the very thorough explanation of the intended survey. Austral Fisheries noted that the area to be surveyed wasn't part their regular fishing grounds, therefore from the Northern Prawn Fisheries perspective there are no conflicting access issues. *No further action required.*

9. *Department of Defence (BPC)*
   BPC (via email 11/11/2013) acknowledged receipt of the stakeholder notification and thanked CGG for the opportunity to provide comment. The BPC noted that they have no comments, but appreciated being kept informed of any further developments. CGG will comply with this request. *CGG will comply with this request.*

10. *DoE-Offshore Petroleum*
    DoE (via email 29/11/2013) acknowledge receipt of the stakeholder notification. Noted as per their responses on 1 July and 31 July 2013 CGG has an obligation under the *Environment Protection and Biodiversity Act 1999* (EPBC Act) to refer actions it considers likely to have a significant impact on a matter of National Environmental Significance (EPBC Act). Further noted that non-referred projects may be forwarded to the department's Compliance and Enforcement Branch for further follow up if required.

11. *Department of Fisheries (DoF)*
    DoF (via email and letter 19/11/2013)) acknowledged receipt of the stakeholder notification and noted the increase in size (from ~445 km^2 to ~12,150 km^2) and that there was no commencement date. The DoF advised that a number of commercial fishing interests exist in, or in close proximity to, the areas associated with the proposed activity and include the Beche de mer Fishery, Mackerel Managed Fishery, Pearl Oyster Fishery and the Northern Demersal Scalefish Managed Fishery. Also noted that customary, recreational and charter fishing may also occur within the proposed area of activities. The DoF acknowledged that the organisations and licensees associated with these activities have been informed of

proposed operations and advised that ongoing consultation with the Western Australian Fishing Industry Council (WAFIC), Recfishwest and directly with fishers should be undertaken.

The DoF noted that seismic surveys have the potential to affect fish populations and the operations of fishers. A list of key fish species and their spawning/aggregation times was provided and the DoF requested that spawning grounds and nursery areas are considered in the development of the EP and strategies to mitigate possible impacts of survey activities are developed.

The DoF noted the potential for the introduction of Invasive Marine Species and provided advice and contact information for reporting.

Given the substantial increase in survey size, duration and the lack of a definite commencement date the DoF requested further information closer to the actual time of commencement to enable the DoF to consider significant and relevant changes in fisheries management. CGG will be contacting DoF with the information requested once the survey dates have been confirmed.

12. *MG Kailis*
    MG Kailis (via email 07/11/13) acknowledged receipt of the stakeholder notification and noted the Gravis MC3D MSS will not impact on their fishing operations. *No further action required.*

13. *Pearl Producers Association*
    PPA (via email 19/11/2013) acknowledged receipt of the stakeholder notification and noted the Gravis MC3D MSS has no immediate impact on the pearling industry given the proposed location. PPA raised concerns about imported marine pests on survey vessels and pollution mitigation and management issues around subsequent drilling activities. CGG responded to PPA concerns via the third round stakeholder consultation.

8.1.3. PHASE 1 - THIRD ROUND OF STAKEHOLDER CONSULTATION

The third round of stakeholder consultation occurred on the 12th May 2014. To date (29/5/2014) responses have been received from three stakeholders: Recfishwest, Department of Defence and Royal Australian Air Force (RAAF).

14. *Recfishwest*
    Ellen Smith (via email 13/5/2014) thanked CGG for the update and informed CGG that Matt Gillett (matt@recfishwest.org.au) is now dealing with all oil and gas operations, and for all future correspondence to be directed to him. CGG responded to this email on the 27/5/2014, informing Recfishwest that they will comply with this request and will direct all future correspondence regarding marine seismic surveys to Matt Gillett at the email address provided. *CGG will comply with this request.*
15. *RAAF Headquarters Air Command*
    Debbie Fisher (via email 13/5/2014) advised CGG that the stakeholder update letter was received via email at AIS-AF and had been forwarded for action/response as required. *CGG is not required to respond to this communication.*

16. *DoD - Directorate of Property Acquisition, Mining and Native Title*
    Chris Crowley (via email 14/5/2014) advised CGG that the Department of Defence had reviewed the stakeholder update letter and has no objection to the project. *CGG is not required to respond to this communication.*

17. *Customs*
    Customs (via email 16/5/2014) advised CGG that they have forwarded the stakeholder update letter to the relevant work group and in the future to direct enquiries to BPCGOVCOMSUP@customs.gov.au. CGG responded to this email on the 27/5/2014, informing Customs that they will comply with this request and

will direct all future correspondence regarding marine seismic surveys to the email address provided. *CGG will comply with this request.*

18. *Department of Fisheries*

Scope (via email 30/5/2014) confirmed with the DoF that CGG intend to acquire the survey in the next 12 months and that the EP being submitted to NOPSEMA for review and acceptance will have a validity period of multiple years. CGG informed the DoF that they cannot confirm when they will acquire the data within this 12 month window as it is dependent on vessel availability. CGG also stated that if they are not able to acquire the survey within the 12 month timeframe given, they will re-consult with the WA Department of Fisheries and address any concerns raised by DoF at the time. CGG advised DoF that before acquisition begins, CGG will be advising all stakeholders with a pre-start notification letter within the timeframe requested. CGG informed DoF to contact them if they request further information and that they look forward to the response from DoF.

CGG will continue to liaise with the DoF in the ongoing stakeholder consultation process for the duration of the Gravis MC3D MSS survey.

DoF (via letter 25/6/2014) DoF informed CGG that fish and fishers are regularly impacted by environmental, social and commercial drivers, and this can result in significant changes to the fishing industry over relatively short timescales. For this reason they are reluctant to provide advice on petroleum activities that are due to commence more than six months in the future. DoF believes that this will allow sufficient time for proponents to resolve any objections or claims raised prior to EP submission and in line with this policy DoF cannot provide advice for 'multiple year' proposal. DoF provided general and bioregional scale advice for the permit areas identified, DoF advised CGG that the advice does not replace the Departments request for consultation on individual activities closer to their commencement date.

DoF advice is follows:

Consultation

DoF refers to the "Guidance Statement on Undertaking Seismic Surveys in Western Australian Waters available from www.fish.wa.gov.au. The DoF advised CGG to consult with the Western Australian Fishing Industry Council (WAFIC), Recfishwest and individual licenced fishers regarding the proposal, including methods and incorporate comments from this consultation in the EP submission. DoF has requested in the event of the regulator (NOPSEMA) approving a multi-year EP, they advise CGG to inform stakeholders of the project activities a minimum of one month prior to the survey commencing. The DoF advises CGG provide stakeholders with specific start and finish dates, spatial extent of the proposed activity and information on identified specific fishing interests including previous consultation with individual licenced fishers. DoF also requests that in the event that there are any objections or claims raised during the consultation process, CGG is to address the matters to the satisfaction of the regulator prior to the commencement of the activity, and that the DoF requests that in the event of unresolved issues, the Department reserves the right to seek further engagement.

CGG is committed to maintaining a good rapport with stakeholder and will adhere to the DoF request to keep stakeholders informed of the activities, with a minimum of 4 weeks prior to the start of an individual survey. CGG is willing to provide stakeholders with information on specific start dates and the spatial extent of the proposed activity. However, due to issues with maintaining individuals' privacy, CGG will not disclose previous individual stakeholder communications to other stakeholders. CGG will however provide a summary of the merits of any previous stakeholder objections or claims, without identifying individual person's identity, this is in accordance with Regulation 16(b).

Fishing activities in the area

DoF have identifies the following fisheries in the bioregions associated with the proposed Multiclient activity.

Bioregion & Province	Commercial Fishing Interests
North Coast Timor & North West Shelf	Pearl Oyster Managed Fishery; Beche de Mer Fishery; Broome Prawn Managed Fishery; Kimberley Prawn Fishery; Marine Aquarium Managed Fishery; Mackerel Managed Fishery; North Coast Shark Fishery; Specimen Shell Managed Fishery; Northern Demersal Scalefish Managed Fishery

Fish Spawning

DoF requests that CGG specifically includes strategies in the EP to minimise the impacts of survey activities on fish spawning, such as soft starts, and sound exposure time minimisation. Alternatively, DoF suggest that it is preferable if seismic activities do not occur during the times of year that the following key fish species **may be** spawning within your proposed area of activities:

Bioregion	Key Fish Species within zone	Spawning / Aggregation times
North Coast	Blacktip shark *(Carcharhinus tilstoni & C. limbatus)*	Nov - Dec
	Goldband snapper *(Pristipomoides multidens)*	Jan - April
	Rankin Cod (*Epinephelus multiinotatus*)	Aug - Oct
	Red Emperor *(Lutjanus sebae)*	Jan, Mar
	Pink Snapper (*Pagrus auratus*) (rare)	May – Jul
	Sandbar shark *(Carcharhinus plumbeus)*	Oct - Jan
	Spanish mackerel *(Scomberomorus commerson)*	Aug - Nov

CGG implements the soft start procedure for all seismic surveys and will minimise unnecessary use of the acoustic source. The times of year that the DoF identify that fish species **may be** spawning, overlap a 12 month period, if CGG was to avoid these times the survey would not be able to proceed at any time of year and geophysical objectives would not be met.

Biosecurity

The DoF also noted there is a biosecurity risk associated with this activity. The DoF requires all vessel managers and operators of submersible equipment to minimise the risk of translocating pests and diseases into or within WA Waters in accordance with the *Fish Resources Management Regulations 1991* (reg. 176(1)). They also noted that vessels must be 'clean' before each voyage.

It is DoF policy that the suspected or confirmed presence of any organism which is listed on the Western Australian Prevention List for Introduced Marine Pests (http://www.fish.wa.gov.au/Documents/biosecurity/epa_introduced_marine_pests.pdf), and any other organisms that appears to have clear negative impacts or invasive characteristics, must be reported with 24 hours to the Department by email (biosecurity@fish.wa.gov.au) or telephone (FishWatch tel: 1800 815 507).CGG will comply with these requests.

19. *Pearl Producers Association*

CGG (via email 3/6/2014) addressed the concerns raised by the PPA in correspondence received on the 19/11/2013. Firstly CGG acknowledged that the PPA advised CGG that the proposed survey has no immediate impact on their industry, given the proposed location. CGG informed the PPA that no rigs will be used on the Gravis project and that they will adhere to the Department of Fisheries (DoF) *Fish Resources Management Regulations 1995* (reg. 176(1)), all vessel hulls, sea chests and niche areas will be 'clean' before each voyage and any suspected or confirmed presence of any marine pest or disease will be reported within 24 hours to the DoF.

PPA (via email 3/6/2014) confirmed they received the correspondence from CGG.

CGG will continue to include the PPA in the ongoing stakeholder consultation process for the duration of the Gravis MC3D MSS survey.

8.1.4. PHASE 1 - FOURTH ROUND OF STAKEHOLDER CONSULTATION

The fourth round of stakeholder consultation occurred on the 29th October 2014. To date (15/12/2014) responses have been received from six stakeholders (DoE, Northern Wildcatch, RAAF, AMSA, IFAW and DoF):

20. *Department of the Environment*

    DoE (via email 29/10/2014) - thanked CGG for the email and informed CGG that the offshore petroleum and greenhouse gas activities in Commonwealth waters must now be assessed and accepted by the NOPSEMA under the OPGGS(E) Regulations to have EPBC Act coverage. DoE also provided a link to an online information paper outlining considerations for titleholders in the preparation of submissions for activities that may impact matters protected under the EPBC Act (http://www.nopsema.gov.au/assets/Information-papers/N-04750-IP1382-Streamlining-environmental-regulation-of-petroleum-activities-in-Commonwealth-waters.pdf).

    DoE informed CGG that coordinated advice for titleholders is available about where other Commonwealth agencies may be relevant for consultation purposes under the OPGGS(E) Regulations and the ongoing role of relevant Commonwealth agencies, in the Commonwealth marine area, beyond the scope of the NOPSEMA environmental management authorisation process. This advice can be accessed here: http://www.environment.gov.au/system/files/pages/06872cd4-b755-4ecf-a4e7-dd16145e1384/files/offshore-australian-government-guidance-roles-relevance_0.pdf.

    This response does not require a reply, CGG will be submitting the Gravis MC3D MSS EP to NOPSEMA for acceptance as per the OPGGS(E) Regulations.

21. *Northern Wildcatch - Grant Barker*

    Mr Barker (via email 29/10/2014) informed CGG that their company NWSA operates three trap fishing vessels in the polygon. Mr Barker informed CGG that the Gravis MC3D MS survey will impact on their business. Mr Barker informed CGG that they "*will not move vessels or gear attached to traps on the ocean floor".* Mr Barker also stated that he has been fishing the area for a long time and he feels that CGG are making it increasingly difficult for them to carry out their fishing operations and that they feel the size and nature of the surveys are out of control.

    CGG (via phone call 29/10/2014) phoned Mr Barker and explained to him that CGG will probably not be shooting (acquiring data) for the whole area, and that we will work with them to avoid any on water incidents.

    CGG will continue to liaise with Northern Wildcatch throughout the Gravis MC3D MSS survey.

22. *RAAF*

    Ms Fisher (via email 29/10/2014) informed CGG that the Gravis stakeholder letter had been received and forwarded for action/response to the appropriate areas. *No further action required.*

23. *AMSA*

    Alec Millett (via email 29/10/2014) acknowledge receipt of the Gravis stakeholder letter, noting the expansion of the initial polygon. AMSA provided CGG with a chartlet, showing historical vessel track data in and around the Gravis MC3D MSS polygon. AMSA requested CGG to take note of the commercial shipping traffic in the area, AMSA informed CGG that such traffic appears to be relatively contained (AHV/support craft notwithstanding). AMSA requested vessel operators to be extra cautious within the

area of the survey that overlaps the Osborne Passage and the charted Preferred Route and to ensure that the survey and support vessels are in receipt of this chartlet.

AMSA requested that both the support vessel and survey vessel to be active and maintain exceptional communications with all commercial shipping, should any be encountered, within or around the polygon noting there will be a considerable speed difference between commercial shipping and the survey vessel whilst the latter is conducting operations. AMSA also informed CGG that any related avoiding action by commercial shipping, should it be necessary, should not increase and/or compound the navigational risk to other shipping in the vicinity.

AMSA reiterated that seismic vessel must display appropriate day shapes, lights and streamers, reflective tail buoys, to indicate the vessel is towing and is therefore restricted in her ability to manoeuvre, and in addition visual and radar watches must be maintained on the bridge at all times.

AMSA advised CGG to ensure that AMSA's RCC is contacted through rccaus@amsa.gov.au for Auscoast warning broadcasts before operations commence. AMSA's RCC will require the vessels details and area of operation and need to be advised when the survey starts and ends. AMSA also advised CGG to include the AHS in all stakeholder correspondence via hydro.ntm@defence.gov.au. AHS will need to be informed well in advance (i.e. no less than 2 working weeks) for the promulgation of related NTM. AMSA requested CGG to be in touch with the Authority at the conclusion of the survey to comment on the operations and the interaction with commercial shipping at the time of the survey (i.e. any lessons learned).

CGG (via email 3/11/2014) – thanked AMSA and stated that they will comply with the requests from AMSA, and once the start date is confirmed CGG will notify AMSA with the timing of the survey.

CGG will adhere to all request from AMSA, and to inform AHS of the survey start date, no less than 2 weeks prior to the start of the survey. CGG will continue to liaise with AMSA throughout the Gravis MC3D MSS survey.

24. *IFAW*

IFAW (via email 2/12/2014) informed CGG that they welcome the opportunity to provide feedback on the proposed Gravis MC3D MSS. IFAW explains that the letter received provides such a limited amount of information about actual survey plans that it is virtually impossible for them to give any meaningful feedback. IFAW highlights that the letter provides neither specific detail about the actual area intended to be surveyed nor a timeframe. IFAW informed CGG that they are an organisation interested in the protection of marine life, they find it impossible to make an informed assessment of the possible consequences of the activity on our functions, interests or activities or to raise any issues or concerns we may have without more specific information.

IFAW has requested the following information from CGG:

- What consideration has CGG have given for cumulative impacts in the planning of the Gravis seismic survey?
- What information is CGG using to determine which other cetacean species may be present in the survey area?
- What data gaps have been identified in cetacean knowledge in the area?
- What steps CGG intends to take to address those gaps in knowledge?
- What steps CGG intends to take to ensure the best possible chance of detecting cetacean species when conducting seismic surveys in the area?
- What measures CGG intends to take to minimise the risk of impacts on these species?
- What calculations or methods CGG uses to estimate the level of risk reduction these measures provide?

CGG (via email 5/12/2014) informed IFAW that they fully understand their response and the difficulty in making an informed assessment of the possible consequences of the activity. CGG informed IFAW that they are required to send out such a letter prior to submission of an environment plan, and that CGG has found it necessary to develop a larger survey area approach due to the way in which EP's are assessed. CGG informed IFAW that the EP contains a commitment to consult further with stakeholders once a survey area is defined, and a vessel scheduled to perform the survey, so they will be provided with the information requested in the future and that a summary of the EP (once approved by NOPSEMA) will also be available on NOPSEMA's website at:

http://www.nopsema.gov.au/environmental-management/ep-submissions-and-summaries/

CGG provided IFAW with the following information:

CGG acknowledges that there is the possibility of a "cumulative deterioration in acoustic habitat for migratory species" due to concurrent or sequential surveys in the same area. However, deterioration in acoustic habitat could occur as a result of a number of other anthropogenic sources of underwater noise, of which shipping is probably the greatest contributing factor.

Whilst concurrent or sequential surveys in the same area may result in some impacts for migratory species, it is highly likely that these impacts will be comprised of short-term behavioural responses only. These responses will not cause population-level effects, unless the cumulative noise exposure occurs in an area that represents critical habitat (e.g. feeding, breeding, calving, nesting and resting areas and aggregations, narrow restricted migratory pathways) for migratory species.

There are no areas of critical habitat for any migratory species within the Gravis MC3D MSS polygon. Over the past 30-40 years there have been multiple 2D and 3D marine seismic surveys across the North-west Marine Region (NWMR), including concurrent and sequential surveys in the same general locations, and yet there is no evidence of any population-level effects on the Group IV population of humpback whales, which continues to increase at a level of 11-12% per annum and has probably reached pre-whaling numbers.

CGG is using all relevant sources of publicly available data and material to determine cetacean diversity, distribution, abundance, seasonality etc. in the Gravis MC3D MSS polygon. This includes papers in the peer reviewed scientific literature, conference proceedings and reports, as well as the Commonwealth Department of Environment resources for listed threatened and migratory species, such as the National Conservation Values Atlas (which includes spatial information on Biologically Important Areas [BIA] for cetaceans, turtles, sharks and dugong), the Species Profile And Threats (SPRAT) database, the EPBC Protected Matters database, published recovery plans, and reports from the Australian Marine Mammal Centre (AMMC) on recent satellite tagging and tracking of humpback and pygmy blue whales. The information sources also include any environmental impact statements and associated technical appendices/reports produced by the oil and gas industry for proposed gas developments in the Browse Basin – documents in the public domain include those for the Woodside Browse LNG Development Project, the Shell Prelude Development and the INPEX Ichthys Development. These companies have funded extensive research and monitoring programmes examining distribution, abundance, movements, migratory pathways for a number of species of marine mammals and turtles. Additional data sources also include marine fauna observer (MFO) reports from previous surveys that CGG (and its predecessor Fugro Multi Client Services) has conducted in the region over the last 10 years.

Primary data gaps that exist for cetaceans in the offshore waters of the Browse Basin include a lack of detailed knowledge regarding pygmy blue whale movements through the region during their annual northbound and southbound migration (the existing information is based on satellite tagging and tracking, which has a very small sample size at present; some acoustic data funded by the industry; and limited vessel-based sightings data from Curt and Michelene Jenner at the Centre for Whale Research [CWR]); plus

a limited understanding of the ecological significance of the Browse Cliffs feature, which could be an area important for upwelling and may represent a key foraging habitat for a number of species.

CGG is not in the business of commissioning and funding fundamental research concerning cetacean diversity, abundance/distribution, and critical habitat etc. in the Browse Basin, or anywhere else where the company conducts seismic surveys in Australian waters or overseas. In Australia, this is the domain and responsibility of relevant Commonwealth agencies (e.g. Department of Environment; AMMC), universities, cooperative research centres, CWR and other researchers. The offshore industry has a role to play, and as outlined above the various companies operating in the Browse Basin have already made a significant contribution to research and monitoring programmes in the region. For its part, CGG will continue to gather cetacean sightings data via dedicated MFO aboard survey or chase vessels during all surveys in the region, and will also keep abreast of any new information that may be produced by current and future research and monitoring projects (whether funded by Government or the industry), and will support and participate in any relevant initiatives developed by peak industry bodies such as the Australian Petroleum Production & Exploration Association (APPEA) and the International Association of Geophysical Contractors (IAGC). All of the sightings data collected by MFO on vessels during CGG surveys are entered into the AMMC Cetacean Sightings Application (CSA), and then incorporated into the National Marine Mammal Database.

As outlined above, CGG will continue to utilise a minimum of two dedicated, expert MFO during all surveys within the Gravis MC3D MSS polygon, to collect sightings data during daylight hours, and to ensure correct implementation of the EPBC Act Policy Statement 2.1 during seismic operations. All requirements of EPBC Act Policy Statement 2.1, including all Part A Standard Management Procedures, are implemented during any seismic operations on all CGG marine seismic surveys in Australian waters. Even though use of MFO is not a requirement included in the Part A Standard Management Procedures, CGG will continue to utilise a minimum of two MFO for all surveys that it conducts in Australian waters, as a matter of course.

The primary management and mitigation measure employed by CGG to minimise risk of impacts to cetaceans from underwater noise from seismic operations is spatial separation from areas of critical habitat, and/or temporal separation from key seasonal activities. For instance, for surveys conducted in the Gravis MC3D MSS polygon CGG has a number of management/mitigation measures that implement this spatial and temporal separation – i.e. seismic operations will not occur within the BIA for the green turtle, during the peak nesting period for this species between 1 October to 28 February (Ashmore Reef is an important green turtle nesting/breeding/hatching habitat), and implementation of the precautionary 500 m shutdown zone for whale sharks between 1 July to 30 November. On a case-by-case basis, dependent on individual survey location, timing and duration, CGG will also assess whether any relevant EPBC Policy Statement Part B Additional Management Procedures will be implemented. This may include the implementation of increased observation and low power zones (i.e. 3 km low power zone and 1 km shutdown zone, additional MFO on survey and/or chase vessel, and restrictions for night-time and periods of poor visibility.

Regulation 10A(b) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations requires a demonstration that environmental impacts are reduced to ALARP (As Low As Reasonably Practicable). Additionally, Regulation 10A(c) of the Environment Regulations requires a demonstration that environmental impacts are of an "acceptable level". As part of the Implementation Strategy component of the Environment Plan, CGG is required to demonstrate that all environmental impacts and risks associated with a seismic survey are ALARP and acceptable, in compliance with the Environment Regulations and to the satisfaction of the Regulator – NOPSEMA.
Please contact Scope Resources at environment@scoperesources.com.au, should you require any further information.

CGG will continue to liaise with IFAW throughout the Gravis MC3D MSS survey.

25. *DoF*

DoF (via letter 8/12/2014) DoF informed CGG that fish and fishers are regularly impacted by environmental, social and commercial drivers, and this can result in significant changes to the fishing industry over relatively short timescales. For this reason they are reluctant to provide advice on petroleum activities that are due to commence more than six months in the future, and cannot provide advice for projects that do not have a start date. DoF recognises that the need for certainty and forward planning, the Department provided the 'current advice' below stating that it is suitable for inclusion in the Gravis MC3D MSS EP application.

DoF also states that the information given does not represent the Department's final advice on this proposal, and to allow DoF to provide up to date advice, they request that the department is notified a minimum of three months prior to the commencement of any new activities described in the EP. Once notified the DoF will determine if there have been any significant changes to the information provided below and expect that any objects or claims resulting from these changes are resolved prior to commencement of any activity.

DoF advice is follows:

Consultation

DoF advise CGG consult with WAFIC, Recfishwest and individual licence holders regarding the overall proposal, including methods and incorporate comments from this consultation in the EP submission.

CGG has adhered to this request from the DoF.

DoF refers to the "Guidance Statement on Undertaking Seismic Surveys in Western Australian Waters available from www.fish.wa.gov.au. DoF requests that CGG identified a full range of mitigation strategies in the EP, and that all feasible mitigation strategies will be implemented, the department requests that analysis is undertaken to ensure that CGG use the minimum required acoustic capacity to achieve its objectives.

CGG has adhered to this request from the DoF.

DoF has requested that if the regulator (NOPSEMA) approves the EP, they advise CGG to further consult with the department and other stakeholders of the project activities a minimum of three month prior to the commencement of the activity. The DoF advises CGG provide stakeholders with specific start and finish dates, spatial extent of the proposed activity and information on identified specific fishing interests including previous consultation with individual licenced fishers. DoF also requests that in the event that there are any objections or claims raised during the consultation process, CGG is to address the matters to the satisfaction of the regulator prior to the commencement of the activity, and that the DoF requests that in the event of unresolved issues, the Department reserves the right to seek further engagement.

CGG is committed to maintaining a good rapport with stakeholders and will adhere to the DoF request to keep stakeholders informed of the activities. CGG is willing to provide stakeholders with information on specific start dates and the spatial extent of the proposed activity. However, due to issues with maintaining individuals' privacy, CGG will not disclose previous individual stakeholder communications to other stakeholders. CGG will however provide a summary of the merits of any previous stakeholder objections or claims, without identifying individual person's identity, this is in accordance with Regulation 16(b).

Fishing activities in the area

DoF have identifies the following fisheries in the bioregions associated with the proposed Multiclient activity.

Bioregion & Province	Commercial Fishing Interests
North Coast, North West Shelf, Timor Province	Pearl Oyster Managed Fishery; Beche de Mer Fishery; Broome Prawn Managed Fishery; Kimberley Prawn Fishery; Marine Aquarium Managed Fishery; Mackerel Managed Fishery; North Coast Shark Fishery; Specimen Shell Managed Fishery; Northern Demersal Scalefish Managed Fishery

Fish Spawning

DoF requests that CGG specifically includes strategies in the EP to minimise the impacts of survey activities on fish spawning, such as soft starts, and sound exposure time minimisation. Alternatively, DoF suggest that it is preferable if seismic activities do not occur during the times of year that the following key fish species **may be** spawning within your proposed area of activities:

Bioregion	Key Fish Species within zone	Spawning / Aggregation times
North Coast	Blacktip shark *(Carcharhinus tilstoni & C. limbatus)*	Nov - Dec
	Goldband snapper *(Pristipomoides multidens)*	Jan - April
	Rankin Cod (*Epinephelus multiinotatus*)	Aug - Oct
	Red Emperor *(Lutjanus sebae)*	Jan, Mar
	Pink Snapper (*Pagrus auratus*) (rare)	May – Jul
	Sandbar shark *(Carcharhinus plumbeus)*	Oct - Jan
	Spanish mackerel *(Scomberomorus commerson)*	Aug - Nov

CGG implements the soft start procedure for all seismic surveys and will minimise unnecessary use of the acoustic source. The times of year that the DoF identify that fish species **may be** spawning, overlap a 12 month period, if CGG was to avoid these times the survey would not be able to proceed at any time of year and geophysical objectives would not be met.

Biosecurity

The DoF also noted there is a biosecurity risk associated with this activity. The DoF requires all vessel managers and operators of submersible equipment to minimise the risk of translocating pests and diseases into or within WA Waters in accordance with the *Fish Resources Management Regulations 1991* (reg. 176(1)). They also noted that vessels must be 'clean' before each voyage.

It is DoF policy that the suspected or confirmed presence of any organism which is listed on the Western Australian Prevention List for Introduced Marine Pests (http://www.fish.wa.gov.au/Documents/biosecurity/epa_introduced_marine_pests.pdf), and any other organisms that appears to have clear negative impacts or invasive characteristics, must be reported with 24 hours to the Department by email (biosecurity@fish.wa.gov.au) or telephone (FishWatch tel: 1800 815 507).CGG will comply with these requests.

CGG has adhered to the requests from the DoF and will continue to liaise with the Department throughout the Gravis MC3D MSS survey.

CGG (via email 15/12/2014) CGG acknowledged receipt of the stakeholder response letter from the DoF on the 8th December 2014 and provided responses to, and further information, all issues/comments raised in the DoF letter.

CGG reiterated to DoF that the Gravis MC3D MSS EP is not a basin-wide EP, therefore CGG requests from the Department of Fisheries (DoF) advice for the title areas identified above, for a potential survey to be conducted at any time within a 12 month period, i.e. seasonal advice. CGG would like to advise that the commencement of the Gravis MC3D MSS is planned for Q1 2015, therefore adhering to their request of a 3 month pre-start notification.

1. Consultation

CGG informed the DoF that both WAFIC and Recfishwest were consulted as part of the preparatory consultation during preparation of the Environment Plan (EP) for the proposed activity. CGG obtained extracts from the Public Register held by the DoF for the relevant State-managed fisheries that can operate in the waters overlapped by the Gravis MC3D MSS. CGG also informed the DoF that all communication and consultation with individual licence holders in the Pearl Oyster Managed Fishery (POMF) was via the peak industry body for this fishery - Pearl Producer Association (PPA). CGG informed the DoF that fifty-six -separate individuals or entities holding licences were identified across the different fisheries, and letters were sent on 29th October 2014 informing them of the proposed activities. CGG advised the DoF that any comments, issues or concerns from the preparatory consultation have been incorporated into the EP.

CGG advised DoF that prior to the commencement of the Gravis survey, CGG will undertake further consultation with the Department and other stakeholders. This additional consultation will take place a minimum of three weeks prior to the planned commencement of the Gravis MC3D MSS, and will include all of the stakeholders (i.e. WAFIC, Recfishwest, PPA, individual licence holders etc.) contacted as part of the preparatory consultation process. CGG informed DoF as part of this consultation, CGG will provide the stakeholders with:

- specific start and finish dates; and
- information on identified specific fishing interests, including previous consultation with individual licenced fishers.

CGG informed the DoF that should there be any objections of claims raised during this consultation process, then they will assess the issues raised and determine whether or not there are any new risks that would result in having to submit a revision of the EP to NOPSEMA for assessment, and the Department will be kept informed on how these issues have been resolved, and whether there are any outstanding/unresolved issues. CGG also informed DoF, if the department requires a copy of stakeholder correspondence with fisheries licence holders to send an email request to Scope Resources (environment@scoperesources.com.au).

2. Fishing activities in the area

The DOF was informed that CGG and Scope Resources have conducted an analysis of the State and Commonwealth-managed commercial fisheries that overlap the Gravis MC3D MSS, and determined which of these fisheries may be directly or indirectly affected by the survey. This information has been included in the EP. CGG informed DoF the mitigation measures to deal with the issue of potential impacts on recreational fishers proposed are as follows:

- communications protocol to manage interactions with fishing and shipping vessels;
- risk assessment of the impacts of the discharge the seismic pulses over the Gravis polygon; and
- acoustic modelling has been undertaken to ensure that that the minimum required acoustic capacity is being used to image the targeted deep geological layers.

3. Fish spawning

CGG informed the DoF of the specific control/mitigation measures that have been included in the EP to minimise the potential impacts of the proposed seismic survey on fish spawning. This includes:

- the use of the smallest possible seismic source; and
- the use of soft starts of the seismic source.

CGG acknowledged that the DoF has provided an extensive list of the key fish species that may be spawning within the proposed area of activities for the Gravis MC3D MSS, and has requested that seismic activities do not occur during the times of the year that represent spawning/aggregation times. However,

the spawning/aggregation times identified cover every month of the year, and the Department has not provided any specific locations of fish spawning grounds or aggregation areas within the Gravis MC3D MSS polygon. Without this information, CGG cannot development and implement appropriate mitigation measures to avoid spawning/aggregation locations during spawning periods or events.

4. Biosecurity

CGG informed DoF management strategies to minimise the likelihood of introduction of marine pests or disease includes inspection and cleaning of the survey vessel hull, other niches, and submersible towed equipment (e.g. vanes, airgun arrays, streamers and tail buoys) prior to entry into WA waters and ports, is described in the EP. CGG will adhere to the Department's policy, if the suspected or confirmed presence of any marine pest or disease will be reported within 24 hours by email or telephone, and this requirement will be communicated directly to the operator of the survey vessel (CGG).

CGG acknowledged that there is a possibility that there may be other marine seismic surveys taking place within the same area, and during the same timeframe (Q1 2015 to Q1 2017) as the proposed Gravis MC3D MSS, which could result in cumulative impacts on fish and fisheries in the area. The EP includes an assessment of the cumulative impacts that could occur if concurrent surveys were to take place in the same area, and describes a number of control measures to eliminate or mitigate potential impacts that would be implemented if this situation were to arise.

CGG will continue to liaise with the DoF and inform stakeholders of vessel operations within the Gravis MC3D MSS throughout the entire duration of the project as part of the ongoing consultation process for the activity.

8.1.5. PHASE 1 - FIFTH ROUND OF STAKEHOLDER CONSULTATION

A fifth round of stakeholder consultation occurred on 14-15th May 2015. All stakeholders contacted during previous rounds consultation rounds were provided with a letter providing a notification of the change in scope for the activity, and an invitation to comment (**Appendix G**). Stakeholders were informed that the EP (once accepted) will have a validity of two years, although the actual acquisition period is expected to take no more than 12 months, and individual surveys may be conducted in phases during that two year period.

Seven new commercial fishing licence holders have been identified since the fourth round of consultation. Consequently, these new stakeholders have been included on the stakeholder notification spreadsheet, and a letter informing them of the proposed activity and inviting comment was posted to them on 14th May 2015.

To date (03/06/15) three responses have been received from the AHS, AMSA Nautical Advice and the PPA.

1. *Department of Defence (AHS)*

   DoD (via email 14/05/15) acknowledged receipt of the stakeholder notification and indicated that they would await further information prior to commencement.

   CGG will comply with this request.

2. *AMSA Nautical Advice*

   AMSA Nautical Advice (via email 14/04/15) provided a recent vessel tracking plot and reiterated their advice about the need for extra caution in the area around Osborne Passage and the charted Preferred Route:

   Please find attached a recent vessel traffic plot showing historical vessel track data in and around the Gravis MC3D MSS area of interest noting commercial shipping traffic would appear to be relatively contained (AHV/support craft notwithstanding). Extra caution must be taken as the survey area overlaps Osborne Passage and the charted Preferred Route. Please ensure the survey and support craft are in receipt of this chartlet.

Reiterating previous advice supplied to CGG, given the length of tow (ie previously stated at 10,000m), both the support vessel and survey vessel will need to be active and maintain exceptional communications with all commercial shipping, should any be encountered, within or around the survey area noting there will be a considerable speed difference between commercial shipping and the survey vessel whilst the latter is conducting operations.

It is worth noting that any related avoiding action by commercial shipping, should it be necessary, should not increase and/or compound the navigational risk to other shipping in the vicinity.

The seismic vessel must display appropriate day shapes, lights and streamers, reflective tail buoys, to indicate the vessel is towing and is therefore restricted in her ability to manoeuvre. Visual and radar watches must be maintained on the bridge at all times.

Please ensure AMSA's Joint Rescue Coordination Centre (JRCC) is contacted through rccaus@amsa.gov.au for Auscoast warning broadcasts before operations commence. AMSA's JRCC will require the vessels details and area of operation and need to be advised when the survey starts and ends. Additionally, the Australian Hydrographic Service must be contacted through hydro.ntm@defence.gov.au well in advance (ie no less than 2 working weeks) for the promulgation of related Notices To Mariners.

At the conclusion of the survey, please be in touch to comment on the operations and the interaction with commercial shipping at the time of the survey (ie any lessons learned).

CGG will comply with these requests.

3. *PPA*
   The PPA (via email 29/05/15) acknowledged receipt of the communication and thanked CGG for keeping them informed.

   No further action required.

8.2. PHASE 2 - ONGOING CONSULTATION AND PHASE 4 - POST SURVEY NOTIFICATION

Consultation with relevant stakeholders will be ongoing while the Gravis MC3D MSS EP is valid. CGG will comply with requests by stakeholders for additional information and requests for updates during surveys undertaken within the operational area. In addition, stakeholders will be notified of any changes to scope of the EP that may affect their interests or activities in advance of a survey to be undertaken under that change (minimum ~ 3 weeks prior). Relevant stakeholders will be supplied a pre-start notification three weeks prior to commencement of activities within the Gravis MC 3D MSS polygon.

As required under sub regulation 16(b), CGG shall assess the merits of any new claims or objections made by a relevant stakeholder whereby they believe the activity may have adverse impacts upon their interest or activities. If the claim has merit, where appropriate, CGG shall modify management of the activity. An internal risk assessment will be undertaken. To ensure fairness and transparency for stakeholders, and that the internal risk assessment will properly account for their views, stakeholders will be invited to partake in meetings or discussions regarding their objection or claim.

If the claim has merit, where appropriate, CGG shall modify management of the activity. CGG shall finalise the assessment of merit of any claim or objection received before or during a survey and undertake any resulting management of change actions as soon as practicable. The assessment of merit and any resulting management of change actions (including revision to the EP) shall be shared with the concerned stakeholder.

Should a stakeholder not be satisfied with the outcome of the assessment and proposed actions, their claims and objections may again be assessed. CGG shall present the stakeholder with a copy of the risk assessment and all accompanying information demonstrating the process undertaken was appropriate, and how selected control measures have reduced, and will continue to reduce, environmental impacts and risks to ALARP.

If the outcome of the assessment of merit of a claim or objection received during a survey suggests that impacts and risks are new or increased (if the residual risk ranking has changed) then this will trigger a revision to the EP.

Table 8.1 - Details of the stakeholder consultation plan for surveys within the Gravis MC3D MSS polygon

Organisation	Objective	Method of Communication	Frequency	Timeframe
A Raptis & Sons Austral Fisheries Australian Southern Bluefin Tuna Association (ASBTIA) MG Kailis Group Northern Fishing Companies Association (NFCA) Northern Wildcatch Seafood Australia (NWSA); Pearl Producers Association WA Seafood Exporters WA Department of Fisheries (DoF) Licence Holders	• Planning notification: during the planning of operations once specific survey areas have been identified to address any potential issues raised • Pre-start up notification: to provide data on each individual survey such as size, location, coordinates, timing and duration, survey vessels and seismic parameters to be used • Operational forecast: to provide 7-10 forecast of operations, including a map showing the area already acquired and forward acquisition plan and time frame • Survey completion notification: to provide notification of termination of acquisition activities	• Email (letters) • Post (letters to licence holders) • Fax • Phone calls (if required) • Face-to-face meetings (if requested)	• During planning and execution of ALL individual surveys	• Planning notification – minimum of **three (3) months** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon • Pre-start up notification - minimum of **three (3) weeks** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon • Operational forecast – **weekly** during acquisition • Survey completion: within **two (2) months** of survey completion
Australian Fisheries Management Authority (AFMA) Commonwealth Fisheries Association (CFA)	• Planning notification: during the planning of operations once specific survey areas have been identified to address any potential issues raised • Pre-start up notification: to provide data on each individual survey such as size, location, coordinates, timing and duration, survey vessels and seismic parameters to be used	• Email (letters) • Online submission (DoF) • Phone calls (if required) • Face-to-face meetings (if requested)	• During planning of ALL individual surveys	• Planning notification – minimum of **three (3) months** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon • Pre-start up notification - minimum of **three (3) weeks** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon

Organisation	Objective	Method of Communication	Frequency	Timeframe
WA Department of Fisheries				
Western Australian Fishing Industry Council (WAFIC)				
Australian Hydrographic Service (AHS)	• Planning notification: during the planning of operations once specific survey areas have been identified to address any potential issues raised • Pre-start up notification: to provide data on each individual survey such as size, location, coordinates, timing and duration, survey vessels and seismic parameters to be used, so an NTM can be issued • Survey completion notification: to provide notification of termination of acquisition activities	• Email (letters)	• During planning and execution of ALL individual surveys	• Planning notification – minimum of **three (3) months** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon • Pre-start up notification - minimum of **two (2) weeks** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon • Survey completion: within **two (2) weeks** of survey completion
Defence Property Services Group	• Planning notification: during the planning of operations once specific survey areas have been identified to address any potential issues raised • Pre-start up notification: to provide data on each individual survey such as size, location, coordinates, timing and duration, survey vessels and seismic parameters to be used	• Email (letters)	• During planning of ALL individual surveys	• Planning notification – minimum of **three (3) months** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon • Pre-start up notification - minimum of **three (3) weeks** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon
Directorate of Property Acquisition, Mining and Native Title				
Headquarters Air Command				

Organisation	Objective	Method of Communication	Frequency	Timeframe
Centre for Whale Research International Fund for Animal Welfare (IFAW)	• Planning notification: during the planning of operations once specific survey areas have been identified to address any potential issues raised • Pre-start up notification: to provide data on each individual survey such as size, location, coordinates, timing and duration, survey vessels and seismic parameters to be used	• Email (letters) • Phone calls (if required) • Face-to-face meetings (if requested)	• During planning of ALL individual surveys	• Planning notification – minimum of **three (3) months** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon • Pre-start up notification - minimum of **three (3) weeks** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon
Australian Maritime Safety Authority (AMSA)	• Planning notification: during the planning of operations once specific survey areas have been identified to address any potential issues raised • Pre-start up notification: to provide data on each individual survey such as size, location, coordinates, timing and duration, survey vessels and seismic parameters to be used, so an Auscoast warning can be issued • Survey completion notification: to provide notification of termination of acquisition activities	• Email (letters)	• During planning and execution of ALL individual surveys	• Planning notification – minimum of **three (3) months** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon • Pre-start up notification - minimum of **two (2) weeks** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon • Survey completion: within **two (2) weeks** of survey completion
Australian Customs Services (Coastwatch)	• Planning notification: during the planning of operations once specific survey areas have been identified to address any potential issues raised • Pre-start up notification: to provide	• Email (letters)	• During planning of ALL individual surveys	• Planning notification – minimum of **three (3) months** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon • Pre-start up notification - minimum of **three (3)**

Organisation	Objective	Method of Communication	Frequency	Timeframe
Strategic Border Protection Command - Customs	data on each individual survey such as size, location, coordinates, timing and duration, survey vessels and seismic parameters to be used			**weeks** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon
Geophysical companies active in offshore seismic activities	• Planning notification: to ascertain if there are any other seismic surveys proposed for areas within and adjacent to the Gravis MC3D MSS polygon over the same time period • Pre-start up notification: to provide data on each individual survey such as size, location, coordinates, timing and duration, survey vessels and seismic parameters to be used	• Email (letters) • Phone calls (if required) • Face-to-face meetings (if requested)	• During planning of ALL individual surveys	• Planning notification – minimum of **three (3) months** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon • Pre-start up notification - minimum of **three (3) weeks** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon
Recfishwest	• Planning notification: during the planning of operations once specific survey areas have been identified to address any potential issues raised • Pre-start up notification: to provide data on each individual survey such as size, location, coordinates, timing and duration, survey vessels and seismic parameters to be used	• Email (letters) • Phone calls (if required) • Face-to-face meetings (if requested)	• During planning of ALL individual surveys	• Planning notification – minimum of **three (3) months** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon • Pre-start up notification - minimum of **three (3) weeks** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon

Organisation	Objective	Method of Communication	Frequency	Timeframe
Department of the Environment (DoE)	• Planning notification: during the planning of operations once specific survey areas have been identified to address any potential issues raised • Pre-start up notification: to provide data on each individual survey such as size, location, coordinates, timing and duration, survey vessels and seismic parameters to be used	• Email (letters)	• During planning of ALL individual surveys	• Planning notification – minimum of **three (3) months** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon • Pre-start up notification - minimum of **three (3) weeks** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon
National Offshore Petroleum Titles Administrator (NOPTA)	• Planning notification: during the planning of operations once specific survey areas have been identified to obtain the necessary titles (Access Authority [AA] and /or Special Prospecting Authority [SPA])	• Email (letters) • Phone calls (if required) • Face-to-face meetings (if required)	• During planning of ALL individual surveys	• Planning notification – minimum of **three (3) months** prior to the commencement of ALL individual surveys within the Gravis MC3D MSS polygon
National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA)	• Pre-start up notification: as required by Regulation 29 of the Environment Regulations • Survey completion notification: as required by Regulation 29 of the Environment Regulations	• Online submission	• Prior to commencement of ALL individual surveys • On completion of ALL individual surveys	• Pre-start up notification: at least **10 days** before the activity commences • Survey completion notification: within **10 days** after completion
WA Department of Mines and Petroleum (DMP)	• Pre-start up notification: as required by Regulation 30 of the Environment Regulations	• Email	• Prior to commencement of ALL individual surveys	• Pre-start up notification: at least **10 days** before the activity commences

8.3. MERITS OF THE STAKEHOLDER OBJECTIONS AND CLAIMS

An assessment of the merits of objections or claims about the adverse impact of the Gravis MC3D MSS was made, and where practicable those with merit were incorporated into the survey design. The following objections and claims were identified (note where possible these have been grouped into common themes):

- **Marine Safety:** AMSA and DoF were concerned about shipping safety and interactions with fishing vessels. The polygon overlaps Osborne Passage. Shipping traffic is expected to/from the Montara Rig (AHV/Support craft), and potential fishing vessels from the Northern NDSF may be fishing in the Gravis MC3D MSS polygon. All control measures relating to AMSA RCC notification to initiate AusCoast warnings, AHS notification to issue a Notice to Mariners (NTM) for the activity, use of a support vessel to manage vessel interactions, display of appropriate navigational beacons and lights, radar watch, radio contact to indicate the vessel is towing and has restricted ability to manoeuvre and a visual and radar watch will be implemented. Compliance with maritime orders, COLREGS, establishment of a SNA (Safe Navigation Area) vessel exclusion zone around the survey vessel will be implemented to minimise disruption to commercial shipping and commercial fishers Recfishwest informed CGG that they do not anticipate any issues of conflict with the Gravis MC3D MSS.

- **Commercial Fishing:**
    - ***Fishing Vessel interactions:*** Concerns were raised by fishers about the potential of entanglement of fishing equipment and about the size and nature of the proposed operations. The CGG Operations Manager contacted fishers via phone and explained that CGG will probably not be shooting (acquiring data) for the whole area, and that CGG will work with them to avoid any on water incidents. Potential interactions can be avoided via the processes that will be implemented for ongoing consultation with stakeholders in the commercial fishing sector (see below, and **Table 7.12**).
    - In response to concerns of displacement from commercial fishers (DoF and licence holders), CGG will be contacting fishers 3 weeks prior to individual survey commencement and will continue to liaise with licence holders in the NDSF throughout the Gravis MC3D MSS so that displacement of fishers is kept to a minimum. This process has worked well for past CGG surveys that have overlapped the NDSF area.
    - CGG will continue to liaise and inform stakeholders of vessel operations within the Gravis MC3D MSS throughout the entire duration of the project as part of the ongoing consultation process for the activity (see **Table 7.12**).

    - ***Impacts to Fish:*** Concerns were raised by DoF who were concerned about the impact of the Gravis MC3D MSS on fish spawning areas. However, to date, DoF has not provided any specific locations of fish spawning grounds or nursery areas within the Gravis MC3D polygon. Without this information CGG cannot practically devise a mitigation measure to avoid spawning locations or nursery areas. This is also reflected in the fact that there are no restrictions or spatial closures in place for any activity (such as anchoring or the discharge of an acoustic source) in the Gravis MC3D MSS polygon during spawning periods for fishes targeted by both recreational and commercial fishers.

- **Biosecurity risk:** DoF and PPA expressed concerns regarding the risk of introduction of invasive marine species. CGG advised stakeholders that the survey vessel will have had a recent dry dock, invasive marine species (IMS) inspection and antifoulant application prior to mobilising to Australian waters and that the AF coating meets IMO 2001 Convention requirements and the survey and support vessel(s) have all the necessary DoA Biosecurity clearances to operate unrestricted anywhere in Australian waters.

- **EPBC Protected Matters Impacts:** Concerns were raised by IFAW regarding cumulative impacts and the cumulative deterioration in acoustic habitat for migratory species over the larger area because of concurrent or sequential surveys in these habitats. Stakeholders requested additional information including means of determining species in the area, current gaps in knowledge, steps that will be taken to

ensure the best possible chance of detecting cetaceans and how CGG will minimise risks and impacts. CGG provided a list of all sources of information used in compilation of the EP and stated that data will continue to be gathered via dedicated MFOs during all surveys in the operational area. In addition, CGG will endeavour to be kept abreast of all new information that may be produced by future research and monitoring programs, and will support and participate in any relevant initiatives developed by peak industry bodies.

9. DETAILS OF THE TITLEHOLDER AND LIAISON PERSON

TITLEHOLDER:	CGG Services (Australia) Pty Ltd
BUSINESS ADDRESS:	Level 1, 1 Ord St West Perth WA 6005
TELEPHONE NUMBER:	+61 8 9219 6200
ACN:	**081 777 755**
TITLEHOLDER NOMINATED PERSON:	Ian Hay
BUSINESS ADDRESS:	As above.
TELEPHONE NUMBER:	+61 8 9219 6624
EMAIL ADDRESS:	Ian.Hay@CGG.com

The Regulator will be notified according to the requirements of Regulation 15(3), of changes to the titleholder or nominated liaison.

CGG will submit in writing to the Regulator; within 30 days of the change, information regarding a change in:

- the titleholder.
- the titleholder‘s nominated liaison person.
- contact details for the titleholder.
- contact details for the liaison person.

10. REFERENCES

BOEM (2014). Proposed Geological and Geophysical Activities, Mid-Atlantic and South Planning Areas, Final Programmatic Environmental Impact Statement. U.S. Department of the Interior Bureau of Ocean Energy Management Gulf of Mexico OCS Region. New Orleans.

BOM (2014). Bureau of Meteorology - Australia Tropical Cyclone Information. Australian Government. Accessed 18 September 2014.

Brewer DT, Lyne V, Skewes TD and Rothlisberg, P (2007). Trophic Systems of the North West Marine Region. Report to The Department of the Environment and Water Resources. CSIRO Cleveland. 156 pp.

Clarke RH (2010). The Status of Seabirds and Shorebirds at Ashmore Reef and Cartier and Browse Islands: Monitoring program for the Montara Well release - Pre-impact Assessment and First Post-impact Field Survey. Prepared on behalf of PTTEP Australasia and the Department of the Environment, Water, Heritage and the Arts, Australia. 102 pp

DEH (2002). Ashmore Reef National Nature Reserve and Cartier Island Marine Reserve (Commonwealth Waters) Management Plans. Department of the Environment and Heritage. Australia, Canberra

DEWHA (2007). Characterisation of the Marine Environment of the North Marine Region - Outcomes of an expert workshop, Darwin, Northern Territory, 2-3 April 2007. Prepared by the North Marine Bioregional Planning section, Marine Division, Department of the Environment, Water, Heritage and the Arts. Canberra, ACT. 37 pp.

DEWHA (2008a). EPBC Act Policy Statement 2.1 – *Interaction between offshore seismic exploration and whales* September 2008. Australian Government Department of the Environment, Water, Heritage and the Arts. Canberra. 14 pp.

DFO (2004). *Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals*. Canadian Science Advisory Secretariat (CSAS), Habitat Status Report 2004/002, Department of Fisheries and Oceans (DFO), Canada. 15 pp.

DNP (2014). Ashmore Reef and Cartier Island Commonwealth Marine Reserves Information for visitors. Director of National Parks, Canberra

DoE (2014f). Matters of National Environmental Significance. Significant Impact Guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999. 39 pp. http://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf

DoE (2014g). Species Profile and Threats Database. Australian Government Department of the Environment, Canberra. http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

DSEWPaC (2012). Commonwealth marine environment report card - Supporting the marine bioregional plan for the North-west marine region. Department of Sustainability Environment, Water, Population and Communities. Commonwealth of Australia. Canberra.

Fletcher, W.J. and Santoro, K. (eds). (2013). Status Reports of the Fisheries and Aquatic Resources of Western Australia 2012/13: The State of the Fisheries. Department of Fisheries, Western Australia.

Gausland I (2000). Impact of seismic surveys on marine life. SPE 61127. SPE International Conference on Health, Safety and the Environment in Oil and Gas Exploration and Production. 26-28 June 2000. 4 pp.

Geoscience Australia (2002). Impacts of marine Acoustic technology on the Antarctic Environment. Version 1.2. SCAR Ad Hoc Group on marine acoustic technology and the environment. Canberra. 67 pp

Heyward A, Moore C, Radford B, Colquhoun J (2010). Environmental Study S5. *Monitoring Program for the Montara Well Release Timor Sea: Final Report on the Nature of Barracouta and Vulcan Shoals*. Report for PTTEP Australasia (Ashmore Cartier) Pty. Ltd. by Australian Institute of Marine Science, Townsville

Heyward A, Jones R, Meeuwig J, Burns K, Radford B, Colquhoun J, Cappo M, Case M, O'Leary R, Fisher R, Meekan M and Stowar M (2011). Monitoring Study S5 Banks & Shoals, Montara 2011 Offshore Banks Assessment Survey. Report for PTTEP Australasia (Ashmore Cartier) Pty. Ltd. Australian Institute of Marine Science, Townsville. 253pp.

Heyward A, Jones R, Meeuwig J, Burns K, Radford B, Colquhoun J, Cappo M, Case M, O'Leary R, Fisher R, Meekan M and Stowar M (2012). *Monitoring Study S5 Banks & Shoals, Montara 2011 Offshore Banks Assessment Survey. Report for PTTEP Australasia (Ashmore Cartier) Pty. Ltd*. Australian Institute of Marine Science, Townsville. 253pp

Jochens AE and Biggs DC (2003). Sperm Whale Seismic Study in the Gulf of Mexico. US Minerals Management Service OCS Study 2003-069. Report published by US Department of Minerals Management Service OCS Region, New Orleans. 135 pp

McCauley RD (1994). The environmental implications of offshore oil and gas development in Australia – seismic McCauley RD (1994). The environmental implications of offshore oil and gas development in Australia – seismic surveys. *In*: Swan, J.M., Neff, J.M. and Young, P.C. (eds.), Environmental Implications of Offshore Oil and Gas Development in Australia - The Findings of an Independent Scientific Review, pp. 123-207. Australian Petroleum Exploration Association, Sydney. pp. 19-21.

McCauley, RD (2011). Woodside Kimberley sea noise logger program, Sept-2006 to June 2009: Whales, fish and man-made noise. Report produced for Woodside Energy Ltd. pp.86.

McCauley RD and Jenner C (2010). Migratory patterns and estimated population size of pygmy blue whales (Balaenoptera musculus brevicauda) traversing the Western Australian coast based on passive acoustics. Paper SC/62/SH26 presented to the IWC Scientific Committee.

McCauley RD, Fewtrell J, Duncan A, Jenner C, Jenner M-N, Penrose JD, Prince RIT, Adhitya A, Murdoch J and McCabe K (2003). *Marine seismic surveys: analysis and propagation of air-gun signals; and effects of exposure on humpback whales, sea turtles, fishes and squid*. Curtin University Centre for Marine Science and Technology (CMST) Report R99-15 for the Australian Petroleum Production and Exploration Association (APPEA). Published in: *Environmental Implications of Offshore Oil and Gas Development in Australia: Further Research*, APPEA, 2003, 520 pp.

Meekan MG and Radford B (2010). Migration patterns of Whale Sharks: A summary of 15 satellite tag tracks from 2005 to 2008. Report produced for Woodside Energy Ltd. Australian Institute of Marine Science, Perth. 21 pp.NOAA (2013). Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals. Acoustic Threshold Levels for Onset of Permanent and Temporary Threshold Shifts. National Oceanic and Atmospheric Administration, draft 23 December 2013. 83 pp.

Popper AN, Hawkins AD, Fay RR, Mann DA, Bartol S, Carlson TJ, Coombs S, Ellison WT, Gentry RL, Halvorsen MB, Løkkeborg S, Rogers PH, Southall BL, Zeddies DG and Tavolga WN (2014). ASA s#/SC1.4 TR-2014 Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. SpringerBriefs in Oceanography. Published by the ASA Press and Springer.

Richardson WJ, Greene Jr. C, Malme CI and Thomson DH (1995). Marine Mammals and Noise. Academic Press, Sydney. 576 pp.

Skalski, JR, Pearson, WH and Malme, CI (1992). Effects of sounds from a geophysical survey device on catch-per-unit-effort in a hook-and line fishery for rockfish (*Sebastes* spp.). *Canadian Journal of Fisheries and Aquatic Sciences* **49**: 1357-1365.

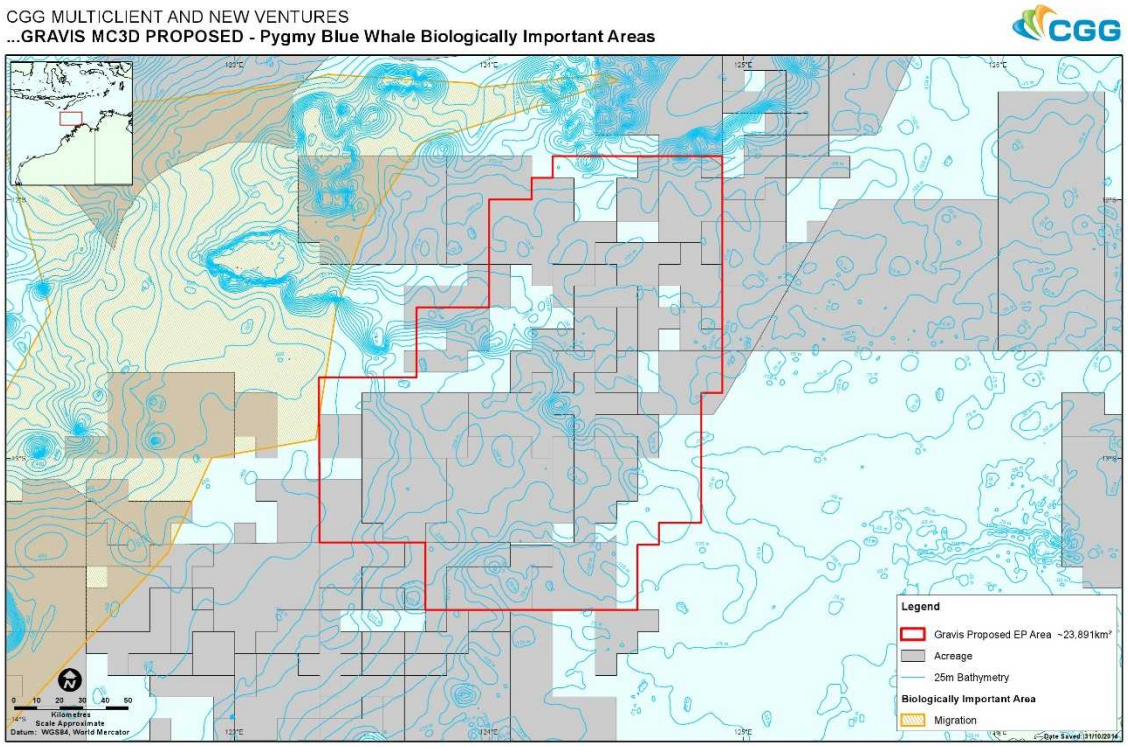
Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.T., Gentry, R.L., Greene Jr., C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A. and Tyack, P.L. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations, *Aquatic Mammals* 33: 411- 521

Weinberg C, Westphal H, Kwoll E and Hebbeln D, 2010, An isolated carbonate knoll in the Timor Sea (Sahul Sheld, NW Australia): facies zonation and sediment composition, Facies 56:179-193

Wilson, SG, Polovina, JJ, Stewart, BS and Meekan, MG (2006). Movements of whale sharks (Rhincodon typus) tagged at Ningaloo Reef, Western Australia. Marine Biology. Vol. 148 pp. 1157-1166.

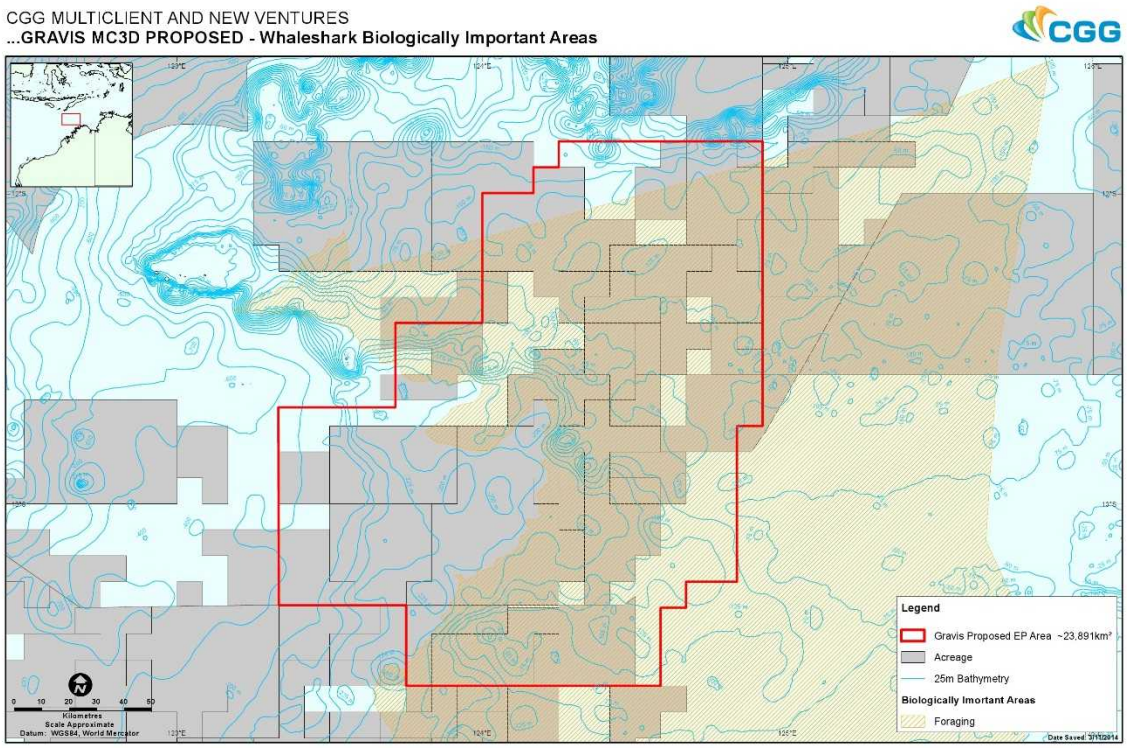
11. APPENDIX 1 - BIOLOGICALLY IMPORTANT AREAS

Figure 1: BIA for the pygmy blue whale *(Balaenoptera musculus brevicauda)*



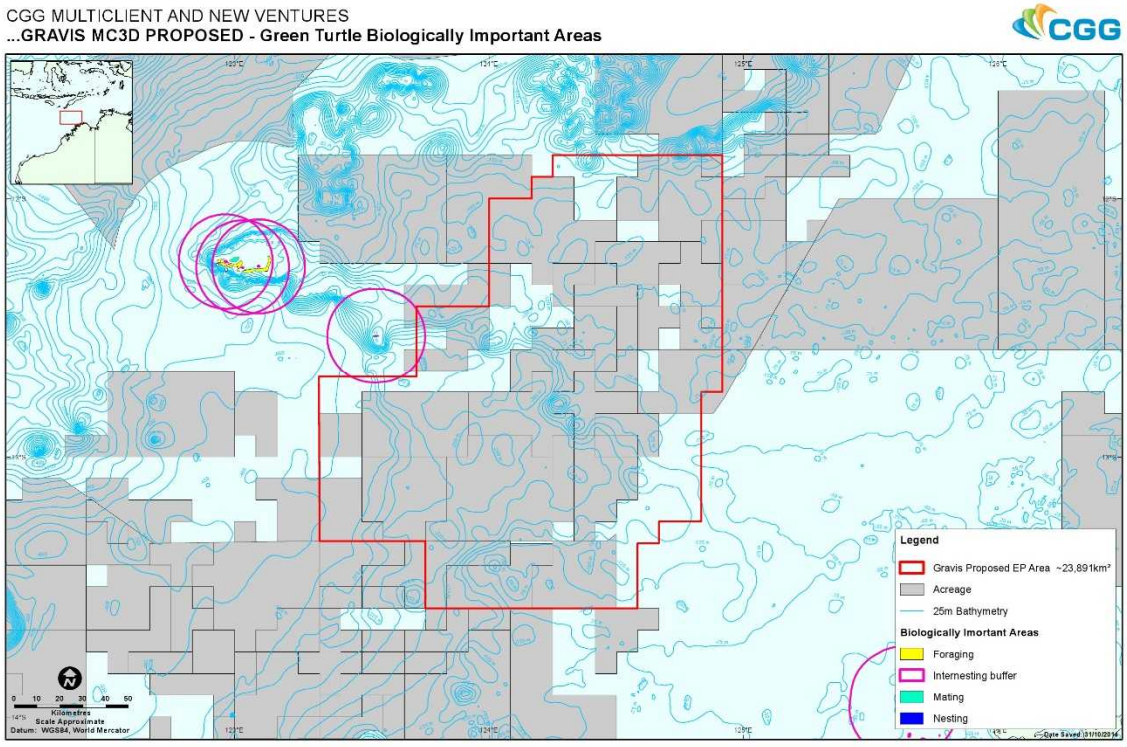
Source: Modified from DoE (2013c)

Figure 2: BIA for the whale shark *(Rhincodon typus)*



Source: Modified from DoE (2013c)

Figure 3: BIA for the green turtle *(Chelonia mydas)*



Source: Modified from DoE (2014b)