TITAN MULTI CLIENT 3D MARINE SEISMIC SURVEY

ENVIRONMENT PLAN: PUBLIC SUMMARY

PGS Australia Pty Ltd

REVISION 1

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1. INTRODUCTION

The geophysical company Petroleum Geo-Services (PGS) proposes to acquire a multi-client three-dimensional (MC3D) marine seismic survey (MSS) within the North-west Marine Region (NWMR) offshore from Western Australia (WA; see **Figure 1.1**). The Titan MC3D MSS operational area ~43,515 square kilometres (km^2) includes an acquisition area of ~36,320 km^2.

The summary of the Environmental Plan (EP) for the Titan MC3D MSS has been submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), to comply with Regulations 11(3) and 11(4) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.

The Titan MC3D MSS EP has the objective of covering a MC3D survey over specific petroleum titles and adjacent vacant acreage over a period of approximately 24 months. PGS plans to commence the Titan MC3D MSS no earlier than 1 December 2014, but it may be conducted in phases and with more than one vessel, depending on weather and vessel availability for conducting the survey and client data requirements.

1.1. LOCATION OF THE ACTIVITY

The Titan MC3D MSS operational area lies entirely in Commonwealth waters within the NWMR, and is located at the closest point ~125 km to Port Hedland on the mainland coast of Western Australia. The northeast corner of the operational area is located ~40 km from the Rowley Shoal State Marine Park and ~130 km from Mermaid Reef. The southern boundary is located ~117 km north of Eighty Mile Beach and the western boundary is located ~175 km to the east of Legendre Island (Dampier Archipelago; see **Figure 1.1**). Water depths within the Titan MC3D MSS operational area range from ~60 m to ~3,400 m, while water depths in the smaller acquisition area only range from ~80 m to ~3,300 m. The deepest water depths are located on the northwest corner of the operational area.

1.2. COORDINATES OF THE PROPOSED ACTIVITY

Boundary coordinates for the operational area (see **Table 1.1**) are shown in

.

Table 1.1- Coordinates of the Titan MC3D MSS Operational Area

Latitude (S)	Longitude (E)
Decimal degrees	
118.555358	-17.263708
118.512162	-17.411232
118.510701	-17.665777
118.576782	-17.836418
118.739320	-17.998483
118.918677	-18.036553
119.334732	-18.428586
119.345443	-19.202447
117.991442	-19.214775
117.274900	-18.523556
116.831890	-18.524342
116.830429	-18.001402
116.776289	-17.826244
116.830429	-17.456819
117.250809	-17.045994
117.645711	-17.262553
118.555358	-17.263708

Datum: WGS 84

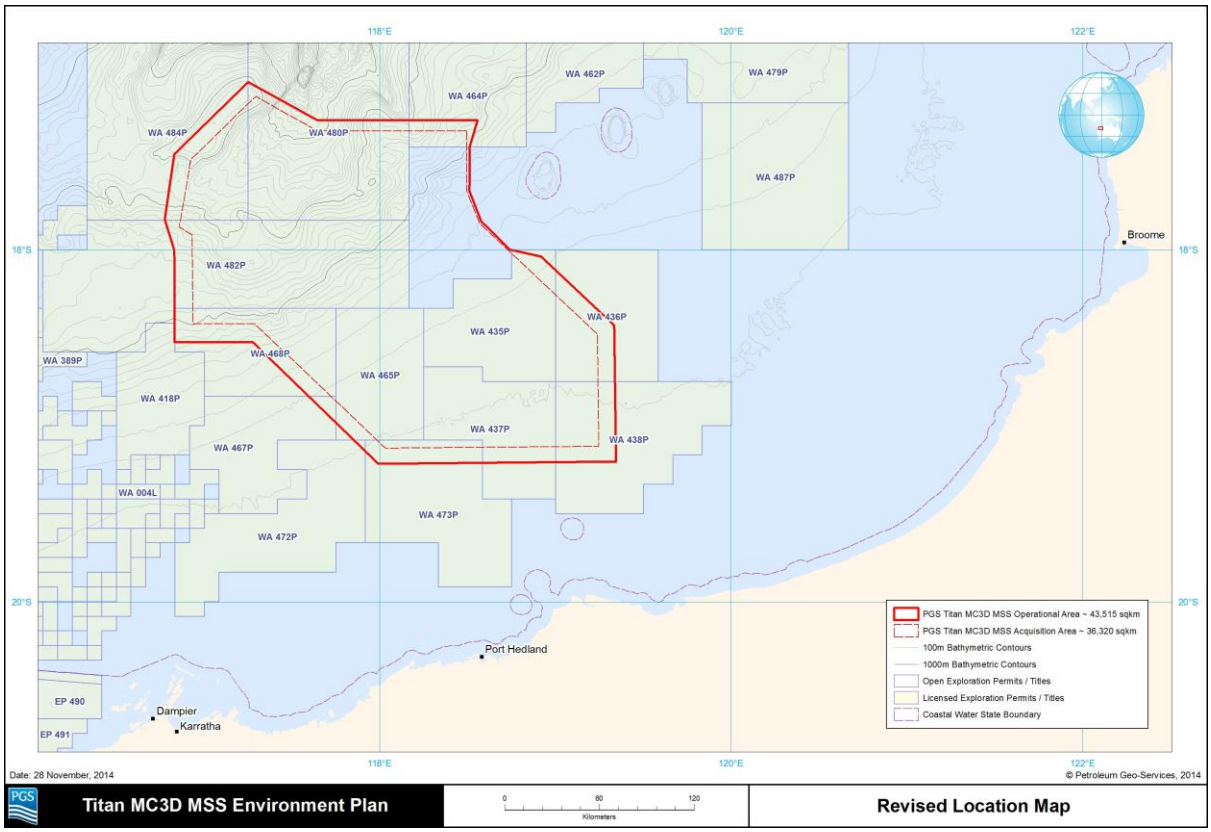


Figure 1.1- Location of the Operational Area for the Titan MC3D MSS

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 Titan MC3D 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.

The description includes Regional Setting (**Section 2.1**); Physical Environment (**Section 2.2**); Biological Environment (**Section 2.3**) and Socio-Economic Environment (**Section 2.4**) and covers the aspects of the environment that are relevant for consideration of the environmental risks and impacts of the proposed operations.

2.1. REGIONAL SETTING

The Titan MC3D MSS operational area lies entirely within Commonwealth marine waters of the NWMR. The NWMR extends from offshore of Kalbarri in Western Australia (WA) to the Western Australian / Northern Territory (NT) border and includes all waters three nautical miles (nm) from the territorial baseline to the 200 nm Exclusive Economic Zone (EEZ) boundary. The region is adjacent to, but does not cover, the State waters of WA.

The NWMR is divided into three large scale ecological systems based on the influence of primary ecological drivers such as the influence of ocean currents, seafloor features and eco-physical processes. These systems are the Kimberley, the Pilbara and the Ningaloo-Leeuwin systems. The Titan MC3D MSS overlaps the Pilbara system, which extends west of Broome on its northern boundary to the northern edge of the Exmouth Plateau while the southern boundary follows a line west of the North West Cape, along the southern boundary of Exmouth Plateau.

There are a number of islands and reefs within the NWMR. Cunningham Island (Rowley Shoals) is located ~45 km to the northeast; Bedout Island is located ~42 km to the south of the southern boundary; and the Dampier Archipelago is located, at the closest point (Legendre Island), ~175 km to the southwest of the western boundary.

2.2. PHYSICAL ENVIRONMENT

2.2.1. Climate and Meteorology

The NWMR is subject to an arid (mainly summer rain) subtropical climate with tropical cyclone activity from December to March. Weather is largely controlled by the seasonal oscillation of an anti-cyclonic belt. Winters are characterised by clear skies, fine weather and predominantly strong east to southeast winds and infrequent rain. Summer winds are more variable, but west to south-west predominates. Annual rainfall is typically low and highly variable, with most intense falls occurring during the first half of the ‘wet’ season. The region has a very high cyclone incidence and these occur primarily between December and March. Lower rainfall and humidity are typically associated with the Southeast Monsoon, in contrast to the high levels of rainfall and humidity associated with the Northwest Monsoon. The Pilbara Region is characterised by summer daily temperatures ranging between 22°C and 36°C, and winter mean daily temperatures of between 13°C and 32°C.

2.2.2. Oceanography

The NWMR's large scale currents are subject to strong seasonal variations, largely due to annual variation in the alongshore pressure gradient that is the main driver of the Region's surface currents. The South Equatorial Current and Eastern Gyral Current intensify during July-September. Similarly the Leeuwin Current is strongest in autumn, and diminishes during the North-west Monsoon in summer (December-March). This complex system of ocean currents changes between seasons and between years, generally resulting in the surface waters being warm, nutrient poor and of low salinity.

Overall, a key characteristic of the regional oceanography of the NWMR is the poleward flow of the main surface currents. The significant difference in steric height between the Pacific and Indian Oceans drives Pacific waters through the Indonesian archipelago via the Indonesian Throughflow (ITF) into the Indian Ocean. A portion of these waters eventually travel polewards via a strong alongshore pressure gradient. This pressure gradient is not present along the eastern edge of other major oceans and makes the Western Australian system unique globally.

During the southeast tradewinds (April to September), the predominant direction of the ocean current is west-southwest. In the monsoon season (December to March), winds come from the northwest or west, and the direction of the ocean current reverses, becoming east-northeast.

Astronomical tides on the NWMR are semi-diurnal and generally quite large. Tidal ranges increase in amplitude from south to north, corresponding with the increasing width of the shelf, and range from ~2 m at Exmouth to ~10 m near Broome. The Pilbara system is believed to have the strongest internal tides of the entire NWMR, which are thought to be an important physical driver in water depths of between ~50 and 500 m depth on the shelf. These internal tides result in the drawing up of deeper cooler waters into the photic zone, stirring up nutrients and triggering primary productivity, which is thought to be greatest at the 200 m isobath.

The region typically receives a persistent swell of around 2 m, generated by low-pressure systems in southern latitudes during winter; strong easterly winds can also generate 2 m seas. Both swell and seas tend to be smaller during summer. Tropical cyclones generate waves propagating out in a radial direction from the storm centre, and generate swells from any direction, with wave heights between 0.5 and 9.0 m.

2.2.3. Geomorphology

A range of topographic features such as canyons, plateaux, terraces, ridges, reefs, and banks and shoals are distinguishing features of the seafloor across the NWMR. The slope is relatively flat, but includes a number of large canyon heads that were probably excavated during and after continental break-up by sediment and water movements. Sediment transport on the shelf is largely influenced by tidal currents while on the slope and abyssal plains sediment transport is mostly influenced by large ocean currents and slope processes.

Water depths over the Titan MC3D MSS operational area range from ~60 m to ~3,400 m, with the deepest water depths located along the north-western boundary of the operational area, and the shallowest water depths located along the eastern boundary.

There are a number of reefs and islands in the Pilbara system of the NWMR adjacent to the Titan MC3D MSS operational area, including;

- Bedout Island:
  - located ~42 km to the south of the southern boundary of the operational area, and in WA State waters;
  - important breeding area and foraging area for the brown booby, lesser crested terns, lesser frigatebird, roseate tern; and

- Rowley Shoals:
  - ~40 km to the east of the eastern boundary of the operational area and in the Kimberley System (including Imperieuse, Clerke and Mermaid Reefs), the first two which are emergent features;
  - important resting area for the little tern; and
  - breeding and foraging area for the white-tailed tropicbird.

2.3. BIOLOGICAL ENVIRONMENT

2.3.1. Biological Productivity

Seasonal changes in the region's oceanography are the primary drivers of biological productivity in the NWMR. These include: weakening of the ITF and Leeuwin Current; the seasonal reversal in wind direction, which supports the development of currents such as the Ningaloo Current; conditions more favourable for upwelling on the NWS; and episodic events such as cyclones. As a result of the periodic nature of these changes, biological productivity follows boom and bust cycles, is sporadic and significantly geographically dispersed.

The offshore waters of the NWMR are oligotrophic with planktonic abundances most likely low, and is characterised by high species diversity but relatively low endemicity. Bentho-pelagic fish are a vital link in the trophic systems of the Region. As they migrate vertically between the pelagic and benthic (seafloor) systems they consume nutrients and aid the transfer of the nutrients between the two systems. Other processes also transfer nutrients from pelagic systems to benthic systems. Many deep-water benthic communities are either attached to the seafloor or have limited ranges and are heavily reliant upon nutrients in the form of detritus falling through the water column into the benthic environment.

Most of the NWMR species are tropical and also found in other parts of the Indian and western Pacific oceans. The NWMR contains more coastal and shelf fish species than anywhere else off the WA coast, particularly in the Kimberley and the NWS and is home to globally significant populations of internationally threatened species. The NWMR also supports internationally important breeding and feeding grounds for a number of threatened and migratory marine species, including humpback whales, which mate and give birth in the waters off the Kimberley coast. 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.

2.3.2. Biological Communities

The NWMR has high species diversity, but fewer endemic species than are present in cooler and more temperate waters. The Region contains more coastal and shelf fish species than anywhere else on the WA coast, and the high species richness partially reflects its strong biogeographic links with Indonesia and the west Pacific through the ITF.

The high species richness of the NWMR is 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. Soft bottom substrates include areas of sandy seafloor that support seagrass habitat along the Pilbara coast, muddy substrates on the slope, as well as the deep waters of the Cuvier Abyssal Plain and the Argo Abyssal Plain, which support sparsely distributed sessile organisms such as filter-feeding and deposit-feeding species.

Studies of the North West Shelf show a strong depth related structuring of the benthic environment, with epibenthos (corals and sponges) showing a decrease in observed percentage cover with increasing depths. The information that exists on sediments in the bioregion indicates that benthic communities are likely to include filter feeders and epifauna; however, there are no notable large populations of sponges in this system.

Biologically, the finfish fauna of this system is distinct from the Ningaloo-Leeuwin system. The system supports large prawn, scampi and crab populations, generally in inshore muddy sediments (DoF 2013) along with pearl oysters. As well as being preyed upon by large pelagic fish, crustaceans are also a significant food for cephalopods (squid and octopus species; DEWHA 2008a).

Over 8 species of cephalopod are believed to occur in the NWMR, with area between Kalbarri and the Dampier Archipelago particularly significant for octopus, dumpling squids and several species of cuttlefish (DEWHA 2008a). Squid are an important food item for a number of species in the NWMR including sperm whales and seabirds such as black noddies and red-footed boobies.

Other species known within the system include turtles, dugongs and whales (humpback whales aggregate in Exmouth Gulf during their southern migration and pass through the system on their way to and from breeding grounds in the Kimberley.

2.3.3. Protected Marine Fauna

A review of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) database (Protected Matters search tool; PMST) held by the Department of Environment (DoE) was conducted for the operational area described by the boundary coordinates provided in **Table 1.1**, with the application of a 1 km buffer zone. The Protected Matters search indicates a total of 93 marine species listed under the provision of protection status (9 listed as Threatened; 24 as Cetaceans; 20 as Migratory; and 64 Listed marine species) that

are likely to occur within, or adjacent to, the Titan MC3D MSS operational area. The 9 listed Threatened species that may occur in, or relate to, the operational area are as follows:

1. the blue whale;
2. the flatback turtle;
3. the green turtle;
4. the hawksbill turtle
5. the humpback whale;
6. the leatherback turtle;
7. the loggerhead turtle;
8. the great white shark; and
9. the whale shark.

The proposed Titan MC3D MSS operational area 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 Titan MC3D MSS operational area.

The PMST report identified one Key Ecological Feature (KEF) located within or adjacent to the Titan MC3D MSS operational area: the Ancient coastline at 125 m isobath.

The Biologically Important Areas (BIA) that overlap the Titan MC3D MSS operational area include:

- migration area (north and south) for the pygmy blue whale;
- migration area (north and south) for the humpback whale;
- foraging area for the whale shark;
- internesting areas for the flatback turtle; and
- breeding area for the brown booby, lesser frigatebird and white-tailed tropicbird.

2.3.3.1. Cetaceans

The EPBC Act database lists 24 cetacean species that may occur in, and adjacent to, the Titan MC3D MSS operational area, all of which are protected under the EPBC Act. One of these is classified as Endangered, the blue whale; and one as Vulnerable, the humpback whale.

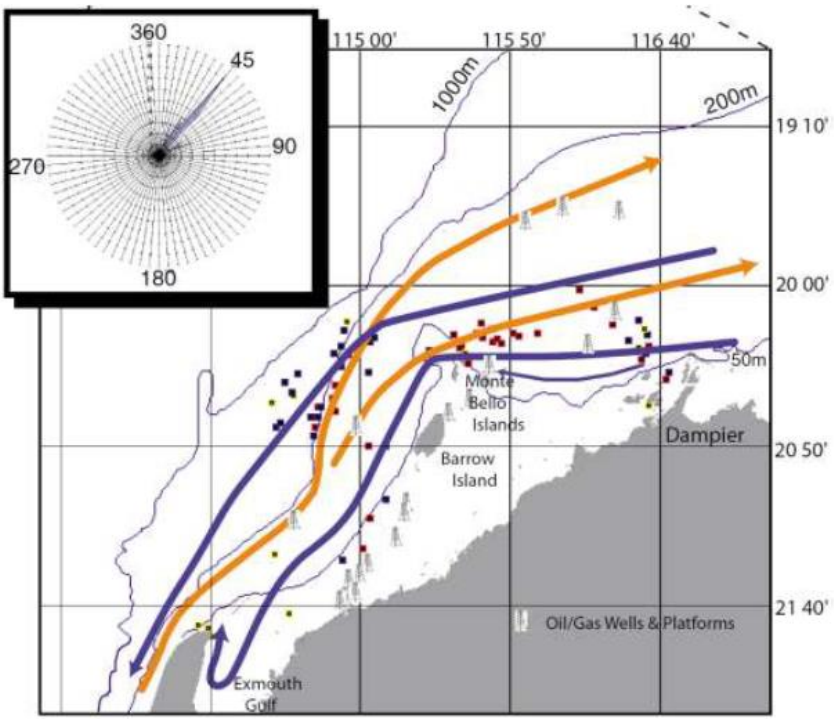
Humpback whale

Humpback whales are listed as Vulnerable and Migratory under the EPBC Act, are protected under the WA *Wildlife Conservation Act 1950* and are the most commonly sighted whale in northern WA waters. The species has been observed seasonally to complete their northern migration in the Camden Sound area of the west Kimberley, after feeding in Antarctic waters during the summer months.

During the northern migration, whales appear to remain on or within the 200m bathymetry line near the Montebello Islands, ~ 300km south of the Titan polygon. Sightings off Dampier Archipelago (~170km south of the Titan polygon) indicate that the humpbacks whales may

extend out to the edge of the continental shelf at ~130 km (70nm) offshore. However, studies of populations further north between the Dampier Archipelago and Broome, found that north and south bound whales were encountered in equal numbers near the 30m depth contour off Eighty Mile beach (~ 50km offshore). Even though surveys went further offshore (~ 60 to 70m depth contour, which is approximately 100 km), no denser concentrations were found. Similarly, opportunistic observations from a fishing vessel in 1998, identified 31 pods that were both north and south bound, along the 30m contour. This was further reinforced by a subsequent transit survey conducted by the Centre for Whale Research when travelling from Broome to Fremantle.

The two maps presented in **Figure 2.1** identify where actual sighting of whales were recorded and their proximity to the coastline. It should be noted that the arrows showing the north and south migration routes are only 'estimated 'by Jenner *et al* (2001).



Red dots= northbound, blue = south bound

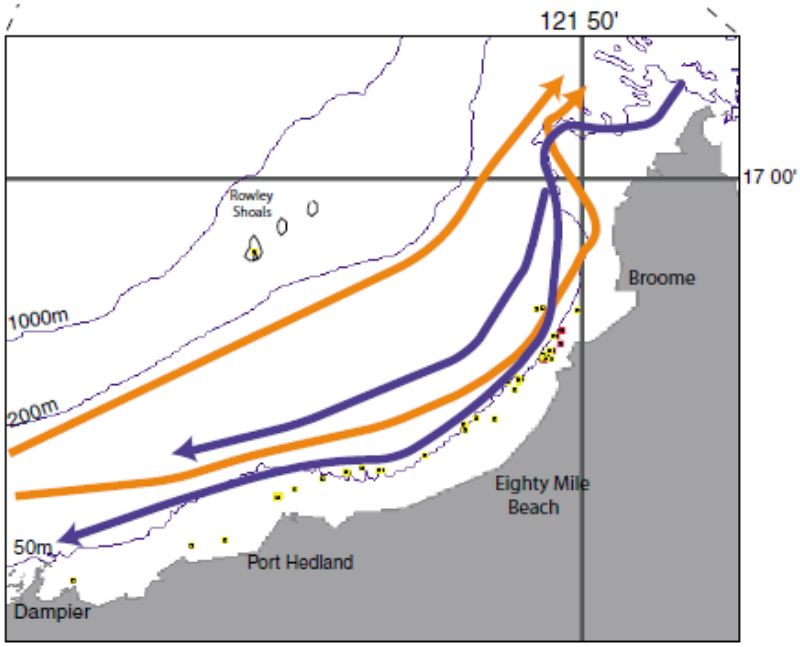


Figure 2.1 - 'Estimated' Humpback whale migratory routes and actual observation points near the Dampier Archipelago and Pilbara coast.
Actual sightings are recorded as points (yellow = north bound)
Source: modified from Jenner *et al.* (2001).

The NW Marine Bioregional Plan (DEWHA 2008) states: '*The following BIA have been identified for humpback whales: migration corridor from the southern border of the North-west Marine Region to the breeding and calving grounds in the north of the Kimberley. The migration corridor represents the route for northern and southern migrating humpback whales*." Subsequently, despite some outliers in deeper water, and based on the available scientific evidence, the DoE has determined that the BIA for northern and southern migration extends to approximately 100km offshore.

Blue/pygmy blue whale

Blue whales are widely distributed throughout the world's oceans. This species has been recorded offshore in all states excluding the Northern Territory. Their migration paths are widespread and do not clearly follow coastlines or particular oceanographic features. The blue whale is rarely present in large numbers outside recognised aggregation areas. Blue whales are believed to calve in tropical waters in winter and births peak in May to June; however, the exact breeding grounds of this species are unknown.

In the NWMR, pygmy blue whales (*Balaenoptera musculus brevicauda*) migrate along the 500 m to 1,000 m depth contour on the edge of the slope, and are likely to be feeding on ephemeral krill aggregations. The northbound component of this migration takes place from May to mid-August, with a peak in July–August, and the southbound component occurs from late October to November–December, with a few isolated individuals moving south in January, and the migration appears to be centred on the 500 m depth contour.

The Titan MC3D MSS operational area overlaps the BIA for pygmy blue whales. Consequently, there is the possibility that migrating (and possibly feeding) pygmy blue whales may be encountered in the deeper waters of the Titan MC3D MSS operational area. However, it is unlikely that significant numbers of individuals will be encountered as the majority of animals will be moving north/south offshore of the Titan MC3D MSS operational area, as supported by the satellite tracking data shown in **Figure 2.2**.

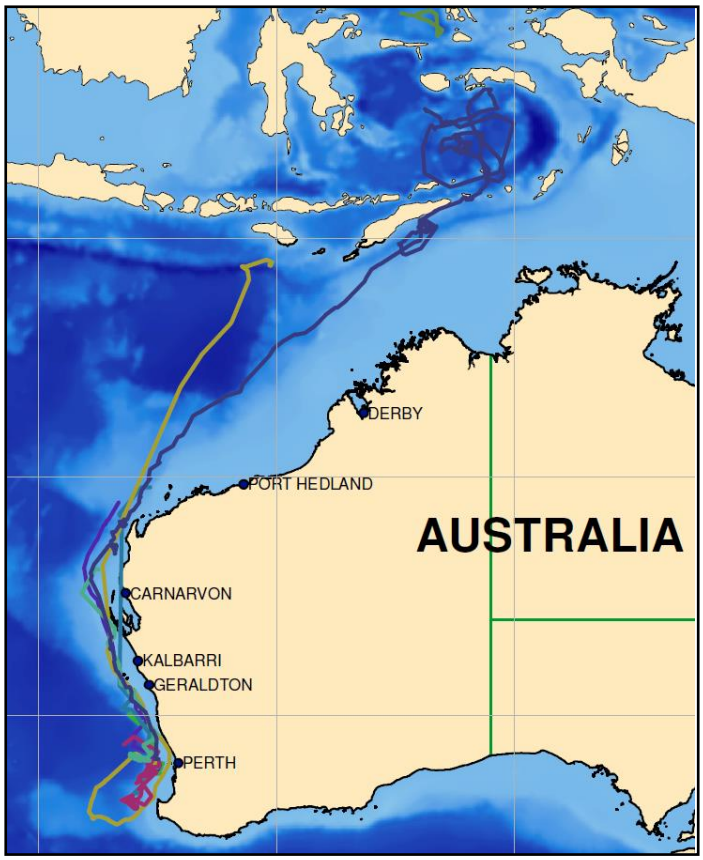


Figure 2.2 - Satellite tracking of blue whales in 2010/2011
Source: Modified from Double *et al*. 2012.

Dolphins

Dolphins are relatively common in the waters of the NWS. Species known to occur in this region include the common, bottlenose and Risso's dolphins. The bottlenose dolphin is a cosmopolitan species found in all Australian waters (except the Northern Territory), and is coastal, estuarine, pelagic and oceanic in nature. Common dolphins are recorded in all Australian waters and are not thought to be migratory. Risso's dolphin is distributed through all oceans, occurs inshore and offshore, but is generally considered pelagic and oceanic. The Titan MC3D MSS operational area does not contain any significant or limiting habitat or feeding grounds for these dolphin species.

2.3.3.2. Sharks

The whale shark (*Rhincodon typus*) 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. In WA, whale sharks are protected under the *Wildlife Conservation Act 1950*, the *Conservation and Land Management Act 1984* and the *Fish Resources Management Act 1994*. This species is normally oceanic and cosmopolitan in their distribution occurring in both tropical and temperate waters. They are known to aggregate in the reef front waters adjacent to the Ningaloo Reef between March – July. A BIA (foraging area) for the whale shark overlaps the Titan MC3D MSS operational area.

The Titan MC3D MSS operational area does not represent any critically important areas (migration, breeding or foraging areas) for the whale shark. It is possible that whale sharks may be encountered during individual surveys undertaken within the operational area. However, it is not expected that whale sharks will be encountered in significant numbers and those individuals that are encountered are likely to be transient.

The shortfin mako and longfin mako sharks are listed as Migratory under the EPBC Act. The longfin mako is a widely distributed but rarely encountered oceanic shark that ranges from Geraldton around the north coast to at least Port Stephens. The shortfin mako is an oceanic and pelagic species, although they are occasionally seen inshore. They are found throughout temperate seas but are rarely found in waters colder than 16°C.

2.3.3.3. Marine Turtles

The PMST identified five species of marine turtle that may occur within or in the waters surrounding the Titan MC3D MSS area, including the flatback, green and hawksbill turtle, (all listed as Vulnerable and Migratory) and the leatherback and loggerhead turtle (listed as Endangered and Migratory). Eighty Mile Beach has been identified as a major nesting site for the flatback turtle. For the green turtle, Lacepede Islands and to a lesser extent North Turtle island have been identified as nesting areas.

2.3.3.4. Sea Snakes

Sea snakes are widespread through the waters of the NWS in offshore and near-shore habitats. They can be highly mobile and cover large distances or they may be restricted to relatively shallow waters and some species must return to land to eat and rest. Most sea snakes have shallow benthic feeding patterns and are rarely found in water depths exceeding 30 m. However, very little is known about the distribution of the individual species of sea snakes in the region. Given the water depths over the operational area (~60 m to ~3,400 m) and distance offshore (> 83 km) it is unlikely that sea snakes will be encountered during individual surveys undertaken within the Titan MC3D MSS operational area

2.3.3.5. Seabirds

The Titan MC3D MSS operational area extends almost to the continental shelf, but there is little information concerning the populations of seabirds utilising these offshore waters. A search of the EPBC Protected Matters database listed four species that may occur in the Titan MC3D MSS operational area: the brown booby *(Sula leucogaster),* the lesser frigatebird *(Fregata ariel),* the white-tailed tropicbird (*Phaethon lepturus*) and the osprey *(Pandion haliaetus),* all listed Marine Species and all, except the osprey, listed as migratory. The BIAs (foraging) for the brown booby, lesser frigatebird and the white-tailed tropicbird overlap the operational area. However, given their mobility and foraging range, although

some individuals may be encountered during the survey it is unlikely to be in significant numbers.

2.4. SOCIO-ECONOMIC ENVIRONMENT

2.4.1. Commercial Fisheries

The proposed Titan MC3D MSS has the potential to interact with several Commonwealth and State-managed fisheries. The following section details the commercial fisheries that may be operating within, or adjacent to, the operational area.

2.4.1.1. Commonwealth Fisheries

Commonwealth fisheries are managed by the Australian Fisheries Management Authority (AFMA) and operate from 3 nm of baseline out to 200 nm (the extent of the Australian Fishing Zone - AFZ). The Titan MC3D MSS has the potential to overlap the following Commonwealth-managed fisheries:

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

North West Slope Trawl Fishery

The NWSTF operates off north Western Australia from 114°E to 125°E, roughly between the 200 m isobath and the outer boundary of the Australian Fishing Zone. The NWSTF has traditionally targeted scampi and deep-water prawns. However, in recent years, Australian scampi has been the main target of the fishery. In recent years (2006-2011) most of the effort and catch within the fishery has occurred in shallower, upper slope waters (350-600 m) to the southwest and northeast of the Rowley Shoals. Therefore, it is possible that vessels fishing in the NWSTF could operate in the vicinity of the Titan MC3D MSS operational area during the proposed activities. However, since only two vessels were active in 2011-12, interactions are expected be minimal.

Southern Bluefin Tuna Fishery

The SBTF targets juvenile southern bluefin tuna (2–3 years old) in the GAB using purse-seine gear, mainly from December to April. Throughout the rest of its range, southern bluefin tuna is targeted by pelagic longliners. Activities in the SBTF are primarily confined to the waters off southern Australia (such as the GAB) with smaller areas along the south east coastline, such as northeast of Eden in New South Wales. Therefore activity in this fishery does not overlap the Titan MC MSS operational area.

Western Skipjack Fishery

The WSTF is not active in continental shelf waters of the Carnarvon Basin. The skipjack tuna (*Katsuwonus pelamis*) is the only target species in the fishery and in recent years, activities in the WSTF have largely been confined to waters in the GAB and northeast of Eden in New South Wales. No Australian vessels were active in either zone (Western or Eastern) of the WSTF during the 2010–11 fishing season. Therefore activity in this fishery does not overlap the Titan MC MSS operational area.

Western Tuna and Billfish Fishery

The WTBF extends from Cape York westwards around the NT and WA coast and across to the Great Australian Bight, out to the limit of the AFZ and includes additional areas around Cocos and Christmas Islands. The majority of catch and effort in the WTBF occurs in Commonwealth waters off the central west coast of WA, with fishing effort in the northwest located north of Broome in the Kimberley, west of Scott Reef with the majority of effort concentrated south of Geraldton (approx. 30°S). The Titan MC3D MSS operational area overlaps the WTBF current fishing area; therefore, it is possible that vessels fishing in these areas could operate in the vicinity of the survey vessel(s). However, no fishing occurred within the Titan MC3D MSS operational area in 2012, so the likelihood of interaction is minimal.

2.4.1.2. State Administered Fisheries

There are a number of State-managed fisheries that are in the vicinity of the Titan MC3D MSS operational area. The State fisheries administered by the WA Department of Fisheries (DoF) are:

- Mackerel Managed Fishery (MMF);
- Pilbara Demersal Scalefish Fisheries (PDSF);
    - Pilbara Fish Trawl (Interim) Managed Fishery (PFTIMF);
    - Pilbara Trap Managed Fishery (PTMF);
    - Pilbara Line Fishery (PLF);
- Pearl Oyster Managed Fishery (POMF); and
- West Coast Deep Sea Crustacean Managed Fishery (WCDSCF).

Mackerel Managed Fishery

The MMF uses near-surface trolling gear from small vessels in coastal areas around reefs, shoals and headlands to target Spanish mackerel. Jig fishing is also used to capture grey mackerel with other species from the genera *Scomberomorus*, *Grammatorcynus* and *Acanthocybium* also contributing to commercial catches. Permit holders may only fish for mackerel by trolling or hand-line.

The fishery extends from the West Coast Bioregion to the WA/NT border, with most effort and catches recorded north of Geraldton, especially from the Kimberley and Pilbara coasts. The fishery is divided into three Areas – Area 1 – Kimberley (121°E to WA/NT border); Area 2 – Pilbara (114°E to 121°E); Area 3 – Gascoyne (27°S to 114°E) and West Coast (Cape Leeuwin to 27°S). There are currently 49 permits in the fishery with 15, 15 and 19 permits in Areas 1, 2 and 3 respectively, with the combined quota allocations being consolidated onto 14 boats operating within the fishery (DoF 2013). The total catch for 2012 was 318.1 t, which was in an acceptable range for the fishery. The majority of catch occurs in Area 1 (Kimberley), and in 2012 was 180.3 t (DoF 2013); while Area 2 (Pilbara) catch was 88.0 t.

The Titan MC3D MSS overlaps Area 2 of the MMF. Therefore, it is possible that vessels fishing in Area 2 of the MMF could operate in the vicinity of the operational area during the proposed activities. However, due to the Titan MC3D MSS operational area's distance offshore and that effort and catch within this region (Area 2) is low, it is unlikely that there will

be any interactions between surveys in the Titan MC3D MSS operational area and vessels fishing in the MMF.

Pilbara Fish Trawl (Interim) Managed Fishery
The PFTIMF is situated in the Pilbara region in the north west of Australia. It occupies the waters north of latitude 21°35'S and between longitudes 114°9'36"E and 120°E. The fishery is seaward of the 50 m isobath and landward of the 200 m isobath. The fishery consists of two zones; Zone 1 in the south west of the fishery (which is closed to trawling) and Zone 2 in the north, which consists of six management areas. Part of the Titan MC3D MSS operational area overlaps Zone 2 (Area 4, 5 and 6) of the PFTIMF. Therefore, it is possible that vessels fishing in these areas could operate in the vicinity of the survey vessel(s). However, as there are only 3 full-time active vessels, the likelihood of interaction is low.

Pilbara Trap Managed Fishery
The PTMF lies north of latitude 21°44'S and between longitudes 114°9.6'E and 120°00'E on the landward side of a boundary approximating the 200 m isobath and seaward of a line generally following the 30 m isobath. The Titan MC MSS operational area overlaps the PTMF. Therefore, it is possible that vessels fishing in these areas could operate in the vicinity of the survey vessel(s). However, as there are only 3 full-time active vessels, the likelihood of interaction is low.

Pilbara Line Fishery
The PLF license holders are permitted to operate anywhere within "Pilbara Waters". This means all waters bounded by a line commencing at the intersection of 21°56'S latitude and the high water mark on the western side of the North West Cape on the mainland of Western Australia; then west along the parallel to the intersection of 21°56'S latitude and the boundary of the Australian Fishing Zone (AFZ) and north to longitude 120°E. The PLF is managed under the Prohibition on Fishing by Line from Fishing Boats (Pilbara Waters) Order 2006. Nine fishing boat licenses are exempt from this prohibition for any nominated 5-month block period within the year. The total annual catch of scalefish taken by the PLF is historically much lower than is taken by the trawl and trap fisheries. The Titan MC3D MSS operational area overlaps a large portion of the western half of the PLF. Therefore, it is possible that vessels fishing in the PLF could operate in the vicinity of the operational area during the proposed activities. However, given the size of the permitted area, and that only nine vessel operate with licences, it is unlikely that there will be any interactions between vessel(s) in the Titan MC3D MSS operational area and vessels fishing in the PLF.

Pearl Oyster Managed Fishery
The WA pearl oyster fishery is the only remaining significant wild-stock fishery for pearl oysters in the world. It is a quota-based, dive fishery, operating in shallow coastal waters along the NWS. The Western Australian pearling industry comprises three main components: the collection of pearl oysters from the wild; production of hatchery-reared pearl oysters; and grow-out of pearls on pearl farm leases. Quota limits are set for the take of pearl oysters from the wild to ensure the long-term sustainability of the resource.

In Western Australia pearl oyster spawning begins from September to October, with peaks from late October to December and February to March, to the autumn months of April and

May. There is variability from month to month, the primary spawning occurs from the middle of October to December and a smaller secondary spawning occurs in February and March.

During the last decade the total number of oysters fished annually from the main fishing grounds of the Pearl Oyster Fishery (Zone 2/3) has remained stable, varying by less than 10%. Generally, pearl divers are not allowed to collect pearl oysters unless they are a minimum size of 120 mm in shell length. However, for the 2012 and 2013 fishing seasons, pearl divers were permitted to take a sustainable amount of pearl oysters of a size no less than 100 mm, on a trial basis, for research purposes.

The Titan MC3D MSS operational area is located in Fishing Zone 1 and 2 of the POMF. There are five licences within Zone 1 and nine within Zone 2. However, no fishing has been undertaken in Zone 1 since 2008, and given that the POMF is a dive fishery operating in shallow coastal waters (<35 m water depth), it is extremely unlikely that there will be any activity in this fishery in the deeper offshore waters of the survey area.

West Coast Deep Sea Crustacean Managed Fishery
The boundaries of this fishery include all the waters lying north of latitude 34°24'S (Cape Leeuwin) and west of the Northern Territory border on the seaward side of the 150m isobath out to the extent of the AFZ. The WCDSCF targets crystal (snow) crabs (*Chaceon albus*), giant (king) crabs (*Pseudocarcinus gigas*) and champagne (spiny) crabs (*Hypothalassia acerba*) using baited pots operated in a long-line formation in the shelf edge waters (>150 m) of the West Coast. The WCDSCF is a quota based 'pot' fishery that operates mainly in depths of 500-800 m. No fishing is permitted in depths <150 m, with the only allowable method for capture being baited pots ('traps').

The Titan MC3D MSS operational area overlaps the WCDSCF. Optimal fishing effort occurs in deep offshore waters between 500 and 1000 m, on the continental shelf slope and the Exmouth Plateau. Therefore, it is possible that vessels fishing in the WCDSCF could operate in the vicinity of the operational area during the proposed activities. However, given that only a small portion of the 'optimal fishing zone' passes through the Titan MC3D MSS operational area, it is unlikely that there will be any interactions between surveys and vessels fishing in the WCDSCF.

2.4.2. Petroleum Exploration and Production

There are no offshore production facilities within or immediately adjacent to, the Titan MC3D MSS operational area.

2.4.3. Commercial Shipping

Within the NWMR, there is significant commercial shipping activity, the majority of which is associated with the mining and oil and gas industry. Major shipping routes in the area are associated with entry to the Port of Dampier, Port Hedland and Barrow Island with less traffic through the Port of Broome.

The Australian Maritime Safety Authority's (AMSA) nautical section was identified as a stakeholder and contacted regarding the proposed Titan MC3D MSS and subsequently supplied details of the location of shipping fairways that overlap and are adjacent to the

operational area. Consultation with AMSA will be ongoing prior to and throughout the duration of the survey.

2.4.4. Tourism and Recreation

Due to the location of the Titan MC3D MSS operational area and distance to Port Hedland (~125 km) and the Pilbara region, there are no recreational activities (such as recreational fishing and marine-based tourism) undertaken in the area. However, the Rowley Shoals (~40 km from the operational area) do have limited visitation, with the most occurring between the months of August and November.

2.4.5. Cultural Heritage

There are no known current or pending Native Title Determinations for the waters and seabed within or immediately adjacent to the Titan MC3D MSS operational area.

There are two historic shipwrecks listed on the National Shipwrecks Database indicates in the vicinity of the Titan MC3D MSS operation area. The nearest historic shipwrecks, are the *Pelsart* at ~39 km, and the *Lively* at ~110 km from the Titan MC3D MSS operational area.

2.4.6. National Heritage

There are no places listed on the Commonwealth Heritage List within or immediately adjacent to the Titan MC3D MSS operational area.

2.4.7. Marine Parks and Reserves

The Titan MC3D MSS operational area overlaps the Argo-Rowley Terrace Commonwealth Marine Reserve (ATCMR) Multiple Use Zone IUCN Category VI. The ATCMR is located ~264 km west of Broome, and is the largest reserve in the northwest region. The reserve provides protection for the communities and habitats of the deeper offshore waters of the region in depth ranges from 220 m to over 5000 m. The ATCMR surrounds the Rowley Shoals as well as parts of the Rowley Terrace, Scott Plateau and Argo Abyssal Plain. The Scott Plateau may be a breeding site for sperm and beaked whales and is a significant seafloor feature in this area. It is fringed by numerous spurs and valleys and is separated from Rowley Terrace by a number of major canyons believed to support large fish aggregations, which in turn attract larger order predators. The upper and mid-slope areas of the continental slope also support rich and diverse demersal fish communities with a high level of endemism.

2.4.1. Other Protected Areas

There are no listed World Heritage Properties or Ramsar Wetlands of International Importance within or immediately adjacent to the Titan MC3D MSS operational area or surrounding waters.

2.4.2. Defence Activities

There are no defence activities overlapping the Titan MC3D MSS operational area.

3. DESCRIPTION OF ACTIVITY

The proposed marine seismic survey 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 proposed survey will be conducted using purpose-built seismic survey vessel(s).

During the proposed activities, the survey vessel(s) will traverse a series of pre-determined sail lines within the Titan MC3D MSS operational area at a speed of ~4.5 knots. As the vessels travel 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(s). The reflected sound is then processed to provide information about the structure and composition of geological formations below the seabed in an attempt to identify hydrocarbon reservoirs.

The seismic array will comprise of 10 to 16 solid streamers, with a length of 8,000 m. Streamer spacing will be 100-150m, and line spacing will be between 500 and 700 m. The source (airgun array) tow depth will be 5-9 m and the streamer tow depth will be ~15 m. The airgun array will consist of two 4,130 cui arrays (maximum volume), each consisting of 3 sub-arrays. The source level has been selected as low as reasonably possible, to identify hydrocarbon targets ~4,000 to 4,500m deep. These arrays will be fired alternately, with a shot point interval of ~18.75 m horizontal distance.

PGS proposes to conduct the Titan MC3D MSS using purpose-built seismic survey vessel(s) from the PGS fleet. Any survey vessel(s) used will have all necessary certification/registration and be fully compliant with all relevant MARPOL and SOLAS convention requirements specific for the vessels size and purpose. One or more support vessels 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(s) will also re-supply the survey vessel with fuel and other logistical supplies if required.

Two survey vessels may acquire data at the same time within the Titan MC3D MSS operational area. Vessels would be spaced at least 40 km apart, so the cumulative effects of noise on the surrounding environment will be negligible. This is consistent with the number of multi-client surveys acquired by the industry in recent years, so there is no increased risk associated with permitting a larger area. The cumulative effects of whether or not the surveys are consecutive or simultaneous is not an issue as PGS will commit, under the EP, to applying certain temporal and spatial restrictions that negate any chance of the surveys having a significant impact on the environment, or on the activities of other marine users.

4. DETAILS OF ENVIRONMENTAL IMPACTS AND RISKS

4.1. ENVIRONMENTAL RISK ASSESSMENT METHODOLOGY

An Environmental Risk Assessment (ERA) of the proposed Titan MC3D 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 risk has been measured in terms of likelihood and consequence, where consequence is defined as the outcome or impact of an event, and likelihood as a description of the probability or frequency of the identified consequence occurring. The key steps used for the risk assessment are shown in **Figure 4.1**.

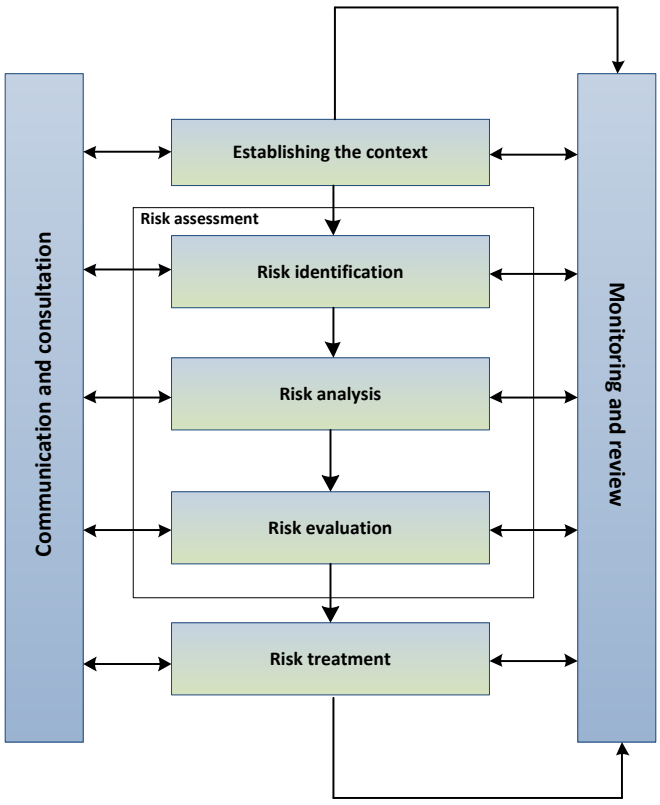


Figure 4.1 - Key Steps used for Risk Assessment

The environmental risks associated with the proposed seismic survey operations have been assessed by a methodology (see **Figure 4.1**) that:

- identifies the activities and the environmental aspects associated with them;
- identifies the values/attributes at risk within and adjacent to the Titan MC3D MSS operational area;
- 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 likelihood of occurrence for the key potential environmental impacts from the Titan MC3D MSS has been estimated based on industry incident reporting (see **Table 4.1**). **Table 4.1** also includes a qualitative description of environmental effects assigned to each category of consequence.

Table 4.1- Definitions for Qualitative Assessment of Likelihood and Environmental Effects

Likelihood	**Qualitative description of likelihood**
Unlikely	Impact has not occurred in the past and there is a low probability that it will occur in exceptional circumstances.
Possible	Impact may have occurred in the past and there is a moderate probability that it will occur at some time.
Likely	Impact has occurred in the past and there is a high probability that it will occur at some time.
Highly Likely	Impact has been a common problem in the past and there is a high probability that it will occur in most circumstances.
Routine	Impact will occur, is currently a problem in the area or is expected to occur in almost all circumstances.
Consequence	**Qualitative description of environmental effects**
Slight	Possible incidental impacts to flora and fauna in a locally affected environmental setting. No ecological consequences.
Minor	Reduction of the abundance/biomass of flora and fauna in the affected environmental setting. No changes to biodiversity or ecological system.
Moderate	Reduction of abundance/biomass in the affected environmental setting. Limited impact to local biodiversity without loss of pre-incident conditions.
Severe	Substantial reduction of abundance/biomass in the affected environmental setting. Significant impact to biodiversity and ecological functioning. Eventual recovery of ecological systems possible, but not necessarily to the same pre-incident conditions.
Catastrophic	Irreversible and irrecoverable changes to abundance/biomass in the affected environmental setting. Loss of biodiversity on a regional scale. Loss of ecological functioning with little prospect of recovery to pre-incident conditions.

Table 4.2 shows the overall environmental risk assessment matrix (also referred to as an event potential matrix) that compares the likelihood and consequences of potential environmental impacts arising from the Titan MC3D MSS and assigns a level of risk.

Table 4.2- Generic 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. IDENTIFICATION OF RISKS AND IMPACTS

The environmental risks and potential environmental impacts of the proposed Titan MC3D MSS have been determined on the basis of PGS's previous seismic survey experience in the region and the outcomes of the ERA.

4.2.1. 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 or 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 vessels;
- accidental discharge of hydrocarbons and chemicals to the ocean from survey and support vessels;
- interactions with commercial fishing and shipping; and

- operation of the survey and support vessels within, or in the vicinity of protected areas and heritage places.

4.2.2. 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, shipping and defence activities;
- disturbance to heritage and conservation values.

4.3. 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.

4.3.1. Disturbance to Marine Fauna

4.3.1.1. Discharge of Underwater Seismic Pulses

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 of marine organisms;
- 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.

Based on empirical measurements of a number of seismic airgun sources in western and southern Australian waters (Dr Rob McCauley, CMST Curtin University, pers. comm., June

2009), the sound pulses from this airgun array are expected to decrease to SEL in the order of 165 to 175 dB re 1µPa^2.s within 1 km of the source and ~160 dB re 1µPa^2.s within 2 km, dependent on the sound propagation characteristics of the area.

In relation to cumulative noise levels, an environmental review recently published by the Bureau of Ocean Energy Management indicated that the typical radii for a 160-dB threshold for a large airgun array was measured at no more than 10 km. Furthermore, the review suggests the implementation of a 40km geographic spacing between survey vessels working simultaneously to leave a potential 20 km 'corridor' between vessels.

Disturbance to Benthic Invertebrates

Few marine invertebrates have sensory organs that can perceive sound pressure, but many have organs or elaborate arrays of mechanoreceptors that are sensitive to hydro-acoustic disturbances. 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.

In a summary of impacts of seismic airguns on marine invertebrates it was found 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 Planktonic Organisms

Except for fish eggs, larvae and other minute planktonic organisms within a few metres of an airgun, no planktonic organisms are likely to be affected significantly by airgun array discharges. The range of pathological effects on fish eggs and larvae is likely to be restricted to less than approximately 2 m, and calculations show that less than 0.02% of plankton in the area would be affected. Any effect on the planktonic organisms from the seismic discharge is insignificant compared with the size of the planktonic population in a survey area or natural mortality rates for planktonic organisms.

Disturbance to Fish

Potential impacts on fish species related to the operation of survey airgun arrays include pathological trauma or mortality, and behavioural avoidance of seismic sound sources. Indirect effects include reduced catches resulting from changes in feeding behaviour and vertical/horizontal distribution.

Based on existing information, significant impacts on fish populations 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.

Available evidence suggests that behavioural changes for some fish species may be no more than a nuisance factor. For example, the temporary, short range, displacement of pelagic or migratory fish populations may have insignificant repercussions at a population level.

There is a high likelihood that seismic airgun noise could cause the following effects in some finfish:

- 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.

There are no documented cases of fish mortality upon exposure to seismic airgun noise under field operating conditions.

Disturbance to Whale Sharks

Limited research has been conducted on shark responses to marine seismic surveys. Sharks differ from bony fish in that they have no accessory organs of hearing such as a swim bladder and therefore are unlikely to respond to acoustical pressure. Other reports indicate that sharks are highly sensitive to sound between ~40 and 800 Hz, which overlaps with seismic sound frequencies.

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 Titan MC3D MSS operational area, do not represent critical habitat for whale sharks. Any whale sharks in the area are likely to be transient—i.e., moving through the Titan MC3D MSS operational area and adjacent waters during migratory movements to and from the Ningaloo Reef area.

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’. Airgun exposure tests on a caged green turtle and loggerhead turtle that were extrapolated to response levels for a typical airgun array operating at full power in 100 m water depth concluded that turtles would, in general, probably show behavioural responses at 2 km and avoidance behaviour at

1 km from such operations. However, it was also noted that such rules of thumb for acoustic sources with frequencies within the range of turtle hearing (<1 kHz), cannot be reliably applied to shallow coastal waters near reefs, islands and nesting beaches, where transmission losses are typically much higher than in deeper, open water areas.

Marine turtles may possibly be exposed to noise levels sufficient to cause physical damage if airgun arrays start suddenly with turtles nearby (less than 30 m). In circumstances where arrays are already operating, (i.e., as a vessel moves along an acquisition line) individuals would be expected to implement avoidance measures before entering ranges at which physical damage might take place.

Based on current information, it would appear that significant impacts on marine turtle populations resulting from seismic survey noise are likely to be restricted to:

- short ranges and high sound intensities (perhaps less than 30 m range from source);
- surveys that take place over protracted periods close to areas important for feeding, breeding and nesting; and
- surveys that take place over protracted periods close to areas that constitute narrow, restricted migratory paths.

Overlap with Critical Turtle Habitats and Peak Periods of Activity

The southern tip of the survey operational area overlaps with the internesting buffer BIA of the flatback turtle. The nearest turtle rookery is approximately 75 km to the south of the operational area, at North Turtle Island.

It is possible that some acquisition may coincide with the nesting, internesting and hatching periods for green (November to April), flatback (November to March), loggerhead turtles (January to March) and hawksbill turtles (year round) in the region.

Turtles do occur within the Rowley Shoals Marine Park (DEC 2007) and in and around Mermaid Reef (DNP 2013); however, these reefs are not known to be regionally significant turtle habitats. Therefore, turtles may be encountered the Titan MC3D MSS. However, given the offshore location of the Titan MC3D MSS operational area and distance to known nesting beaches it is unlikely they will be present in significant numbers.

Disturbance to Cetaceans

Baleen Whales

Baleen whales produce a rich and complex range of underwater sounds and studies of their hearing apparatus suggests that their hearing is also best adapted for low frequency sound. Baleen whales make individual sounds that are believed to be used in social interactions and communication between individuals and groups that may reach levels as high as 192 dB re 1µPa^2 (Richardson *et al.* (1995) and McCauley *et al.* (2003).

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, while McCauley *et al*. (2003) found that migrating humpback whales show a general avoidance of an operating seismic source at 157 to 164 dB re 1µPa.

Noise associated with airguns used during seismic surveys can cause 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. 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. The Titan MC3D MSS polygon does not overlap known critical habitats for any cetacean species.

Toothed Whales

Toothed whales produce a wide range of whistles, clicks, pulsed sounds and echolocation clicks. The sounds produced other than echolocation clicks are very complex in many species and appear to be used for communication between members of a pod in socialising and coordinating feeding activities.

There is little systematic data on the behavioural response of toothed whales to seismic surveys. Smaller toothed cetaceans have poor hearing in the low frequency range of airgun array noise (10 to 300 Hz) and seismic operators sometimes report dolphins and other small toothed whales near operating airgun arrays. However, there are components of seismic pulses in the higher spectrum and in general most toothed whales do show some limited avoidance of operating seismic vessels. The hearing capability of larger toothed whales (such as the killer whale) is unknown, but it is possible that they can hear better in the lower frequencies than the smaller toothed cetaceans. If this is the case, in lieu of any other information, their reactions to seismic survey vessels may be akin to those of the baleen whales. It is considered that the potential adverse effect on toothed whales would only occur if the whale was within close range (i.e., less than a few hundred metres). The Titan MC3D MSS polygon does not overlap known critical habitats for any cetacean species.

4.3.1.2. Light Generation

Owing to their migratory habits, all six species of turtle have the potential to be present in open ocean habitats throughout the Titan MC3D MSS operational area, albeit in low densities. Therefore, the probability of artificial light impacts on turtles is also low; particularly given the distance between the operational area and the nearest shallow water/emergent feature (Cunningham Island ~45 km to the northeast of the operational area).

It is possible that seabirds may fly over the Titan MC3D MSS operational area. However, it is not anticipated that the Titan MC3D MSS will have an impact on any species of seabird, due to their mobility and distance of the survey area to any nesting sites for seabirds.

The potential impacts to other marine fauna of light emissions from seismic vessels is expected to be restricted to localised attraction, temporary disorientation and increased predation and as such, any impacts arising from light emissions are considered to be minor and localised to a small proportion of the population.

4.3.1.3. Vessel and Towed Equipment Interactions with Marine Fauna

Survey and support vessels working within, and travelling to and from the Titan MC3D MSS operational area may present a potential physical hazard (e.g., animal displacement or vessel strike) to marine fauna including whales, dolphins, whale sharks and 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. However, marine seismic surveys involve the use of two or more vessels travelling at slow speed (around 4.5 knots) along defined paths and therefore pose low risk. 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.

4.3.2. Disturbance to Benthic Habitats

4.3.2.1. Anchoring

Anchoring will not occur within the Titan MC3D MSS operational area due to the water depths within the area (~60 – 3,400 m). Anchoring outside the Titan MC3D MSS polygon would only occur in emergency circumstances and the survey and support vessels are fitted with highly sophisticated position fixing equipment.

4.3.2.2. Vessel Grounding

The potential for the survey and support vessel to become grounded while working within the Titan MC3D MSS operational area is non-existent due to the absence of shallow waters (<20 m water depth) and any emergent features within or immediately adjacent to the Titan MC3D MSS operational area. Water depths in the Titan MC3D MSS operational area are ~60 m to ~3,400 m.

4.3.2.3. Equipment Dragging or Loss

In the unlikely event of damage to or loss of a solid seismic streamer, potential environmental effects will be limited to physical impacts on benthic communities arising from the cable and associated equipment sinking to the seabed. Seismic streamers and vanes are fitted with pressure-activated, self-inflating buoys. As the equipment sinks it passes a certain water depth at which point the buoys inflate and bring the equipment back to the surface where it can be retrieved by the seismic or support vessels.

4.3.3. Reduced Air Quality From Atmospheric Emissions

Atmospheric emissions from the proposed survey include greenhouse gas (GHG), NOx (nitrogen oxide), SOx (sulphur oxide), CO (carbon monoxide) and particulate matter (dark smoke) emissions from:

- use of survey and support vessel main engines for propulsion;
- use of survey and support vessel main and emergency power generation equipment;
- use of marine diesel by the survey vessel workboat; and
- incineration of oily sludges onboard the survey vessel.

Atmospheric emissions generated during the survey will result in a localised, temporary reduction in air quality.

4.3.4. 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. Species of concern vary between regions depending on various environmental factors such as water temperature, salinity, nutrient levels and habitat type.

Key vectors requiring management 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 also have the potential to threaten a range of sectors including:

- commercial fisheries and aquaculture;
- tourism industry;
- human health;
- shipping; and
- infrastructure

Commonwealth and state regulatory agencies have implemented increased management requirements in recent years, with further legislation currently under development.

4.3.4.1. Ballast Water

All international vessels intending to discharge ballast water anywhere inside the Australian territorial sea are required to manage their ballast water in accordance with Australia's mandatory ballast water management requirements.

4.3.4.2. Biofouling

Any vessel involved in the Titan MC3D MSS, which has not been operating in Australian waters, will be required to meet the biosecurity standards of both the Department of Agriculture (DoA) and DoF. An independent IMS inspection will be undertaken to ensure vessel(s) are compliant with the aquatic biosecurity standards set out under the *Fisheries Resources Management Act 1994*.

4.3.5. Marine Pollution From Routine Discharges

Risks to marine environmental resources within the Titan MC3D MSS operational area (and adjacent areas) from routine discharges are considered to be negligible given that all wastes, other than sewage, grey water and putrescibles wastes, will be incinerated and treated aboard the survey vessel(s) and support vessels (if applicable), or compacted and disposed of onshore.

4.3.5.1. 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 Titan MC3D MSS will be insignificant in comparison to the natural daily nutrient flux that occurs within the region.

4.3.5.2. Bilge Water

The survey and support vessels may need to discharge bilge water during the Titan MC3D MSS. Bilge water will be treated and disposed of in accordance with MARPOL 73/78 Annex I.

4.3.5.3. Other Wastes

The survey and support vessels will also produce a variety of other solid and liquid wastes, including packaging and domestic wastes. Management measures will be implemented during the Titan MC3D MSS to prevent any accidental release of wastes.

4.3.6. Marine Pollution From Accidental Discharges

The survey and support vessels will store and use fuel and a variety of hazardous materials such as lubricating oils and cleaning chemicals. During the survey, the survey vessel(s) will be refuelled at sea using the support vessel, either within or immediately adjacent to the Titan MC3D MSS operational area. 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 water depth).

4.3.6.1. Hazardous Materials

The vessel will store and use a variety of hazardous materials such as lubricating oils, cleaning chemicals and batteries. 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 litre 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.

4.3.6.2. Fuel and Oil Spills

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.

Transfer spills have a much greater potential to cause large spills than do vessel collisions. Vessel collision spill risk levels from the proposed survey are no different from those presented by any other routine shipping operating in waters off the north-west Australian coastline. The fuel that will be used by the survey vessel(s) is Marine Gas Oil (MGO; marine diesel). The realistic worst-case volume of diesel spilled during refuelling operations is 648 litres, arising from the total loss of the contents of the transfer hose during refuelling. Dry

break couplings would prevent any more than the hose volume being spilled in the event of hose failure.

In the extremely unlikely (improbable) event of a ruptured fuel tank as a result of collision, an ADIOS2 (Automated Data Inquiry for Oil Spills) model was run using the worst-case scenario for an oil spill of MGO from the largest tank at maximum capacity of 1,041 m^3 (98% full). Based on the ADIOS2 modelling output, $>$98% of the slick will have dispersed and evaporated within about 24 hours if occurring in the summer months, resulting in a potential radius of 21 km. During the winter period the ADIOS2 modelling output showed that more than 98% of the slick would have evaporated and dispersed after 17 hours, with a potential radius of 18 km.

4.3.7. Impacts to Stakeholders

4.3.7.1. Commercial Fisheries

As described in **Section 2.4**, there are a number of commercial fisheries operating within the area of the Titan MC3D MSS operational area.

Disruption to commercial 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;
- restriction of access due to diesel spill;
- seismic equipment loss and subsequent interference with fishing gear (entanglement);
- loss of fishing gear e.g. buoyed fish traps; and
- recreational take of finfish species from the survey and support vessels.

The risk of potential impacts to commercial fisheries in or adjacent to the Titan MC3D MSS operational area is considered to be minimal, given the small overlap of active fishing area. Currently, there are no outstanding issues with any organisation, individual or licence holder with respect to potential impacts of the Titan MC3D MSS on any commercial fisheries, other than ongoing discussions with the PPA (see **Section 9.2**). While PGS has made it clear that the industry cannot wait for long term studies as requested by the PPA given the low level of assessed risk, it has committed to further review the potential impact based on current knowledge with a view of looking for opportunities to address the concerns of the PPA over possible impacts. It should be noted that the sensitive area of the acquisition polygon is quite limited with the acquisition boundary currently approximating the 80m bathymetry line and generally not adjacent to the *P.maxima* major commercial pearling grounds at Eighty Mile Beach.

4.3.7.2. Shipping and Defence Activities

The survey vessel and towed array represent a potential navigational hazard and vessels will need to avoid the seismic vessel to prevent collisions, entanglement of seismic cables, and other incidents. Any vessels involved in the survey(s) will comply with MARPOL requirements and other applicable maritime laws and operate strictly in accordance with standard operating procedures for marine operations.

4.3.7.3. Heritage and Conservation Values

It is highly unlikely that the proposed Titan MC3D MSS will impact on the environmental values of any heritage listed places or protected areas, given the location of the survey area in deep offshore waters.

4.4. SUMMARY OF ENVIRONMENTAL RISK ASSESSMENT RESULTS

The risk assessment indicates that the potential impacts arising from the proposed Titan MC3D MSS operational area can be categorised as having Low to Medium risk levels. No risks were assessed as High. **Table 4.3** 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 or support vessels.
- Vessel collisions resulting in fuel and oil spills.

In this case a number of additional control measures were also assessed, and were found to be not practicable—i.e., the cost, time and effort required to implement the measure is grossly disproportionate to the benefit gained. A summary of the control measures that will be implemented are shown in **Table 6.1**, **Section 6.**

Table 4.3 - Summary of Environment Risk Assessment for the Titan MC3D MSS

Hazard	Environmental aspect	Potential environmental impacts	Risk		
			Consequence of impact	Likelihood of the identified consequence	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 immersible equipment		Minor	Possible	**Low**
Marine pollution from	Discharge of sewage, grey water and	Localised reduction in water quality due to nutrient	Slight	Routine	**Low**

Hazard	Environmental aspect	Potential environmental impacts	Risk		
			Consequence of impact	Likelihood of the identified consequence	Residual risk level
routine discharges	putrescible wastes	enrichment			
	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	Possible	**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 and defence activities	Disruption to shipping and military aircraft	Slight	Possible	**Low**
	Operation of vessels within protected areas and heritage places	Disturbance to heritage and conservation values	Slight	Possible	**Low**

5. IMPLEMENTATION STRATEGY

5.1. ENVIRONMENTAL MANAGEMENT FRAMEWORK

5.1.1. ALARP Demonstration

Regulation 11(1)(b) of the Environment Regulations require a demonstration that environmental impacts are reduced to ALARP (as low as reasonably practicable).

Determining whether risks have been reduced to ALARP requires an understanding of the nature and cause of the risk to be avoided and the sacrifice (in terms of safety, time, effort and cost) involved in avoiding that risk. The hierarchy of decision tools used in this case (from lowest risk to highest risk) has been adapted from the UKOOA Industry Guidance on Risk Related Decision Making. **Figure 5.1** illustrates the UKOOA framework.

Within the context of a specific decision situation, the framework provides a means to:

- Determine the relative importance of the various methods of assessing risk (e.g. by reference to standards, cost benefit analysis, or societal values).
- Judge which of these methods is best placed to determine whether the risks are tolerable and ALARP.

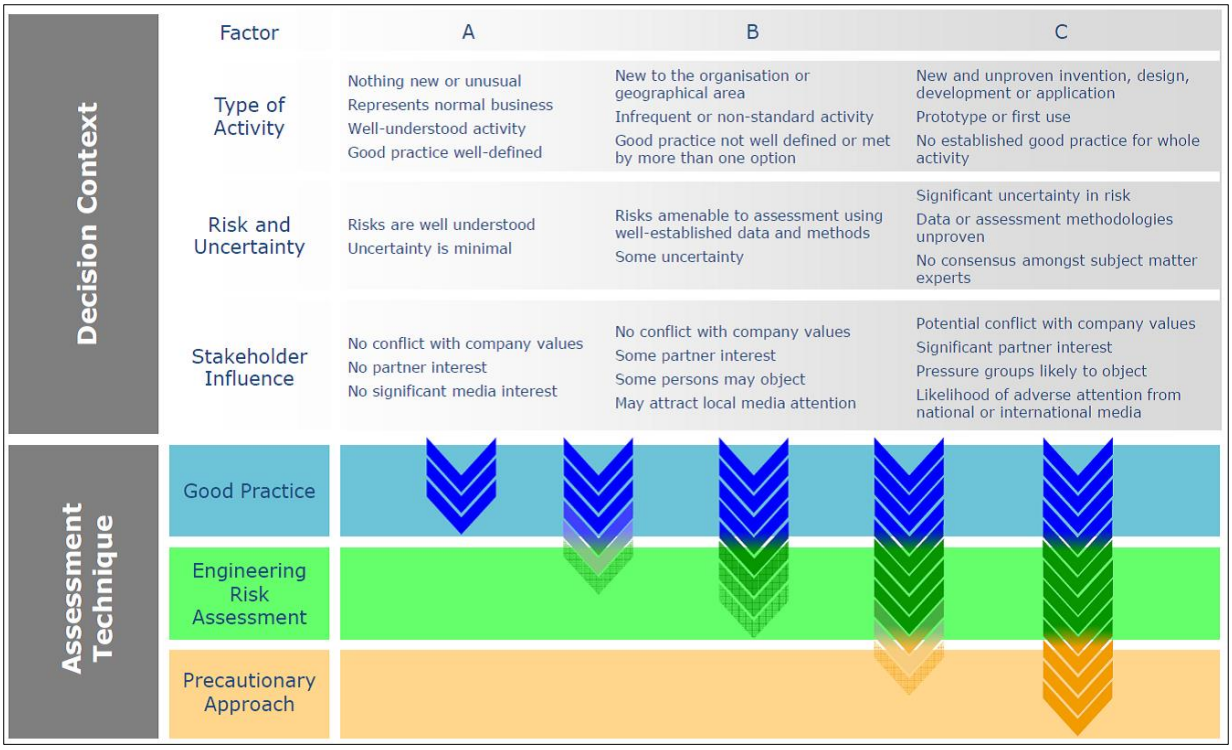


Figure 5.1 - Risk Related Decision Making Framework

The UKOOA guidance describes a range of appropriate bases (i.e. tools or protocols) for risk decision-making. These bases provide a means to assess the relative importance of adherence to, and reliance on, the following when making decisions to either accept or further treat risks:

- Codes and Standards.
- Good Practice.
- Engineering Judgement.
- Risk Analysis.
- Company Value.
- Societal Values.

A summary of the application of these decision-making tools and protocols in relation to the different levels of risk identified is provided in **Table 5.1**.

Table 5.1 – Decision Making Tools and Protocols

Risk rating	Decision making tools	Decision making protocols
Low Risk (Acceptable Zone)	Comparison to codes and standards, good oilfield practice and professional judgement are used to assess risk acceptability	If the environmental risk of the hazard has been found to be "Acceptable" and the control measures are consistent with applicable standards and 'good oilfield practice' then no further action is required to reduce the risk further. However, if a control measure that would further reduce the impact or risk is readily available, and the cost of implementation is not disproportionate to the benefit gained, then it is considered 'reasonably practicable" and should be implemented.
Medium Risk (ALARP Zone)	Risk based analysis are used in addition to comparison to codes and standards, good oilfield practice and professional judgement to assess risk acceptability.	An iterative process to identify alternative / additional control mechanisms has been conducted to reduce the risk to the "Acceptable" zone. However, if the risk associated with a hazard cannot be reasonably reduced to the "Acceptable" zone without grossly disproportionate sacrifice; then the mitigated environmental risk is considered to be ALARP.
High Risk (Intolerable and Unacceptable Zone)	All of above decision-making tools apply plus consideration of company values and societal values	If the environmental risk of the hazard has been found to fall within this zone then the activity should not be carried out. Work to reduce the level of risk should be assessed against the precautionary principle with the burden of proof requiring demonstration that the risk has been reduced to the ALARP Zone before the activity can be commenced.

The risk assessment approach described above implies a level of proportionality wherein the principles of decision-making applied to each particular impact category (or hazard) are proportionate to acceptability of environmental risk of that potential impact. The decision-making principles for each level risk are based on the precautionary principle (as defined in the EPBC Act) and provide assurance that the environmental impacts and risks are of an acceptable level and reduced to ALARP.

For the purposes of determining whether the identified risks associated with the Titan MC3D MSS have been reduced to ALARP, the "decision context" for each of the risks identified in the Titan MC3D MSS ERA was reviewed. All of the risks associated with the survey correspond to the description of Decision Context Type "A" (see **Figure 5.1**)—i.e. they do not represent anything new or unusual; are well understood risks; control measures represent established "good practice"; and there are no major stakeholder implications.

A number of control measures were assessed for practicability. All represent existing, recognised 'good practice', have been found to be practicable, and accordingly, will be implemented during the Titan MC3D MSS. Additional control measures were also assessed, and were found to be not practicable—i.e. the health and safety risks associated, cost, time and effort required to implement the measure is grossly disproportionate to the benefit gained. The control measures that will be implemented for the Titan MC3D MSS are described in **Table 6.1**, **Section 6**.

When formulating control measures for each environmental hazard, the 'Hierarchy of Controls' philosophy is applied, shown in **Table 5.2**. The Hierarchy of Controls is a system used in industry to minimise or eliminate exposure to hazards, and is part of PGS's HSE&Q Management System. The Hierarchy of Controls are, in order of effectiveness:

- Eliminate;
- Substitute;
- Engineer;
- Isolate;
- Administration; and
- Protection.

Although commonly used in the evaluation of occupational health and safety (OHS) hazard control, the Hierarchy of Controls philosophy is also a useful framework to evaluate potential environmental controls to ensure reasonable and practicable solutions have not been overlooked. Treatments considered by PGS to be reasonably practicable have been implemented, while those considered to be not reasonably practicable have not been implemented.

Table 5.2 - Hierarchy of Controls

Control	Effectiveness	Seismic survey examples
Eliminate		*Get rid of the impact or risk.* Excess chemicals are returned to shore rather than discharged overboard.
Substitute		*Change the impact or risk for a lower one.* Substitute a large airgun array for a smaller one.
Engineering		*Engineer out the impact or risk.* Use solid streamers rather than fluid-filled streamers.
Isolation		*Isolate people or the environment from the impact or risk.* Avoid acquiring data near sensitive turtle nesting beaches during nesting season.
Administrative		*Provide instructions or training to people to lower impact or the risk.* The use of procedures (e.g., at sea refuelling procedures) and pre-work job hazard analysis (JHA) to assess and minimise the environmental impacts or risks of an activity.
Protective*		*Use of protective equipment.* The provision and use of personnel protective equipment (PPE).

5.1.2. Demonstration of Acceptability

Regulation 11(1)(c) of the Environment Regulations requires a demonstration that environmental impacts are of an acceptable level.

PGS considers a range of factors when evaluating the acceptability of environmental impacts and risks associated with its activities. This evaluation works at several levels, as outlined in **Table 5.3.**

Table 5.3 - Acceptability Test

Test	Question	Acceptability demonstrated
Policy compliance	Is the proposed management of the impact or risk aligned with the PGS Environmental Policy?	The impact or risk must be compliant with the objectives of the company policies.
Management System Compliance	Is the proposed management of the impact or risk aligned with the PGS Environmental Policy and HSE Management System?	Where specific PGS procedures and work instructions are in place for management of the impact or risk in question, acceptability is demonstrated.
Social acceptability	Have stakeholders raised any concerns about activity impacts or risks, and if so, are measures in place to manage those concerns?	Stakeholder concerns must have been adequately addressed and closed out.
Laws and standards	Is the impact or risk being managed in accordance with existing Australian or international laws or standards, such as EPBC Policy Statements, MARPOL, AMSA Marine Orders, Marine Notices etc.	Compliance with specific laws or standards is demonstrated.
Industry best practice	Is the impact or risk being managed in line with industry best practice, such as APPEA Code of Environmental Practice, IAGC guidelines etc.?	Management of the impact or risk complies with relevant industry best practice.
Environmental context	Is the impact or risk being managed pursuant to the nature of the receiving environment (e.g. sensitive or unique environmental features generally require more management measures to protect them than environments widely represented in a region)?	The proposed impact or risk controls, EPO and EPS must be consistent with the nature of the receiving environment.
Environmentally Sustainable Development (ESD) Principles	Does the proposed impact or risk comply with the APPEA Principles of Conduct (APPEA 2003), which includes that ESD principles be integrated into company decision-making.	The Titan MC3D MSS is consistent with the APPEA Principles of Conduct.
ALARP	Are there any further reasonable and practicable controls that can be implemented to further reduce the impact or risk?	There is a consensus that residual risk has been demonstrated to be ALARP.

A description of demonstration of acceptability has been undertaken in the Titan MC3D MSS EP in a manner consistent with the Acceptability test (shown in **Table 5.3**).

6. SUMMARY OF THE CONTROL MEASURES

Table 6.1 – Summary of Control and Mitigation Measures

Impact Category	Potential Impacts	Control and Mitigation Measures	Residual Risk Level
Disturbance to Marine Fauna	• Potential noise impacts on cetaceans, whale sharks and turtles from underwater seismic pulses	• Adherence to EPBC Act Policy Statement 2.1, Part A Standard Management Procedures with application of 2 km low power zone • Adherence to Part B Additional Management Procedures, implemented by experienced MFOs: **1.** within the pygmy blue whale BIA, during pygmy blue whale migration periods: • 1 May to 30 June (northbound); and 1 October to 30 November (southbound) • MFOs will undertake a 45 min pre-watch before any source activation • increased precaution and buffer zone - 2 km shutdown zone **2.** within the humpback whale BIA, during humpback whale migration periods: • 1 July to 31 October • MFOs will undertake a 45 min pre-watch before any source activation • increased precaution and buffer zone - 2 km shutdown zone **3.** between the humpback whale BIA and 200m contour, during humpback whale migration periods; if there have been 3 or more whale instigated power-downs or shut-downs in the preceding 24 hour period, or if operations were not previously underway during the preceding 24 hours, the vessel (or a support vessel) has been in the vicinity (approximately 10km) of the proposed start up position for at least 2 hours (under good visibility conditions) within the preceding 24 hour period, and whales have been sighted: • MFOs will undertake a 45 min pre-watch before any source activation • increased precaution and buffer zone - 2 km shutdown zone **4.** within the whale shark BIA, during whale shark migration periods: • 1 August to 31 October • at least one MFO will look for whale sharks during the 30 min pre-watch period prior to any source activation • 500 m shut-down zone **5.** within the flatback turtle BIA, during nesting period: • 1 December to 31 January • no seismic activity will occur • Use of two MFOs for entire duration of project lifespan • Pre-survey induction includes coverage of EPBC Act Policy Statement 2.1 requirements • Use of the smallest possible airgun array size (total capacity of each sub-array 4,130 cui). • PGS vessels shall not acquire data simultaneously within 40 km of each other • Application of relevant PGS procedures and work instructions: - PGS Environmental Management Procedures - PGS soft start procedure for airguns - PGS Guidelines for Extrication of Marine turtles for any incidents involving turtle entrapment in the tail buoys	**Low**

Impact Category	Potential Impacts	Control and Mitigation Measures	Residual Risk Level
	• Potential disturbance from light emissions from survey and support vessel to surrounding sea surface	• External lighting of survey vessel is minimised to that required for navigation, vessel safety, safety of deck operations	
	• Potential behavioural physical impacts on cetaceans, whale sharks and turtles from vessel interactions	• Application of support vessel-marine fauna interaction procedures modified from the Australian National Guidelines for Whale and Dolphin Watching • Turtle guards will be fitted to tail buoys throughout the survey • Application of relevant PGS procedures and work instructions: - PGS Environmental Management Procedures - PGS soft start procedure for airguns - PGS Guidelines for Extrication of Marine turtles for any incidents involving turtle entrapment in the tail buoys	
Disturbance to Benthic Habitats	• Potential damage to benthic habitats from vessel anchoring	• Anchoring will not be undertaken due to water depths across the operational area (~60 – 3,400 m) • Anchoring in shallow waters near shoals (e.g. reefs, islands or the mainland coastline will only occur in an emergency. All measures will be taken to avoid sensitive benthic habitats (corals, seagrasses, macroalgal beds) • Survey and support vessels equipped with approved electronic navigation systems and radar • Application of relevant PGS procedures and work instructions: - PGS Environmental Management Procedures - PGS Bridge Routines - Anchoring and Anchor Watch Checklist - PGS Bridge Routines - Navigation in Critical Waters	**Low**
	• Potential damage to benthic habitats from vessel grounding	• Use of approved navigation systems and depth sounders. • Application of relevant PGS procedures and work instructions: - PGS Environmental Management Procedures - PGS Bridge Routines - Anchoring and Anchor Watch Checklist - PGS Bridge Routines - Navigation in Critical Waters	
	• Potential damage to benthic habitats from equipment damage, dragging or loss	• In-water equipment lost will be recovered, if technically and financially feasible • Streamers will not be towed at more than 15 m below the sea surface. Given the water depths across the operational area (60 - 3,400 m) equipment will not be in contact with or close to the seabed • Application of relevant PGS procedures and work instructions: - PGS Environmental Management Procedures - PGS Close Approaches, Undershoots, Dead Heads, Shallow Waters Procedures - PGS Back Deck Operations – Deployment and Recovery of Streamers - PGS Back Deck Operations – Streamer Maintenance Using the Workboat	

Impact Category	Potential Impacts	Control and Mitigation Measures	Residual Risk Level
Atmospheric Emissions	• Localised reduction air quality • Greenhouse gas emissions	• Adherence to Marine Orders – Part 97 • Implementation of Planned Maintenance System (PMS) aboard survey vessel(s) • Use of low sulphur diesel fuel • Vessel combustion equipment (including incinerator) compliant with MARPOL 73/78 Annex VI requirements • Incinerator to be IMO approved • Implementation of Ship Energy Efficiency Management Plan (SEEMP) • Application of relevant PGS procedures and work instructions: - PGS Planned Maintenance System - PGS Bunker Delivery – Quantity & Quality Control	**Low**
Introduction of invasive marine species	• Introduction and establishment of IMS and displacement of native marine species	• Adherence to Marine Orders – Part 98 • Vessels required for the proposed activity will not discharge ballast water without prior authorisation from Department of Agriculture (DoA) Biosecurity • Adherence to the requirements of Vessel Ballast Water Management Plan • Recent IMS Risk Assessment and anti-fouling coating application for survey and support vessels • AF coating meets IMO 2001 Convention requirements • Survey and support vessels will have all the necessary DoA Biosecurity clearances to operate unrestricted anywhere in Australian waters • Application of relevant PGS procedures and work instructions: - PGS Ballast Water Management Plan	**Low**

Impact Category	Potential Impacts	Control and Mitigation Measures	Residual Risk Level
Marine pollution from routine discharges	• Localised reduction in water quality • Acute toxicity effects on marine fauna and flora • Physical impacts on marine fauna i.e. from plastics	• Adherence to Marine Orders – Part 95 & Part 96 • All sewage and putrescible wastes handled and disposed of in accordance with MARPOL Annex IV requirements • Application of sewage and putrescible wastes treatment and discharge requirements: - sewage and putrescible wastes macerated prior to disposal. - discharge restrictions for treated versus non-treated sewage (treated >3 nm from land; non-treated >12 nm from land) • Survey vessel(s) and support vessel (if applicable) equipped with grinder/comminuter for maceration of sewage and putrescible wastes • Survey vessel(s) and support vessel (if applicable) 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(s) including tanks for storage of grey and black water • Bilge water treated and disposed of in accordance with MARPOL Annex I requirements • Discharge restrictions for bilge water with oil content >15 ppm, or bilge water contaminated with toxic chemicals • Bilge water contaminated with chemicals must be contained and disposed of onshore, except if the chemical is demonstrated to have a low toxicity • Provision of appropriate segregation facilities on survey and support vessel, including tanks for storage of bilge water • Garbage handled and disposed of in accordance with MARPOL Annex V requirements • Application of garbage, solid and liquid wastes handling and disposal requirements: - No discharge of plastics or plastic products of any kind from vessel or support vessel(s) - No discharge of domestic wastes or maintenance wastes from survey and support vessel - All waste receptacles aboard survey and support vessel covered with tightly fitting, secure lids to prevent any solid wastes from blowing overboard - All solid, liquid and hazardous wastes (other than sewage, grey water and putrescible wastes) will be incinerated or compacted (if possible) and stored in designated areas and sent ashore for recycling, disposal or treatment - Hydrocarbons located above deck stored with some form of secondary containment to contain leaks or spills (e.g. bund, containment pallet, transport packs) - Correct segregation of solid and hazardous wastes - Incinerator will be operated in accordance with established operating procedures that align with manufacturers specifications • Provision of appropriate segregation facilities on survey and support vessel including integral waste oil tank for oils and sludge • Application of relevant PGS procedures and work instructions: - PGS Environmental Management Procedures - PGS Waste Disposal Garbage Record Book - PGS Hazardous materials and handling	**Low**

Impact Category	Potential Impacts	Control and Mitigation Measures	Residual Risk Level
Marine pollution from accidental discharges	• Toxic effects on marine fauna and flora, from accidental discharges of hazardous materials • Localised reduction in water quality • Indirect effects on commercial fisheries	• Adherence to Marine Orders – Part 21, Part 30, Part 59, Part 91, Part 94 and COLREGS • All chemical and hazardous wastes will be segregated into clearly marked containers prior to onshore disposal • All storage facilities and handling equipment will be in good working order and designed in such a way as to prevent and contain any spillage as far as practicable • All hazardous substances will have an MSDS in place that is readily available • SOPEP implemented and tested for any vessel >400 GT. Drill conducted in Australian waters prior to commencement of survey or during project mobilisation phase prior to commencement of operations of the survey • At least one SOPEP drill will be conducted aboard vessel(s) during survey • A SOPEP drill will be conducted aboard any vessel >400 GT at a minimum of three monthly intervals (which is a SOP) during the course of the Titan MC3D MSS. • Spill response bins/kits located in close proximity to hydrocarbon storage areas • Issuing of appropriate NTM by the AHS, and Auscoast warnings via RCC Australia • Use of solid streamers only • Approval must be obtained from the Vessel Manager before any at sea refuelling can proceed • Refuelling at sea subject to PGS Marine Operations Offshore Bunkering Procedures and PGS Bunker Delivery - Quantity & Quality Control and specific additional requirements: - application of 25 km exclusion zone from emergent land or shallow water features (20 m or less depth) for at sea refuelling operations - refuelling of vessels will be undertaken under favourable wind and sea conditions as determined by the Vessel Masters; - refuelling will take place during daylight hours only; - Job Hazard Analysis (JHA) or equivalent in place and reviewed before each fuel transfer; - all valves and flexible transfer hoses certified for use; - dry break couplings (or similar) in place for all flexible hydrocarbon transfer hoses • In the event of any fuel or oil spills to sea SOPEP / OPEP procedures will be followed for notification and consultation with AMSA and DoT, to ensure prompt and appropriate mobilisation of NATPLAN or MOSCP, as appropriate • When a fuel/oil spill to sea occurs the Vessel Master will inform the RCC Australia using POLREP. RCC Australia, in turn, notify AMSA and or/DoT • Type I Operational Monitoring implemented for spill surveillance and tracking • Allow small diesel spills to disperse and evaporate naturally, and monitor position and trajectory of any surface slicks • Physical break up (using propwash from the support vessel) by repeated transits through slick may be considered for larger diesel slicks (after consultation with Combat Agency [AMSA or DoT]) • Implementation of NATPLAN (by AMSA) or MOSCP (by DoT), if required • AMSA and DoT consulted to ensure agreement in place for SOPEP interface with NATPLAN and MOSCP • Notification and engagement with appropriate stakeholders identified in this EP • Application of relevant PGS procedures and work instructions: - PGS Environmental Management Procedures - PGS Hazardous Materials and Handling - PGS Guidance Notes for Support Vessel Masters and Crews - PGS Collision, Grounding, Hull Damage Procedures - PGS Oil Spill Response Procedure	**Medium**

Impact Category	Potential Impacts	Control and Mitigation Measures	Residual Risk Level
Disturbance to Social and Community Values	• Disruption to commercial fishing vessels, shipping or defence activities • Potential direct and indirect noise impacts on target species	• Adherence to Marine Orders – Part 21, Part 30, Part 59, and COLREGS • Relevant stakeholders notified of proposed activities in advance of survey operations commencing • Consultation with AMSA (Nautical Advice) prior to survey commencing to determine level of commercial shipping • Use of a support vessel to manage vessel interactions • Issuing of appropriate NTM by AHS and Auscoast warnings via RCC Australia • Survey and support vessels will use approved navigation systems and adhere to standard maritime safety / navigation procedures • Other mariners alerted of vessels presence and extent of towed array • Establishment of a vessel exclusion zone around the survey vessel(s) • In-water equipment lost will be recovered, if retrievable. • Recreational fishing from survey and support vessels is prohibited • Adherence to relevant PGS procedures and work instructions: - PGS Back Deck Operations – Streamer Maintenance Using the Workboat - PGS Collision, Grounding, Hull Damage Procedures - PGS Back Deck Operations – Deployment and Recovery of Streamers - PGS Guidance Notes for Support Vessel Masters and Crews	**Low**
	• Disturbance to heritage and conservation values	• All PGS and contractor personnel made aware of, and comply with, requirements of accepted EP	

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

Environmental performance of the Titan 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 phase of the activity to ensure that procedures and equipment for managing routine discharges and emissions are in place to ensure compliance with the EP.
- At least one (1) environmental audit, in accordance with the PGS Environmental Audit Template (941VES00 App 01), shall be undertaken per phase
- A summary of the key information, commitments, EPO, EPS and MC for the activity (ECR) will be distributed aboard the survey vessel(s), and implementation of the environmental performance outcomes and commitments will be monitored on a regular basis by the PGS Site Representative.

Management of changes to scope (e.g., timing, location or operational details) are the responsibility of PGS. A risk assessment will be undertaken for all changes in scope to assess potential impacts of the change. If the change represents a significant modification that is not provided for in the accepted EP in force for the activity, a revision of the EP will be conducted in accordance with Regulation 17 of the Environment Regulations. The revised EP will be submitted to NOPSEMA in accordance with the requirements of Regulation 17(2), and the proposed change to the activity will not commence until the revised EP has been accepted by NOPSEMA.

The PGS Operations Manager, where required, will undertake notification to other government authorities. Notifications will include details of the change and procedures that will be put in place for managing or mitigating the additional or modified risks.

8. SUMMARY OF THE RESPONSE ARRANGEMENTS IN THE OIL POLLUTION EMERGENCY PLAN

8.1. OIL POLLUTION EMERGENCY PLAN

The Oil Pollution Emergency Plan (OPEP) for the Titan MC3D MSS, 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. 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): the 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.
- WA State Emergency Management Plan for Marine Oil Pollution (WestPlan MOP) and Department of Transport (DoT) Marine Oil Spill Contingency Plan (MOSCP) for spills (from vessels) which affect WA State waters.

8.2. VESSEL SOPEP

The survey vessel(s) 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 SOPEP (oil pollution emergency drills), as required under Regulations 14(8AA), 14(8A) and 14(8B) to 14(8E) of the Environment Regulations.

8.3. EMERGENCY RESPONSE ARRANGEMENTS

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. Deployment of small absorbent booms and other materials will be undertaken so as to maximise recovery of spilled material. All deck spills aboard the survey vessel will be cleaned-up immediately, using appropriate equipment from the onboard spill response kits (e.g. absorbent materials etc.) to minimise any likelihood of discharge of spilt hydrocarbons or chemicals to the sea. This is a standard operating procedure (SOP) for the survey vessel.

Given the location of the Titan MC3D MSS operational area, 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 (see below). Physical break up (using propwash from the support vessel) by repeated transits through the slick may be considered for larger slicks (following consultation with the PGS Vessel Manager).

8.3.1. Commonwealth Waters

For Commonwealth waters, initial actions will be undertaken by the survey vessel with subsequent actions determined in consultation with the regulatory authorities (AMSA) under NATPLAN, having regard to the potential impacts posed by the spill. AMSA has indicated that it does not require operators to directly consult on OPEPs for seismic surveys or those addressing the operations of offshore supply vessels. Existing NATPLAN arrangements already covers such operations. AMSA is the designated combat agency for oil spills from vessels within the Commonwealth jurisdiction. Upon notification of an incident, AMSA will assume control of the incident.

8.3.2. State Waters

For State waters, the survey vessel will undertake initial actions in accordance with the vessel(s) SOPEP, with subsequent actions determined in consultation with DoT, under the WestPlan MOP and MOSCP.

8.3.3. Type I Operational Monitoring

In the event of an incident that results in a diesel spill to the waters surrounding the survey or support vessels, PGS would be responsible for undertaking Type I “Operational Monitoring” that would have the primary objective of spill surveillance and tracking. 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 or DoT), via a POLREP form, to determine and plan appropriate response actions under NATPLAN or the WestPlan MOP / MOSCP (if either of these plans are 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 operational monitoring will be restricted to daylight hours only, when surface slicks will be visible from the support vessel and/or chase vessel surveillance. The information gathered from this monitoring will be passed on to the relevant Combat Agency, via the POLREP form, but also via ongoing SITREP reports following the initial spill notification to RCC Australia. PGS will implement, assist with, or contribute to (including funding if required) any other operational monitoring as directed by the Combat Agency.

No Type II “Scientific Monitoring” will be implemented by PGS as part of the OPEP for the Titan MC3D MSS. For the worst case scenario, the largest spill size would be 1,041 m^3; and surface slicks are likely to have dispersed and evaporated almost completely within ~24 hours (in summer months). It would not be possible to get additional vessels and appropriate personnel / equipment to undertake any Type II monitoring (e.g. of water quality etc.)

mobilised to the operational area or surrounding waters in a timeframe of anything less than 24 hours.

8.3.4. Training

In compliance with Regulation 14(4) and 14(5) a designated Oil Pollution Prevention Team (OPPT) will be trained to ensure they are familiar with their tasks and the equipment in the event of an oil spill.

8.3.5. Testing

A drill test of the oil spill emergency response arrangements will be conducted during the mobilisation phase prior to commencement of operations of the survey. All drill tests will be reported as per MARPOL Annex I (Regulation 15) requirements and will be reviewed as part of the ongoing monitoring and improvement of emergency control measures. Vessel >400 GT will conduct SOPEP drills at a minimum of three monthly intervals during the course of the Titan MC3D MSS.

8.3.6. Reporting, Maintenance and Review

Any fuel or oil spills aboard either the survey or support vessels must be reported to PGS via the internal PGS HSE Reporting Procedures. In the event of spillage of any oil or diesel spills to the sea, AMSA or DoT will be notified by the appropriate Vessel Master 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 by PGS, as reportable incidents.

The OPEP will be regularly reviewed to ensure it is appropriate to the nature and scale of the activities within its scope and to ensure maintenance of the response capability and the operator's preparedness. In compliance with Regulation 14(8AA) the OPEP will be continuously reviewed and kept up-to-date to ensure new information or improved technology can be incorporated as specifies in the SOPEP.

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

An initial stakeholder listing was identified through:

- a review of relevant legislation applicable to Commonwealth waters petroleum and marine activities;
- identification of marine user groups in the area (possible recreational/commercial fisheries, fishing industry groups, merchant shipping, eco-tourism providers);
- identification of marine 'interest groups' (i.e., technical and scientific entities); and
- industry/company support groups.

9.1. PHASE 1 – PREPATORY CONSULTATION

The following fisheries bodies and organisations were originally informed of the survey, via letters or emails sent on 28 February 2014.

- A Raptis & Sons
- Austral Fisheries
- Australian Fisheries Management Authority (AFMA)
- Australian Longline Pty Ltd & Petuna Sealord
- Australian Southern Bluefin Tuna Industry Association (ASBTIA)
- Commonwealth Fisheries Association (CFA)
- Kimberley Professional Fishermen's Association (KPFA)
- Northern Territory Seafood Council (NTSC)
- Mary Island Fishing Club (Derby)
- MG Kailis Group
- Northern Fishing Companies Association (NFCA)
- Northern Territory Seafood Council (NTSC)
- Northern Wildcatch Seafood Australia (NWSA)
- NPF Industry Pty Ltd
- Pearl Producers Association (PPA)
- Recfishwest
- Tuna West Indian Ocean Tuna Association
- WA Department of Fisheries (DoF)
- WA Seafood Exporters
- Western Australian Fishing Industry Council (WAFIC)
- WestMore Seafoods

PGS obtained extracts from the Public Register held by the WA Department of Fisheries (DoF) for the 12 WA State-managed fisheries that can operate in the waters overlapped by the initially proposed Titan MC3D MSS operational area:

- Broome Prawn Managed Fishery (BP);
- Exmouth Gulf Prawn Fishery (EGPR);
- Gascoyne Demersal Scalefish Fishery (GDSF);
- Kimberley Prawn Managed Fishery (KPF);
- Mackerel Fishery (MMF);
- Nickol Bay Prawn Managed Fishery (NBPR);

- Northern Demersal Scalefish Managed Fishery (NDSF);
- Onslow Prawn Managed Fishery (ONPR);
- Pilbara Demersal Scalefish Fisheries (PDSF);
- Shark Bay Prawn Fishery (SBPR);
- Shark Bay Scallop Fishery (SBSC);
- West Coast Deep Sea Crustacean Managed Fishery (WCDSCF).

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).

One hundred and ten separate individuals or entities holding licences were identified across the twelve WA State-managed fisheries. These individuals or entities may hold more than one licence either within a fishery or across multiple fisheries. Stakeholder letters were sent on 28 February 2014 to all licence-holding individuals or entities, informing them of the proposed activities.

In addition, the following Commonwealth and WA State government departments and agencies were informed of the proposed activities, via letters or emails sent on 28 February 2014.

- Australian Customs Services (Coastwatch)
- Australian Hydrographic Service (AHS)
- Australian Maritime Safety Authority (AMSA)
- Border Protection Command (BPC)
- Centre for Whale Research (CWR)
- Department of Defence (DoD)
- Department of the Environment (DoE)
- IFAW Oceania
- WA Department of Mines and Petroleum (DMP)
- WA Department of Transport (DoT

The stakeholder letter provided information concerning the location, timing and nature of the proposed activities, and provided contact details should stakeholders wish to seek further information. A number of stakeholders did not reply or only replied to acknowledge receipt with no further comment.

9.2. PHASE 2 – SECOND CONSULTATION

Due to the significant reduction in scope and timing of the Titan MC3D MSS, all stakeholders were contacted a second time on 12 September 2014. Two separate letters were sent via mail or email, dependent on whether the stakeholder was deemed still ‘relevant’ (i.e., operational area overlapped fishing areas) or no longer relevant (i.e., no overlap). The following fisheries bodies and organisations were considered to still be relevant stakeholders for the reduced Titan MC3D MSS operational area, and were sent information regarding the reduction in scope, timing and duration, via letters or emails sent on 12 September 2014:

- A Raptis & Sons
- Austral Fisheries
- Australian Fisheries Management Authority (AFMA)
- Australian Longline Pty Ltd & Petuna Sealord
- Australian Southern Bluefin Tuna Industry Association (ASBTIA)
- Commonwealth Fisheries Association (CFA)
- MG Kailis Group
- Northern Fishing Companies Association (NFCA)
- Northern Territory Seafood Council (NTSC)
- Northern Wildcatch Seafood Australia (NWSA)
- Pearl Producers Association (PPA)
- Recfishwest
- Tuna West Indian Ocean Tuna Association
- WA Department of Fisheries (DoF)
- WA Seafood Exporters
- Western Australian Fishing Industry Council (WAFIC)
- WestMore Seafoods

Additionally, 44 entities or individuals currently holding licences for the following WA State-managed commercial fisheries were contacted and informed of the changes to the proposed operations:

- Mackerel Managed Fishery (MMF)
- Northern Demersal Scalefish Managed Fishery (NDSF)
- Pilbara Fish Trawl (Interim) Managed Fishery (PTIMF)
- Pilbara Trap Fishery (PTF)
- Pilbara Line Fishery (PLF)
- West Coast Deep Sea Crustacean Managed Fishery (WCDSCF)

The same Commonwealth and WA State government departments and agencies were informed of the proposed activities, via letters or emails sent on 12 September 2014.

PGS considers that comprehensive consultation with all persons or organisations whose functions, interests or activities that may be affected by the proposed survey has been carried out and that sufficient information has been provided to allow the relevant person to make an informed assessment of the possible consequences of the activity on the functions, interests or activities of the relevant person (Regulation 11A).

9.2.1. Assessment of the Merits of Stakeholder Concerns

An assessment of the merits of objections or claims about the adverse impact of the Titan 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:** Stakeholders were concerned about shipping safety and interactions with fishing vessels. Stakeholders suggested 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 maintained on the bridge at all times. Compliance with maritime orders, COLREGS, and the establishment of a vessel exclusion zone around the survey vessel will be implemented to minimise disruption to commercial shipping.

- **Commercial Fishing:**
  - ***Impacts to Fish*:** A number of stakeholders expressed concerns regarding the impact of seismic surveys on key fishing industries. These fisheries were consulted and the key concerns related to impacts from seismic activity on catch rates, quota and fishery independent surveys (see **Section 4.6.3**). PGS advised stakeholders that the Titan MC3D MSS EP includes an evaluation of all the potential environmental impacts and risks for the survey.
  - ***Impacts to Fishing Operations***: Concerns were raised regarding the potential interruption to fishing operations within the waters of the Titan MC3D operational area during the proposed timeframe. PGS requested further contact details so that a meeting could be arranged to gain further information about fishing operations prior to survey commencement.
  - ***Impacts specifically relating to PPA:*** Concerns were raised that seismic operations:
    - may impact on the pearl oyster stocks, especially the recruitment to the fishery and the quality of the pearl oysters;
    - potential risk of pollution from rig mishaps;
    - potential marine pest impacts from rigs and support vessels should that activity occur in the future;
    - treatment of oil spills often results in use of dispersants and oil forming in 'balls' and sinking to the bottom – where pearl oysters are situated;
    - less than favourable development of the pearl oyster due to stress impacting the energetics of the animal;
    - impacts on the egg and larvae stages of the pearl oyster life cycle (within the initial 17 m) depth zone from the air guns maximum impact range;
    - impacts on the food web that supports a pearl oyster life cycle.

    PGS initially committed to no seismic activity to occur within the ~100 m isobath, immediately adjacent to Eighty Mile Beach. However, changes were required to the polygon to meet with client commitments to the survey area. This involved a section of the polygon extending over ~80 m water depth. As a result, PGS has made a commitment to the PPA and hired an expert to carry out a review of the risks to the PPA and the pearl oyster *(Pinctada maxima)* and how PGS may be able to approach seismic data acquisition in a manner that reduces any such identified risks. PGS shall assess the information provided in the review, and if deemed necessary and appropriate, and after liaising with the PPA, shall modify management of the activity. If a new or increased impact or risk is identified, as required under subregulation 17(6), *and* it is not already appropriately covered under the EP, PGS shall submit a proposed revision of the EP.
- **EPBC Protected Matters Impacts:** Concerns were raised 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 PGS will minimise risks and

impacts. PGS 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, PGS 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.

9.3. PHASE 3 - PRE-SURVEY CONSULTATION

Prior to commencing the Titan MC3D MSS, PGS will contact relevant stakeholders to provide detailed information for the proposed activity, location and geographical coordinates for the Titan MC3D MSS operational area, timing and duration, parameters for the towed seismic array (airgun array and streamer spread), and details of the survey and support vessels. At this point, stakeholders will have a further opportunity to raise any specific concerns or issues with PGS, regarding the proposed survey. PGS will also consult a number of additional stakeholders, primarily within the offshore E&P industry. These consultations will include, as far as possible, other geophysical companies operating in Australian waters, plus titleholders of petroleum titles adjacent to the proposed Titan MC3D MSS operational area. The primary objective of this consultation will be to ascertain if there are any other seismic surveys proposed for areas adjacent to the Titan MC3D MSS operational area over the same time period.

RCC Australia will be contacted through rccaus@amsa.gov.au for AUSCOAST warning broadcasts before operations commence. PGS will provide the vessels details and area of operation and advise of the survey starts and end dates. The AHS will be contacted through hydro.ntm@defence.gov.au two or more weeks prior to survey commencement to enable NTM to be issued.

9.4. PHASE 4 – ONGOING CONSULTATION AND PHASE 5 – POST SURVEY NOTIFICATION

Consultation with stakeholders will be ongoing throughout the period the Titan MC3D MSS EP is valid. PGS will comply with requests by stakeholders for additional information and requests for updates during any possible phases undertaken within the Titan MC3D MSS operational area. PGS shall assess the merits of any new claims or objections made by a stakeholder whereby they believe the activity may have adverse impacts upon their interest or activities. PGS shall determine at the time of assessment, whether a risk or impact is considered ‘significant’ based on information available at that time.

On completion of phases and upon completion of the entire survey, a notification will be sent to the relevant stakeholders or those that request post survey notification.

10. DETAILS OF THE TITLEHOLDERS NOMINATED PERSON FOR THE ACTIVITY

For further information about the proposed Titan MC3D MSS in the North-west Marine Region, please contact:

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11. REFERENCES

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