OUTER EXMOUTH MULTI CLIENT 3D MARINE SEISMIC SURVEYS

ENVIRONMENT PLAN: PUBLIC SUMMARY

PGS Australia Pty Ltd

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1. INTRODUCTION

The geophysical company Petroleum Geo-Services (PGS) proposes to acquire multi-client three-dimensional (MC3D) marine seismic surveys (MSS) within the Outer Exmouth MC3D MSS polygon in the North-west Marine Region (NWMR) offshore from Western Australia (WA) (see **Figure 1.1**). The area of the Outer Exmouth MC3D MSS polygon is approximately (~) 170,000 square kilometres (km^2).

This summary of the Environment Plan (EP) for the Outer Exmouth MC3D MSS, which will be acquired in the Carnarvon Basin offshore from Western Australia (WA), has been submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), to comply with Regulations 11(3) and 11(4) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.

The Outer Exmouth MC3D MSS EP has the objective of covering MC3D surveys over specific petroleum titles and adjacent vacant acreage over the Exmouth Plateau over a period of five years. The actual timing of individual projects is not yet defined and will be acquired dependent on client requirements, vessel availability and environmental considerations.

1.1. COORDINATES OF THE PROPOSED ACTIVITY

The boundary coordinates for the Outer Exmouth MC3D MSS polygon are as follows:

Table 1.1 - Outer Exmouth MC3D polygon – boundary coordinates

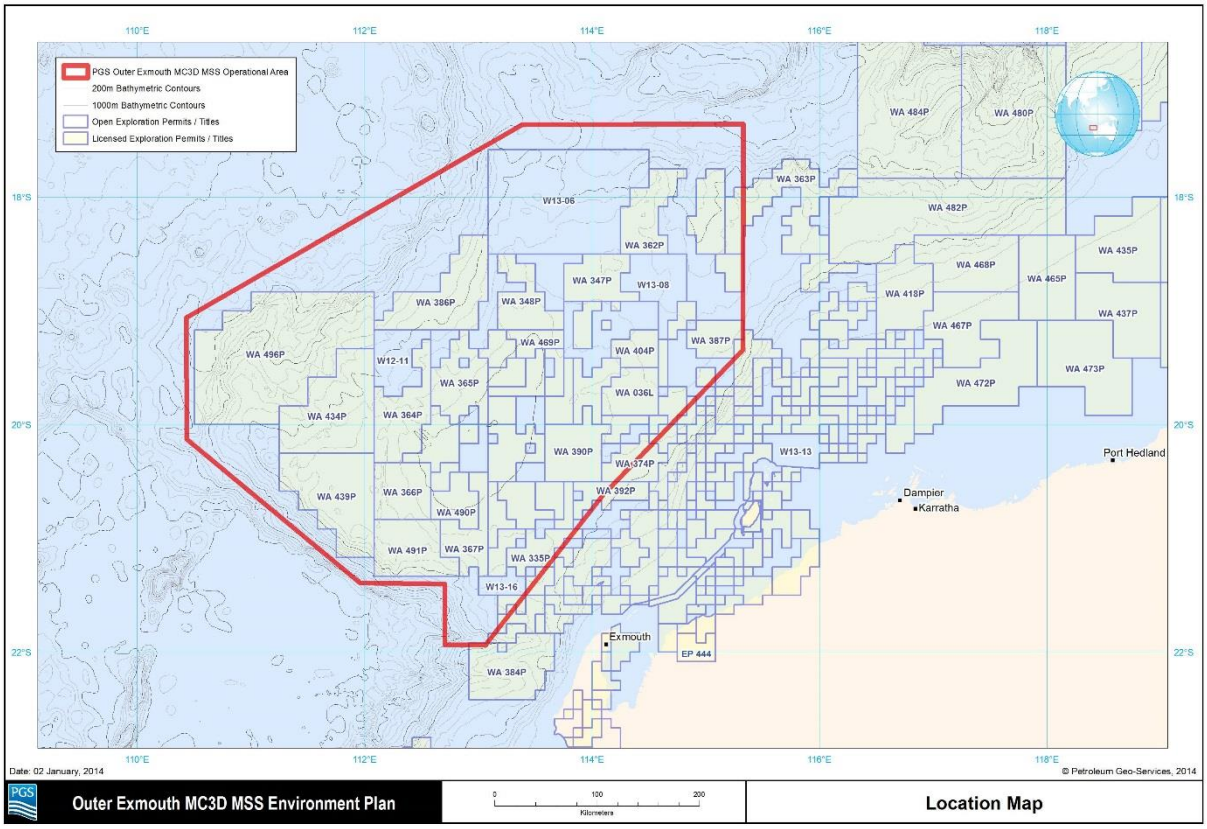
Latitude (S)			Longitude (E)		
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
19	03	29	110	26	00
17	21	41	113	23	14
17	21	22	115	19	50
19	20	31	115	19	34
20	36	55	114	05	47
21	55	56	113	03	52
21	55	56	112	42	24
21	23	49	112	42	24
21	23	20	111	57	30
20	07	37	110	26	07
19	03	29	110	26	00

1.2. LOCATION OF THE ACTIVITY

The Outer Exmouth MC3D MSS polygon lies entirely in Commonwealth waters within the North-west Marine Region (NWMR) and encompasses an area of ~170,000 km². At the closest point, the southeast corner of the polygon is located ~86 km from the mainland coastline at North West Cape. Barrow Island is located ~109 km to the east of the polygon and Exmouth Gulf is located ~100 km to the southeast. The southern boundary of the polygon is located ~108 km northwest of Point Cloates.

Water depths within the Outer Exmouth MC3D MSS polygon range from ~840 m to ~4,900 m, with the deepest water depths located on the northwest boundary of the polygon (see **Figure 1.1**).

Figure 1.1 - Location map Outer Exmouth MC3D MSS polygon



1.3. TITLES

The Outer Exmouth EP covers individual surveys within the Outer Exmouth MC3D MSS polygon for a period of five years, this list will likely change as more permitted areas are released. The Outer Exmouth MC3D MSS overlaps the following petroleum titles, W 12-11, W 13-15, W 13-16, W 13-6, W 13-7, W 13-8, W 14-10, W 14-11, W 14-12, W 14-13, W 14-17, W 14-18, W 14-22, W 14-8, W 14-9, WA-1-R, WA-22-R, WA-24-R, WA-268-P, WA-269-P, WA-271-P, WA-335-P, WA-346-P, WA-347-P, WA-348-P, WA-351-P, WA-36-L, WA-362-P, WA-363-P, WA-364-P, WA-365-P, WA-366-P, WA-367-P, WA-374-P, WA-383-P, WA-386-P, WA-387-P, WA-39-L, WA-390-P, WA-392-P, WA-40-L, WA-404-P, WA-428-P, WA-430-P, WA-433-P, WA-434-P, WA-439-P, WA-461-P, WA-469-P, WA-470-P, WA-474-P, WA-475-P, WA-478-P, WA-489-P, WA-490-P, WA-491-P, WA-496-P, WA-500-P, WA-53-R, WA-268-P LY, WA-346-P LJ, WA-346-P LS, WA-346-P LT, WA-364-P L, WA-364-P LE, WA-365-P LK, WA-365-P LS, WA-365-P LT, WA-374-P LA, WA-374-P LE, WA-383-P LP, WA-383-P L, and WA-390-P L.

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 Outer Exmouth MC3D MSS survey area 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 Outer Exmouth MC3D MSS polygon lies entirely in Commonwealth marine waters in the Northwest Province of the North-west Marine Region (NWMR). The Northwest Province is located offshore between Exmouth and Port Hedland, and occurs entirely on the continental slope. Water depths in the bioregion are predominantly between 1,000-3,000 m and reach a maximum depth of over 5,170 m on the Exmouth Plateau. The southern boundary of the polygon slightly overlaps into the Central Western Transition and the eastern boundary slightly overlaps the Northwest Transition.

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 Outer Exmouth MC3D MSS is located predominantly in the Pilbara system of the NWMR. Within the large scale ecological systems of the NWMR, smaller sub-systems have also been identified. These sub-systems reflect changes in physical and/or biological characteristics that differentiate the (area) sub-system from adjoining areas. The Outer Exmouth MC3D MSS polygon overlaps the Exmouth Plateau sub-system—this Key ecological feature (KEF) is represented in the Gascoyne Commonwealth Marine Reserve (GCMR) (see **Section 2.3.3**).

There are a number of islands and reefs within the NWMR. Along the south eastern boundary of the Outer Exmouth polygon lies Barrow Island, the largest island on the North West Shelf (NWS) located ~109 km to the east of the Outer Exmouth polygon. The Montebello Islands, located ~90 km off the south eastern boundary of the polygon, include North West Island, Trimouille and Hermite Islands.

2.1.1. Climate and Meteorology

The NWS is subject to an arid (mainly summer rain) subtropical climate with tropical cyclone activity from December to March. The summer and winter seasons fall into the periods October-April and May-September, respectively. 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. Three to four cyclones per year can be expected, primarily in the December to March period, though cyclones have been recorded as late as April in the Pilbara region.

The Pilbara Region is characterised by summer daily temperatures ranging between 20°C and 34°C. During winter, mean daily temperatures range between 17°C and 26°C.

The North-west or West Monsoons prevail from December to March and are associated with prominent cloud, rain and thunderstorm activity. Annual rainfall is typically low and highly variable. Most intense falls occur during the first half of the 'wet' season, where Barrow Island receives an average 320 mm per annum from 25.6 rain days. The region has a very high cyclone incidence and these occur primarily between December and March. Typically, cyclones move south-west across the Arafura and Timor Seas. Gale to hurricane force winds are likely to be encountered over an area between 32 km and 240 km wide. 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.
During the summer months (October–March) the prevailing winds are from the southwest, west and northwest, bringing with them warm, humid air. The southern region of the NWS is characterised by a more arid, subtropical climate. The peak wind speeds are in the range of 15–25 knots but tend to average less than 10 knots. The winter wind

(June–August) is characterised by moderate to strong east northeast to southeast winds. These winds result from high-pressure systems which ridge across the Pilbara in winter. April–May and September are the transitional periods when winds are lighter and more variable.

2.1.2. Oceanography

The NWMR is influenced by a complex system of ocean currents that change between seasons and between years, which generally results in its surface waters being warm and nutrient-poor, and of low salinity. Circulation of the Indonesian Throughflow (ITF) waters into the Northwest Province (via the South Equatorial Current and Eastern Gyral Current) comprises the dominant surface flow. This circulation is subject to seasonal variation as well as inter-annual variation.

The Pilbara system is a transitionary oceanographic region between the strong ITF influenced surface waters to the north and the Leeuwin Current-influenced surface waters to the south. The Montebello Islands are a key point of disjuncture in water masses between shallow, turbid inshore waters in the east and deeper oceanic waters to the west.

The continental shelf and Exmouth Plateau are significant features of this system (see **Section 2.3.3**). The continental shelf is relatively smooth and featureless in the Pilbara system yet steepening in slope with distance offshore. The Exmouth Plateau covers an area of ~49,500 km^2 and occurs in water depths of ~800 m to ~3,500 m. The plateau surface is relatively rough and undulating and may include numerous pinnacles. It is an important sea-floor feature that modifies the flow of deep waters, and has been identified as a site where internal waves are generated by internal tides, giving rise to the most dynamic and unique oceanographic feature in the Region. The plateau also receives settling detritus and other matter from the pelagic environment.

The strongest internal tides of the entire NWMR are believed to occur in the Pilbara system, which are thought to be an important physical driver in water depths between ~50 and 500 m depths 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. It is thought that ITF waters via the Eastern Gyral Current occur over the plateau and that they become part of the headwaters of the Leeuwin Current further inshore. Internal tides are believed to occur here and could be associated with unconfirmed upwellings associated with topographic features, such as canyons.

The most distinguishing feature of the oceanography of the Northwest Province, compared with bioregions further north, is the result of the narrowing of the continental shelf at North West (NW) Cape. The generally southward moving surface waters consolidate along the narrow shelf break and become the Leeuwin Current. The Leeuwin Current is shallow (less than 300 m deep), narrow (50-100 km wide), and flows south along the shelf break. The Leeuwin Undercurrent is also a feature of this bioregion and flows northward beneath the Leeuwin Current, between 250-450 m water depth on the continental slope. It transports higher salinity, oxygen-rich waters but nutrient-depleted water, characteristic of subantarctic water masses, northwards.

The Leeuwin Current is strongest during autumn and winter. During summer, strengthening south westerly winds counter the alongshore pressure gradient and weaken the southward flow of the Leeuwin Current, allowing the generation of the northward flowing Ningaloo Current. The Ningaloo Current intrudes into this bioregion inshore of the 50 m depth contour along Cape Range Peninsula. The narrowness of the shelf in these bioregions brings the opposing flows of the Leeuwin and Ningaloo currents into close proximity, creating an area of enhanced mixing and increased productivity.

Other seasonal influences on the oceanography of the Northwest Province include an increase in cyclone incidence and intensity during summer, as well as an increase in internal wave activity around the Exmouth Plateau and its associated canyons. It is thought that the increase in internal wave activity is the result of interaction of tides with seabed topography of the Exmouth Plateau, when the water column is more highly stratified. Such changes in bottom topography required for generation of internal tides or waves are found on the Exmouth Plateau and around the heads of submerged canyons. Where internal waves are generated they may travel both towards the shore across the shelf, and out into deeper water.

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.

Astronomical tides on the NWS are characterised by semi-diurnal tides with tidal ranges increasing in amplitude from north to south, corresponding with the increasing width of the shelf and range from ~2 m at Exmouth to ~10 m near Broome. Tidal amplitude from south to north is most marked north of the Montebello Islands, where the width of the continental shelf increases significantly. Tides and wind strongly influence water flow in the coastal zone and over the inner to mid-shelf influencing the dispersal of bottom sediments. During the southeast trade winds (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, the direction of the ocean current reverses becoming east northeast. The dominant tidal current flows in the NWMR in summer are east-northeast and west-southwest, with speeds generally ranging from 0.1 to 0.3 m/s.

2.2. PHYSICAL ENVIRONMENT

2.2.1. Geology and Sedimentology

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. The deepest areas of the abyssal plain/deep ocean are said to be muddy. The Outer Exmouth MC3D MSS polygon is located on the Exmouth Plateau, a KEF and a significant geomorphic feature of the outer shelf and slope in the NWMR. It covers an area of ~49,500 km^2 or 26% of the Northwest Province bioregion in the NWMR.

2.2.1.1. Bathymetry

Water depths over the Outer Exmouth MC3D MSS polygon range from ~840 m to ~4,900 m, with the deepest water depths located along the northwest boundary of the polygon, and the shallowest water depths located along the southeast boundary. The southern boundary of the polygon overlaps a KEF—the canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula.

2.2.1.2. Sedimentology

Deep sea sediments are dynamic and richly textured environments shaped by physical and biological processes. Turbidity currents, sediment slides and slumps and debris flows move sediments from the slope onto the continental rise and abyssal plains, scarring the sediment surface and carving out canyons. Periodic changes in bottom currents, benthic storms and seasonality in the vertical flux of organic matter add to the spatial and temporal variation in the deep-sea environment.

The Exmouth Plateau, which occurs entirely on the continental slope is comprised mostly of very low gravel and very low mud sediment; 20-60% sand and 40-80% carbonate. The sediments of the Exmouth Plateau are thought to comprise nanoplankton ooze with a volcanic ash component (i.e. abyssal red clay) which are probably limited to depths below the carbonate compensation depth (~5,000 m). Sediments on the Exmouth Plateau contain very little terrigenous material (i.e. material eroded from land) indicating that the surrounding abyssal plains and Montebello Canyon constitute a physical barrier for sediment transport. Sediment characteristics are important determinants of infaunal communities.

There are a number of reefs and islands in the Pilbara system of the NWMR adjacent to the Outer Exmouth MC3D MSS polygon, including;

- Montebello Islands:
    - Located ~90 km to the southeast of the eastern boundary of the polygon in WA State waters; and

- Important nesting area for flatback and green turtles;
- Important rookery for flatback, hawksbill, loggerhead and green turtles.

- Muiron Islands:
  - Located ~90 km southeast of the south eastern boundary; and
  - Support a critical nesting and internesting habitat for loggerhead turtles and also support a major green and loggerhead turtle rookery.
- Barrow Island:
  - Located ~109 km to the east of the eastern margin of the polygon;
  - Important rookery and nesting area for green and flatback turtles; and
  - An important feeding and nesting areas for seabirds.
- Thevenard Island:
  - Located ~130 km southeast of the eastern boundary; and
  - Important rookery for flatback turtles.

2.3. BIOLOGICAL ENVIRONMENT

2.3.1. Biological Productivity

The biological productivity above the Exmouth Plateau and slope is generally low due to the overriding influence of the oligotrophic tropical waters typical of the NWS. However, the Exmouth Plateau acts as a physical obstacle, forcing deeper, cooler and more nutrient-rich waters onto the plateau. Internal wave activity during summer may further stimulate biological productivity when nutrient-rich waters are raised into the photic zone. Satellite imagery has identified areas of increased biological productivity along the northern and southern boundaries of the plateau, as well as in the east along the shelf edge through the Montebello Trough. The extent to which internal waves play a part in these increases in productivity is poorly understood.

The trophic dynamics of deeper waters in the Northwest Province, and in particular on the Exmouth Plateau, can be separated into pelagic and benthic food webs. Detritus falling from the pelagic environment to the seabed plays a key role in nutrient cycling from pelagic to benthic environments and the amount of food sinking to the ocean floor ultimately depends on the feeding rate in the water column. The number of large benthic animals living on the sea floor is thought to be low and the vast majority of deep-sea animals are small invertebrates living in the sediment.

Small pelagic fish are thought to be the main consumers of phytoplankton and zooplankton in the pelagic system and are preyed on by larger tertiary consumers such as billfish, sharks and dolphins. Bacteria on the seabed are likely to utilise available nutrients in sediments and detritus, they are fed upon by primary consumers such as nematodes and copepods. Detritivores such as molluscs and crustaceans also directly feed upon the detritus. Both the primary consumers and detritivores are most likely preyed upon by larger secondary consumers such as crustaceans and demersal fish.

2.3.2. Biological Communities

The Northwest Province represents the beginning of a transition between tropical and temperate biological communities. The predominantly southward flowing surface currents continue to bring tropical Indo-Pacific organisms into this bioregion, but the presence of the northward flowing Leeuwin Undercurrent also transports temperate species from more southern regions.

The Region supports internationally important breeding and feeding grounds for a number of threatened and migratory marine species that transit through the bioregion, 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 habitats (i.e. in between egg laying periods). The annual aggregation of whale sharks around Ningaloo Reef is the highest known density of whale sharks in the world. Cetaceans, marine turtles (e.g. loggerhead, leatherback and green turtles), and sharks are all known to feed on and around the adjacent Ningaloo Reef, which is situated on the shelf and slope of the Cape Range Peninsula.

The Exmouth Plateau is recognised as a KEF (see **Section 2.3.3**) of the NWS for its enhanced biological productivity that supports a range of species. The Exmouth Plateau is thought to be an important area for biodiversity as it provides an extended area offshore for communities adapted to depths of around 1,000 m. The circulation of deep-water currents in the bioregion probably brings deep-water species in closer proximity to species that occur on the plateau and may result in important associations of biological communities. For example, channels and valleys from the plateau to the deeper slope and adjoining abyss may act as conduits for the delivery of materials and sediments and may sustain suites of communities at the base of the plateau. The deeper waters of the inner edge of Exmouth Plateau, around the Montebello Trough, are believed to be an important feeding site for sperm whales (based on nineteenth century whaling data), indicating an area of high biological productivity. However, little specific information is available on the biological communities of the Exmouth Plateau and associated slope.

Information on sediments in the bioregion indicates that benthic communities are likely to include filter feeds and epifauna. Soft-bottom environments are likely to support patchy distributions of mobile epibenthos, such as sea cucumber, ophiuroids, echinoderms, polychaetes and sea-pens. The biological communities within the canyons of the bioregion are also poorly understood. The canyons in this bioregion most likely channel currents onto the plateau, driving upwellings in the canyon heads, such features are associated with large aggregations of baitfish, which in turn attract larger pelagic species such as billfish and tuna.

Pelagic species occurring above the plateau slope and canyons are likely to include nekton and small pelagic fish, attracted to seasonal upwellings, as well as larger predators such as billfish, sharks and dolphins. The upper and middle parts of the continental slope in this bioregion have important demersal fish communities, which display a high degree of endemism. In particular, the continental slope between NW Cape and the Montebello Trough supports over 508 species of fish, of which 76 are endemic. The high numbers of species found here is thought to be associated with areas of enhanced biological productivity as a result of the interaction between seasonal currents and seabed topography. These demersal fish communities have been identified as a KEF of the NWMR.

2.3.3. Protected Marine Fauna

A review of the EPBC Act database held by DoE (DoE 2013a), using the Protected Matters Search Tool (PMST), was conducted for the polygon described by the boundary coordinates provided in **Table 1.1**, with the application of a 1 km buffer zone.

The 11 listed Threatened species that may occur, or relate to, the polygon:

1. the southern giant-petrel
2. the soft-plumaged petrel
3. the sei whale
4. the blue whale
5. the southern right whale
6. the humpback whale
7. the loggerhead turtle
8. the green turtle
9. the leatherback turtle
10. the hawksbill turtle
11. the flatback turtle

As indicated by the Protected Matters search the Outer Exmouth MC3D survey area overlaps three Key Ecological Features (KEF)

1. Exmouth Plateau; and
2. Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula.

There are a number of Biologically Important Areas (BIA) (e.g. breeding, nesting, foraging areas) for EPBC Act-listed species of marine fauna that are in the vicinity of the Outer Exmouth MC3D survey area. The BIA with ranges overlapping the survey area include:

The BIA with a range which overlaps the Outer Exmouth MC3D MSS polygon includes:

- migration area (north and south) for the pygmy blue whale;
- breeding areas for the wedge-tailed shearwater.

The BIA with ranges adjacent to the Outer Exmouth MC3D MSS polygon includes:

- resting area and migration area (north and south) for the humpback whale;
- foraging area (high density seagrass beds) for dugong;
- foraging, mating, nesting and internesting buffer areas for the flatback turtle;
- foraging nesting and internesting buffer for the green turtle;
- foraging, nesting and internesting areas for the hawksbill turtle;
- nesting and internesting areas for the loggerhead turtle;
- foraging (high density prey) and foraging areas for the whale shark;
- breeding and foraging areas for the lesser crested tern;
- breeding and resting areas for the roseate tern; and
- breeding areas for the fairy tern

2.3.3.1. Cetaceans

The EPBC Act database lists 27 cetacean species that may occur in, and adjacent to, the the Outer Exmouth MC3D MSS polygon, all of which are protected under the EPBC Act; two of these are also classified as Endangered, two as Vulnerable and eight as Migratory species.

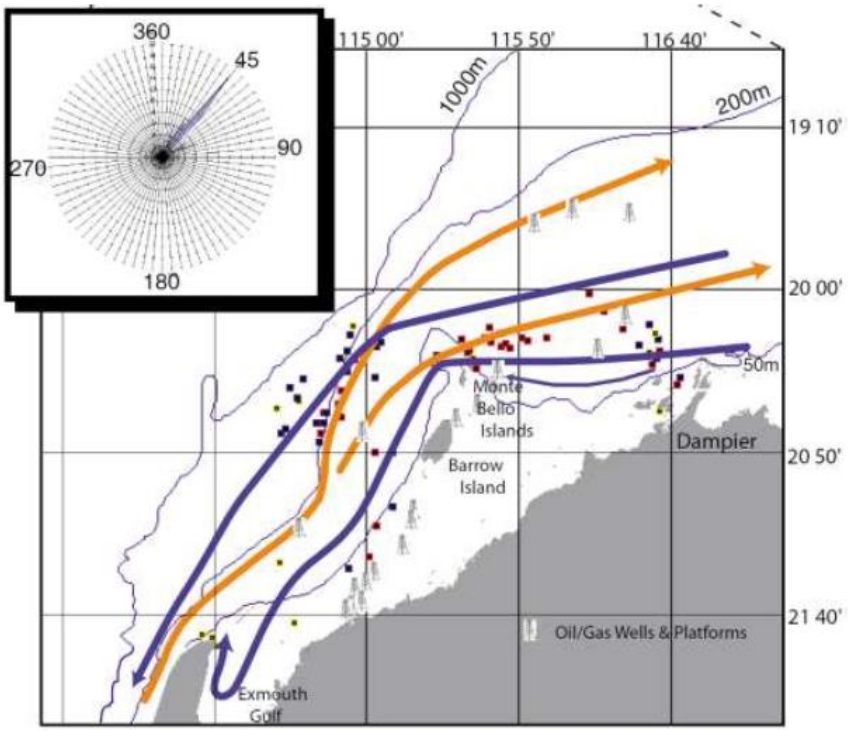
Humpback whales are listed as Vulnerable and Migratory under the EPBC Act and are also protected under the WA *Wildlife Conservation Act 1950* and are the most commonly sighted whale in northern WA waters. The species has been observed seasonally to complete their northern migration in the Camden Sound area of the west Kimberley ~480 km north of the Outer Exmouth MC3D MSS polygon, after feeding in Antarctic waters during the summer months (**Figure 2.1**).

The population that winters off WA is known as the Group IV population. Its migration in the region is characterised by three distinct directional phases:

- Northbound phase - starts April, peaks July and tapers off by August. Around the Barrow Island/Montebello Islands area, northerly migrating humpback whale numbers peak during late July/early August, and may extend north to the continental shelf edge at 130 km offshore, generally out to the 200 m depth contour.
- Transitional phase (peak numbers expected at this time) - between late August and early September.
- Southbound phase – usually occurring between late August and early September, although smaller numbers may occur until November (this phase of migration is segmented by 2–3 week delay in appearance of peak numbers of cow/calf pods after the main migratory body has passed). Southerly migration in this area is contracted in a narrower band than the northerly migration route, generally occurring closer to the coast in waters less than 100 m deep.

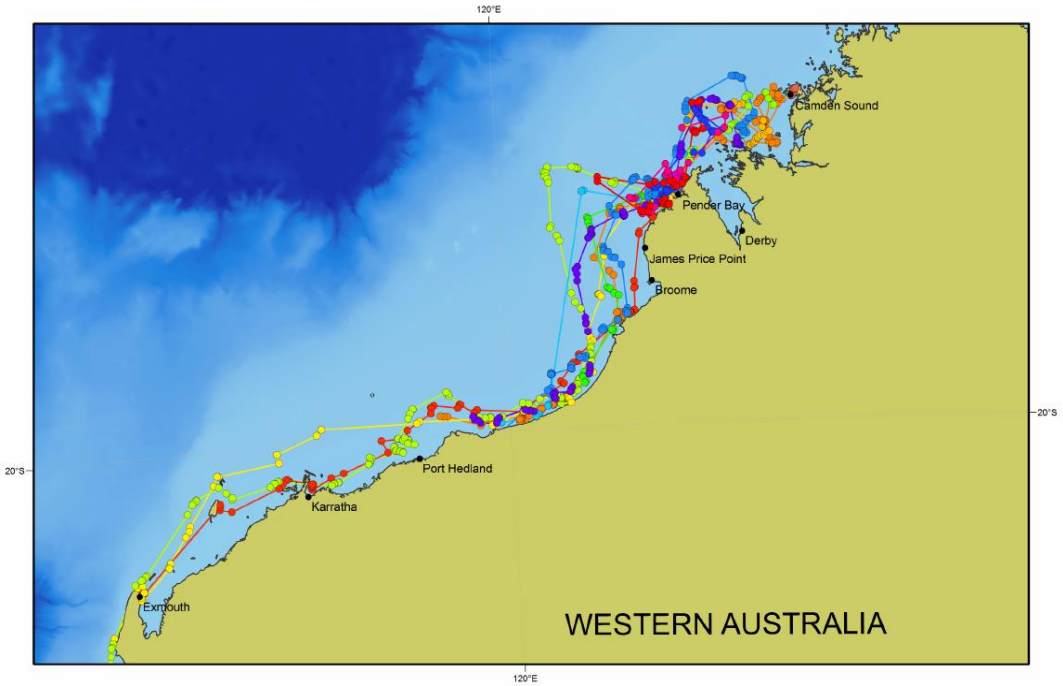
The commencement date of surveys within the Outer Exmouth MC3D MSS polygon is yet to be finalised but as the EP is expected to extend for a period of five years it is likely that some individual surveys will coincide with the humpback whale migration season. However, given the distance offshore (~75 km) and water depths (~840 m to ~4,900 m) it is unlikely that significant numbers of humpback whales will be encountered, and those individuals that are present in the area are likely to be transient.

Figure 2.1 - Humpback whale migratory routes past the Outer Exmouth MC3D MSS polygon



Source: modified from Jenner *et al.* (2001).

Figure 2.2 - Tracks obtained in 2009 from 17 satellite-tagged humpback whales



Source: modified from Double *et al.* (2010).

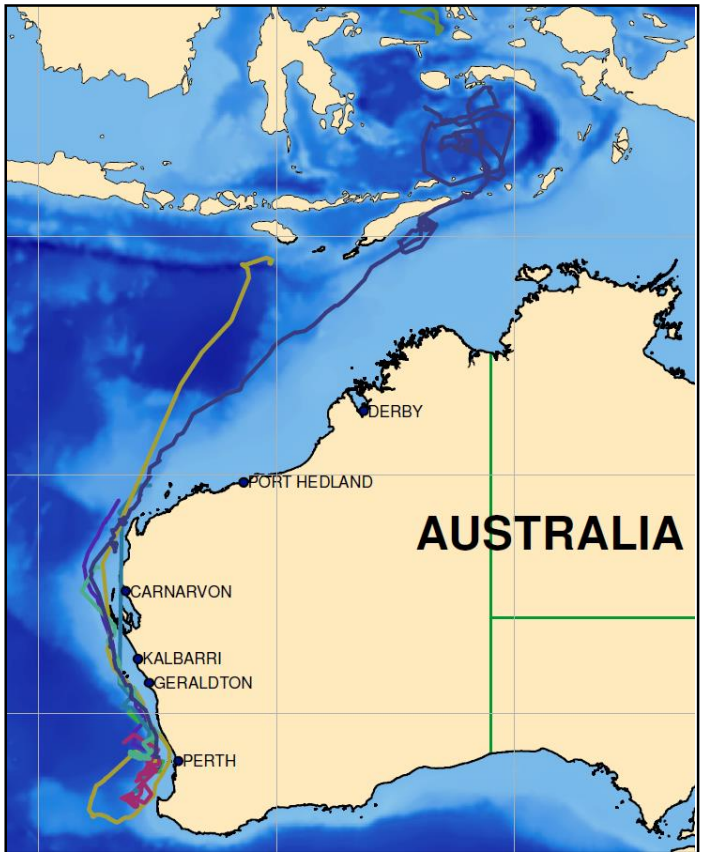
Other rare species of whale include the blue whale (listed as Endangered and Migratory), which may be present in, or adjacent to, the Outer Exmouth MC3D MSS polygon as indicated from the EPBC Act database search. Blue whales are widely distributed throughout the world's oceans. This species has been 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. The migration appears to be centred on the 500 m depth contour. Sea noise loggers set at various locations along the coast of WA have detected an annual northbound and southbound migration of pygmy blue whales past Exmouth and the Montebello Islands. This was confirmed using satellite tracking by Double *et al.* (2012) who observed northbound individuals between April and August and southbound individuals from October to the end of January with peaks in late November to early December (see **Figure 2.2**).

The Outer Exmouth MC3D MSS polygon 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 Outer Exmouth MC3D MSS polygon during some of the proposed surveys. However, it is unlikely that significant numbers of individuals will be encountered as the majority of animals will be moving north/south inshore of the Outer Exmouth MC3D MSS polygon, as supported by the satellite tracking data shown in **Figure 2.3**.

Figure 2.3 - Satellite tracking of blue whales in 2010/2011



Source: Modified from Double *et al*. 2012.

Offshore waters of the NWMR once supported substantial populations of sperm whales. The presence of sperm whales as evidenced by 19th Century whaling industry data suggests occasional bursts in productivity, which may be associated with variations in slope (such as canyon heads) and may support species at a number of trophic levels. Offshore waters once supported substantial populations of sperm whales and recent acoustic evidence suggests that blue whales move

between Scott Reef and Browse Island during July (moving north) and again in October/November (moving south). Therefore, it is possible that sperm whales may be encountered during surveys undertaken in the deeper waters of the Outer Exmouth MC3D polygon.

The southern right whale migrates from summer feeding grounds in the Southern Ocean to calve and breed in warmer coastal waters. Southern right whales are seasonally present off the Australian coast between about May to November and have been recorded in the coastal waters of all Australian states. Primarily they are found aggregating in state waters around the southern coastline off southern WA and far west South Australia. The main calving areas in Western Australia include Doubtful Island Bay, Albany to Cape Riche area and the Yokinup Bay to Cape Arid area Although they are unlikely to be encountered in the Outer Exmouth MC3D MSS polygon or surrounding waters, southern right whales have the potential to transit the polygon. The Protected Matters Search identified the southern right whale as a listed Migratory species, which may be present in the waters of the Outer Exmouth MC3D MSS polygon.

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. The species is associated with high topographical relief of the ocean floor, escarpments and upwelling areas, and there are no known key localities in Australia. Risso's dolphin is distributed through all oceans, occurs inshore and offshore, but is generally considered pelagic and oceanic. The Outer Exmouth MC3D MSS polygon does not contain any significant or limiting habitat or feeding grounds for these dolphin species.

2.3.3.2. Marine Reptiles

The PMST identified five species of marine turtle that may occur within or in the waters surrounding the Outer Exmouth 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). The Montebello Islands and the Lowendal Islands have been identified as regionally significant rookeries for the hawksbill, green and flatback turtles, and to a lesser extent for the loggerhead turtle. The green turtle is common around Barrow Island, while identified rookeries for the flatback turtle include Barrow Island, the Muiron Islands and more north-easterly beaches including those at Cape Thouin, which is located to the east of the Dampier Archipelago.

2.3.3.3. Sharks and Ray-finned Fishes

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 (IUCN 2013). 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 and July. Preliminary research on the migration patterns of whale sharks has shown that after departing Ningaloo Reef they head north through the NWMR with some individuals passing Scott and Ashmore Reefs. A BIA (foraging area) for the whale shark overlaps the Outer Exmouth MC3D MSS polygon.

The Outer Exmouth MC3D MSS polygon 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 polygon. 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 (New South Wales). 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.

2.3.3.4. Sea Snakes

Storr *et al.* (1986) estimate that 22 species of sea snakes and kraits occur in WA waters, however little is known of the distribution of individual species, population sizes or aspects of their ecology. 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. Cogger (1975) stated that 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 (~840 m to ~4,900 m) and distance offshore (~75 km) it is unlikely that sea snakes will be encountered during individual surveys undertaken within the Outer Exmouth MC3D MSS polygon.

2.3.3.5. Shorebirds and Seabirds

Barrow Island is recognised as an important staging site (an area where migrating birds gather to feed before continuing on their migration) and an important non-breeding site for migratory shorebirds. Shorebirds are widely distributed around Barrow Island, which is internationally significant site for six migratory shorebird species (ruddy turnstone, sanderling, red-necked stint, grey-tailed tattler, greater sand plover, and lesser sand plover) and two non-migratory species (fairy tern and sooty oystercatcher). The highest abundance of shorebirds occurs on the south eastern and southern coasts of Barrow Island, which is located ~109 km east of the Outer Exmouth MC3D MSS polygon. Serrurier Island (~60 km to the east of the polygon) and Airlie Island (~75 km to the southeast) are also important breeding areas for migratory birds including little tern, Caspian tern, wedge-tailed shearwaters and ospreys.

The Outer Exmouth MC3D MSS polygon extends beyond the continental shelf and out to the boundary of the EEZ and there is little information concerning the populations of seabirds utilising these offshore waters. A search of the EPBC Protected Matters database listed three species that may occur in the Outer Exmouth MC3D MSS polygon: the southern giant-petrel *(Macronectes giganteus)* listed as Endangered; the soft-plumaged petrel *(Pterodroma mollis)* listed as Vulnerable and the osprey *(Pandion haliaetus)* a listed Marine Species. However, there are no BIA for any of these three species within or adjacent to the polygon and although some individuals might be encountered during the survey it is unlikely to be in significant numbers. The BIA for the wedge-tailed shearwater (breeding areas, overlap the polygon) and the lesser crested tern and the roseate tern (breeding areas and forage within in the vicinity of the polygon).

2.4. SOCIO-ECONOMIC ENVIRONMENT

2.4.1. Commercial Fisheries

The NWMR encompasses both the Gascoyne Coast Fisheries Bioregion (GCBF) and the North Coast Fisheries Bioregion (NCFB). The GCFB plays a significant role in the Western Australian fishing industry, with three of the State's more valuable fisheries located here. The Shark Bay Prawn, Exmouth Gulf Prawn and the Shark Bay Scallop fisheries land a combined catch value in the range of $40 - $50 million annually.

Finfish fisheries of importance in the GCFB are the Gascoyne Demersal Scalefish Fishery (GDSF) and Shark Bay Beach Seine and Mesh Net Fishery. These fisheries have been in operation since the mid-1960s and provide a significant portion of the state's snapper and whiting catch. There are several other small commercial finfish fisheries operating in the bioregion, including a small marine aquarium fishery which collects low numbers of a wide variety of species, outside the Ningaloo Marine Park and other protected areas.

The principal commercial fisheries in the NCFB focus on tropical fin fish, particularly the high-value emperors, snappers and cod, which are taken by the Pilbara Fish Trawl Fishery as well as the Pilbara and Northern Demersal Trap fisheries. The typical catch is in the order of 3,000 tonnes annually, making these fisheries, at an estimated annual value of around $12 million, the most valuable fin fish sector in the state. There are also significant fisheries for Spanish mackerel, barramundi/threadfin salmon and shark.

State fisheries are managed by the WA Department of Fisheries (DoF) and Commonwealth fisheries are managed by the Australian Fisheries Management Authority (AFMA).

State fisheries administered by DoF that can operate in the Outer Exmouth MC3D MSS include the following:

- Mackerel Managed Fishery (MMF);
- Pilbara Line Fishery (PLF); and
- West Coast Deep Sea Crab (Interim) Managed Fishery (WCDSCF).

Commonwealth fisheries administered by AFMA that can operate in the Outer Exmouth MC3D MSS include the following:

- North West Slope Trawl (NWST);
- Southern Bluefin Tuna Fishery (SBFTF);
- Western Deepwater Trawl Fishery (WDTF);
- Western Skipjack Fishery (WSF); and
- Western Tuna and Billfish Fishery (WTBF)

The MMF uses near-surface trolling gear from small vessels in coastal areas around reefs, shoals and headlands to target Spanish mackerel (*Scomberomorus commerson*). Jig fishing is also used to capture grey mackerel (*S. semifasciatus*), 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. 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. The total catch for 2012 was 318.1 t; Area 1 (Kimberley) was 180.3 t and Area 2 (Pilbara) was 88.0 t. The Outer Exmouth MC3D MSS overlaps Area 2 and 3 of the MMF. Therefore, it is possible that vessels fishing in Zone 2 and 3 of the MMF could operate in the vicinity of the polygon during the proposed activities. However, due to the Outer Exmouth MC3D MSS polygon's distance offshore and water depths of over 1,000m, it is unlikely that there will be any interactions between surveys in the Outer Exmouth MC3D MSS polygon and vessels fishing in the MMF.

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. In 2012, the total annual catch for the line fishery was ~77 t, lower than the catch in 2011 of 110 t but still within the 50-115 t target catch range. In recent years (since ~2006), the line fishery catches have been dominated by ruby snapper and goldband snapper, typically accounting for more than 40% of the total annual catch. In 2012, line fishers reported operating for 328 days, compared with 376days in 2011 (DoF 2013). The Outer Exmouth MC3D MSS polygon 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 polygon during the proposed activities. However, due to the Outer Exmouth MC3D MSS polygon's distance offshore and water depths of over 1,000 m it is unlikely that there will be any interactions between surveys in the Outer Exmouth MC3D MSS polygon and vessels fishing in the PLF.

The WCDSCF (Interim) Managed Fishery 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'). These are operated in 'long-lines', which have between 80 and 180 pots attached to a main line marked by a float at each end. The WCDSCF, governed under the *West Coast Deep Sea Crustacean Managed Fishery Management Plan 2012*, transitioned from an interim managed fishery to a managed fishery on 1st January 2013. Within the new management plan, there was the unitisation of the licenses (which replace permits in the previous management plan). Unitisation allowed greater transfer of units between license holders. Furthermore, Giant and Champagne crab catches, previously retained as 'byproduct' of a permit, are now unitised as "B" class units, allowing these to be transferred to a single license, resulting in these species to be specifically targeted. The product is landed live at ports between Carnarvon and Fremantle, generating some additional economic activity and benefits. There were three vessels operating in 2012 (DoF 2013).

The Outer Exmouth MC3D MSS polygon 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 polygon during the proposed activities. However, due to the Outer Exmouth MC3D MSS polygon's distance offshore and water depths of over 1,000 m, it is unlikely that there will be any interactions between surveys in the Outer Exmouth MC3D MSS polygon and vessels fishing in the WCDSCF.

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. Demersal trawl gear is used in the NWSTF and most of the effort and catch occurs over soft, muddy sediments or sandy habitats, typically at depths of 350-600 m on the continental slope especially to the southwest and northeast of the Rowley Shoals. Whilst there are 7 fishing permits in the NWSTF only one vessel was active in the fishery in 2010-2011, and two vessels active in the 2011-12 with Australian scampi being the main target. Some vessels operating in the NWSTF also fish in the Western Deep Water Trawl Fishery (WDTF) and WA state fisheries. Whilst the Outer Exmouth MC3D MSS polygon is located entirely within the overall management area for the NWSTF, it is apparent that in recent years (2006-2011) most of the effort and catch within the fishery has occurred in shallower, upper slope waters (350-600 m) to the southwest and northeast of the Rowley Shoals. Therefore, it is possible that vessels fishing in the NWSTF could operate in the vicinity of the Outer Exmouth MC3D MSS polygon during the proposed activities. However, due to recent fishing efforts being located in shallower depths (300-600 m) and further north, around the Rowley Shoals, it is highly unlikely that there will be any interactions between surveys in the Outer Exmouth MC3D MSS polygon and vessels fishing in the NWSTF.

The WDTF is located off Western Australia, in waters extending from approximately the 200 m isobath to the outer edge of the Australian Fishing Zone boundary, from 115°08'E in the south to 114°E in the north. Principally a finfish trawl fishery, species diversity is considerable. Commercial species are taken on the upper (200-700 m) and mid-continental slope but generally not in large quantities. Catches in the WDTF were historically dominated by six main commercial finfish species including orange roughy (*Hoplostethus atlanticus*), oreos (Oreosomatidae), boarfish (Pentacerotidae), eteline snapper (Lutjanidae: Etelinae), apsiline snapper (Ludjanidae: Apsilinae) and sea bream (Lethrinidae). Between 2000 and 2005 deepwater bugs emerged as the most important target species. However, there has been a large reduction in effort and catch over the past three years. Catches in 2011-12 of deepwater bugs and ruby snapper declined even further from already low levels and orange roughy has not been targeted or catches reported since 2004-2005. Fishing effort in 2011-12 concentrated in the northern portion of the WDTF area (offshore from the NWC and it is therefore, possible that vessels fishing in the WDTF could operate in the vicinity of the Outer Exmouth MC3D MSS polygon during the proposed activities. However, due to recent fishing efforts also located further south, offshore from Carnarvon and Fremantle, it is unlikely that there will be any interactions between surveys in the Outer Exmouth MC3D MSS polygon and vessels fishing in the NWSTF.

The WTBF extends from Cape York westwards around the NT and WA coast and across to the Great Australian Bight (GAB), out to the limit of the Australian Fishing Zone and includes additional areas around Cocos and Christmas Islands. The fishery primary targets broadbill swordfish (*Xiphias gladius*) yellowfin tuna (*Thunnus albacares*), bigeye tuna (*T. obesus*) and albacore tuna (*T. alalunga*). In 2011-2012, 95 permits were issued and two vessels operated. The majority of catch and effort in the WTBF occurs in Commonwealth waters off the central west coast of WA. Fishing effort was restricted to areas south of Geraldton (~30°S) and north of the Rowley Shoals (~15°S) in the NWMR during the 2011-2012 season.

The WSTF is not active in continental shelf waters of the Exmouth Plateau. In recent years, activities in the WSTF have largely been confined to waters in the GAB and north-east of Eden in New South Wales. No Australian vessels were active in either zone (Western or Eastern) of the WSF during the 2010-11 fishing season. The Outer Exmouth MC3D MSS polygon overlaps the fishery but it does not overlap the current catch and effort fishing areas of the WSTF. Therefore, it is highly unlikely that there will be any interactions between surveys in the Outer Exmouth MC3D MSS polygon and vessels fishing in the WSTF. The skipjack tuna (*Katsuwonus pelamis*) is the only target species in the fishery. Low catches in previous years are thought to be a result of the low unit price for skipjack tuna and the natural variability of skipjack tuna in Australian waters. The John West tuna contract with the cannery in Port Lincoln (Port Lincoln Tuna Processors)

ceased in May 2010. This was the last remaining tuna cannery in Australia, and so there is no longer a dedicated domestic market to receive catches of skipjack tuna.

The SBTF targets juvenile southern bluefin tuna (2–3 years) in the GAB using purse-seine gear, mainly from December to April. These operations are concentrated in shelf and upper slope waters of the eastern GAB, with the maximum fishing intensity in 2012 being concentrated on a relatively small area just north of the shelf break. Throughout the rest of its range, southern bluefin tuna is targeted by pelagic longliners, with the focus being on domestic longliners operating along Australia's east coast.

Activities in the WTBF, WSF and 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 the fisheries do not overlap the Outer Exmouth MC3D MSS polygon.

2.4.2. Petroleum Exploration and Production

There are no offshore production facilities within or immediately adjacent to, the Outer Exmouth MC3D MSS polygon. There is one pipeline, from the Jansz-lo gas field to Barrow Island, which extends into the polygon

2.4.3. Commercial Shipping

There are a number of commercial shipping lanes (shipping fairways) that directly overlap the Outer Exmouth MC3D polygon. AMSA's nautical section was identified as a stakeholder and contacted regarding the proposed Outer Exmouth MC3D MSS and subsequently supplied details of the location of shipping fairways that overlap and are adjacent to the survey area, and vessel traffic for January to February 2014. AMSA will be contacted and advice will be sought prior to commencement of all individual multi-client 3D MS surveys to be undertaken within the Outer Exmouth MC3D MSS polygon.

2.4.4. Tourism and Recreation

Due to the location of the Outer Exmouth MC3D MSS polygon and distance to coastal areas of the NW Cape (~86 km) and the Gascoyne and Pilbara regions, there are no recreational activities (such as recreational fishing and marine-based tourism) undertaken in the area.

2.4.5. Cultural Heritage

There are no known Native Title Determinations for the waters and seabed within or immediately adjacent to the Outer Exmouth MC3D MSS polygon. Similarly, there are no current or pending Native Title Determinations for the waters and seabed within or immediately adjacent to the polygon.

There are four historic shipwrecks listed on the National Shipwreck Database in the vicinity of the Outer Exmouth MC3D MSS polygon. The following historic shipwrecks were all wrecked off the NW (Montebello Islands) and are located ~37 km southeast of the southeast boundary of the Outer Exmouth MC3D MSS polygon:

- *Vianen,* a sailing vessel wrecked in 1628.
- *Wild Wave* (China), a sailing vessel wrecked in 1873.
- *Marietta*, an unknown vessel wrecked in 1905.
- *Curlew*, a sailing vessel wrecked in 1911.

2.4.6. National Heritage

There are no places listed on the Commonwealth Heritage List within or immediately adjacent to the Outer Exmouth MC3D MSS polygon (DoE 2013e).

The nearest Commonwealth Heritage site to the polygon is the Ningaloo Marine Area, which is located ~55 km to the southeast of the eastern boundary. Ningaloo Marine Area - Commonwealth Waters (Place ID 105548, Place File No 5/14/192/0010).

2.4.7. Marine Parks and Reserves

The Outer Exmouth MC3D MSS polygon overlaps the Gascoyne Commonwealth Marine Reserve (GCMR) Multiple Use Zone (IUCN Category VI) and is located ~11 km to the north of the GCMR Habitat Protection Zone and ~12 km to the northeast of the GCMR Marine National Park Zone. The Ningaloo Commonwealth Marine Reserve (NCMR) Recreational Use Zone is ~55 km to the southeast of the south eastern boundary of the polygon; and the Montebello Commonwealth Marine Reserve (MCMR) Multiple Use Zone, ~45 km to the southeast of the south eastern boundary of the polygon.

The GCMR covers an area of 81,766 km^2 with water depths ranging from ~15 m in shallow coastal areas to depths ~6,000 m on the abyssal plain. The marine reserve is an important foraging area for migratory seabirds, Threatened and Migratory hawksbill and flatback turtles and the Vulnerable and Migratory whale shark. The reserve includes some of the most diverse continental slope habitats in the whole of Australia, in particular the continental slope area between NW Cape and the Montebello Trough; more than 500 fish species, 76 of which are endemic, have been recorded from this area. Flatback and green turtles occur within the GCMR, as do wedge-tailed shearwaters. The reserve is adjacent to Exmouth Gulf, which is considered to be a significant foraging and nursing area for dugongs, an important nesting and internesting area for hawksbill and loggerhead turtles, a breeding area for roseate and fairy terns and a resting area for humpback whales. The reserve abuts (at its southern boundary) the WA State waters Ningaloo Marine Park, therefore providing connectivity between the inshore waters of the existing NCMR and the deeper waters of the area. It provides protection to many seafloor features including canyons, terraces, ridges, knolls, deep hole/valleys and the continental rise. The canyons linking the Cuvier Abyssal Plain with the Cape Range Peninsula are unusual because their heads are particularly close to the coast.

The GCMR contains three KEF:

- Canyons on the slope between the Cuvier Abyssal Plain and the Cape Range Peninsula;
- Exmouth Plateau; and
- Continental slope demersal fish communities – the most diverse slope bioregion in Australia with over 500 species found and >64 of those endemic to the area.

The NCMR is categorised as a Recreational Use Zone - IUCN Category II and is located along the west coast of the Cape Range peninsula near Exmouth and lies adjacent to the WA State waters Ningaloo Marine Park and Ningaloo Coast World Heritage Property. The northern boundary lies adjacent to the Muiron Islands Marine Management Area (MIMMA). The water depths within the NCMR range from relatively shallow (~30 m) to deep oceanic waters of ~500 m deep. A key feature of the reserve is the rapid increase in depth. The reserve sustains tropical and temperate plants and animals with many species at the limit of their distribution. Ningaloo Reef is globally significant and has international and national significance as it is the only extensive coral reef in the world that fringes the west coast of a continent. The near-shore reef is comprised of a continuous series of wave-swept walls off a limestone peninsula extending for ~260 km and includes extensive coral and sponge gardens (over 200 species) and over 400 species of fish. Marine turtles, dugongs, dolphins, whales and whale sharks frequent the coast. Four marine turtle species have been recorded in the reserve and the area is part of the migratory route for many trans-equatorial shorebirds and waders. The Ningaloo Reef is the longest fringing barrier reef in Australia.

The MCMR is categorised as an IUCN Category VI Multiple Use Zone and covers an area of ~3,413 km^2 with water depths ranging from ~15 m to ~150 m. The MCMR is located ~20 km north of Barrow Island and ~125 km west of Dampier. The reserve abuts the WA Barrow Island Marine Management Area and the Montebello Islands Marine Park. The MCMR Multiple Use Zone is ~45 km to the southeast of the south eastern boundary of the Outer Exmouth MC3D MSS polygon. The MCMR provides representation and protection of continental shelf environments and habitats. It is a resting area for migrating humpback whales and supports resident populations of common bottlenose dolphins and Indo-Pacific humpback dolphins. The Montebello Islands (in adjacent State waters) have been identified as critical nesting and internesting habitat for green, flatback and hawksbill turtles. Summer mating aggregations of green turtles also occur in the area. The Montebello Islands are home to wedge-tailed shearwaters, bridled terns, roseate terns, ospreys, white-bellied sea eagles, eastern reef egrets, caspian terns and lesser-crested terns. The historic shipwreck the *Trial* is located within the MCMR.

2.4.8. Other Protected Areas

There are no listed World Heritage Properties or Ramsar Wetlands of International Importance within or immediately adjacent to the Outer Exmouth MC3D MSS polygon or surrounding waters. The nearest World Heritage Property to the polygon is the Ningaloo Coast World Heritage Property, which is located ~55 km to the southeast of the south eastern boundary of the polygon.

Ningaloo Reef is globally significant as it is the only extensive coral reef in the world that fringes the west coast of a continent. The near-shore reef is comprised of a continuous series of wave-swept walls off a limestone peninsula extending for ~260 km and includes extensive coral and sponge gardens (over 200 species) and over 400 species of fish. Marine turtles, dugongs, dolphins, whales and whale sharks frequent the coast.

The nearest nationally recognised wetland of importance is the Exmouth Gulf East Wetland, ~130 km to the southeast from the south eastern boundary of the polygon. It includes marine waters less than 6 m deep at low tide.

2.4.9. Defence Activities

There are a number of defence activities overlapping the Outer Exmouth MC3D MSS polygon. The RAAF Learmonth Defence Restricted Airspace R853A and R853B overlap the polygon. When activated by a Notice to Airmen (NOTAM), the restricted airspace can operate down to sea level. The MEA RAAF Learmonth Air Weapons Range R859A, R859B, R860A, R860B, R861A, R861B, R862A, R862B, overlaps the polygon. When activated by a NOTAM, the restricted airspace can operate down to sea level.

3. DESCRIPTION OF THE ACTIVITY

The proposed marine seismic surveys will be typical 3D surveys 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 surveys will be conducted using purpose-built seismic survey vessels. During the proposed activities, the survey vessel(s) will traverse a series of pre-determined sail lines within the Outer Exmouth MC3D MSS polygon 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 14 solid streamers, with a length of 7,100 m. Streamer spacing will be 100 m, 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 15m. The operating pressure for the airgun array will be ~2,000 psi. The airgun array will consist of sub-arrays, each with a maximum volume of 4,130 cui. These sub-arrays will be fired alternately, with a shot point interval of ~18.75 m horizontal distance, and will produce at source (i.e. within a few metres of the airguns) sound pulses in the order of 225 dB re 1µPa^2.s (at 1 m) (sound pressure level - SPL), at frequencies extending up to ~210 Hz. The size of the source has been selected as low as reasonably possible to work in water depths from ~840 m to ~4,900 m, and to ensure the geophysical targets below the sea surface are imaged to an acceptable level.

PGS has designed the 4,130 cui source array to meet several criteria regarding operational stability, predictable behaviour, and fit-for-purpose subsurface seismic imaging. Several years of careful numerical modelling and acoustic source description have culminated in a configuration that can be accurately modelled and described across all frequencies of interest; from the perspective of both exploration requirements and for transparent environmental management. The three-dimensional acoustic output is predictable, it is measurably accurate, and therefore the operational towing depths and sub-array separation can be robustly customized for the relevant objectives of any survey location. From the exploration perspective, the total array volume is optimized for the depth ranges of all likely hydrocarbon targets. In contrast to some historically much larger arrays, the 4,130 cui array is able to use only three sub-arrays to yield acoustic output that is close to being azimuthally symmetric (does not involve any directionally-focused effects), minimizes bubble energy, and minimizes in-sea maintenance and handling risks. Based on (unpublished) 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. Surveys within the Outer Exmouth MC3D MSS polygon will be conducted in water depths of from ~840 m to ~4,900 m. Therefore, it is impossible for any of the towed equipment to make contact with the seabed or benthic communities.

PGS proposes to conduct MC3D surveys within the Outer Exmouth MC3D MSS polygon using purpose-built seismic survey vessels from the PGS fleet. Any survey vessel(s) used for the respective MC3D survey 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. The vessel(s) will travel within survey areas within the Outer Exmouth MC3D MSS polygon at an average speed of 4.5 knots.

One or more support vessels will accompany the seismic survey vessel to maintain a safe distance between the survey array and other vessels, and to manage interactions with shipping and fishing activities if required. The support vessel(s), which have a crew of ~15 personnel, will also re-supply the survey vessel with fuel and other logistical supplies. If required (i.e. for vessels over 400 GRT) the support vessel(s) will have an implemented and tested Shipboard Oil Pollution Emergency Plan (SOPEP). Depending on the duration of individual surveys, the survey vessel(s) may need to be refuelled at sea using the support vessel either within or immediately adjacent to specified survey areas within the Outer Exmouth MC3D MSS polygon, this will only take place during daylight hours, and will not take place within a distance of 25 km from any emergent land or shallow water features (<20 m water depth).

4. DETAILS OF ENVIRONMENTAL IMPACTS AND RISKS

An Environmental Risk Assessment (ERA) of the proposed MC3D surveys within the Outer Exmouth MC3D MSS polygon 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 surveys.

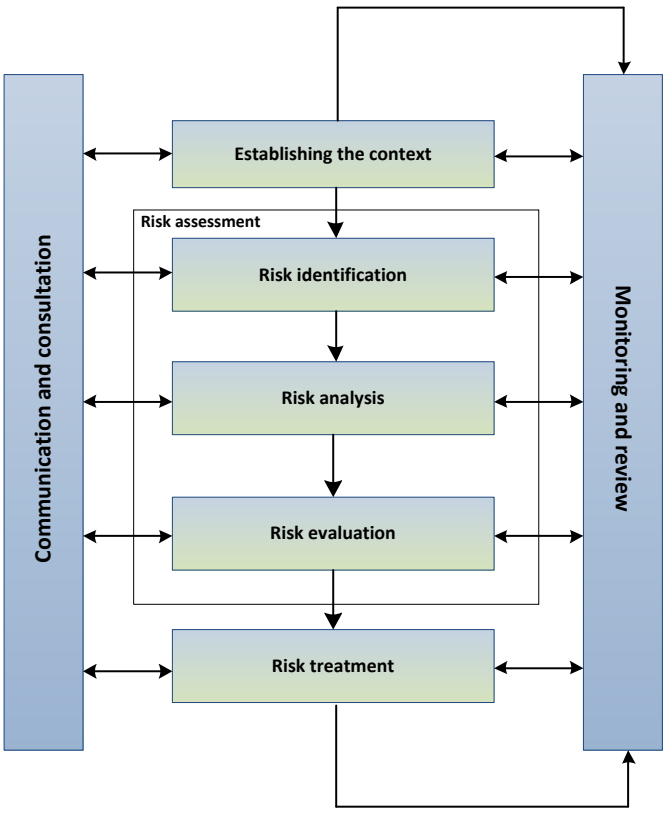
4.1. ENVIRONMENTAL RISK ASSESSMENT METHODOLOGY

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



Source: modified from AS/NZS ISO 31000:2009 Risk management

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 Outer Exmouth MC3D MSS polygon;
- defines the potential environmental effects of the activities;
- identifies the likelihood of occurrence and potential consequences; and
- determines overall environmental risk levels using a likelihood and consequence matrix.

The likelihood of occurrence for the key potential environmental impacts from surveys within the Outer Exmouth MC3D MSS polygon 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 MC3D surveys within the Outer Exmouth MC3D MSS polygon 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 MC3D surveys within the Outer Exmouth 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, shipping and defence activities; 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 military aircraft;
- disturbance to heritage and conservation values.

4.3. ASSESSMENT OF IMPACTS AND RISKS

A total of eighteen (18) potential impacts and risks were identified and assessed for the Outer Exmouth MC3D MSS:

DISTURBANCE TO MARINE FAUNA
- Discharge of Underwater Seismic Pulses
- Light Generation
- Vessel and Towed Equipment Interactions with Marine Fauna

DISTURBANCE TO BENTHIC HABITATS
- Anchoring
- Vessel Grounding
- Equipment Dragging or Loss

REDUCED AIR QUALITY FROM ATMOSPHERIC EMISSIONS
- Operation of Machinery and Vessels Powered by Internal Combustion Engines

INTRODUCTION OF INVASIVE MARINE SPECIES
- Ballast Water
- Biofouling

MARINE POLLUTION FROM ROUTINE DISCHARGES
- Sewage, Grey Water and Putrescible Wastes
- Bilge Water
- Other Wastes

MARINE POLLUTION FROM ACCIDENTAL DISCHARGES
- Hazardous Materials
- Fuel and Oil Spills
- Vessel Collisions

DISTURBANCE TO SOCIAL AND COMMUNITY VALUES
- Commercial Fishers
- Shipping
- Heritage and Conservation Values

4.3.1. Summary of Environment Risk Assessment for the Outer Exmouth MC3D MSS

The risk assessment undertaken by PGS that the potential impacts arising from surveys undertaken in the proposed Outer Exmouth MC3D MSS polygon 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 vessel(s).
- 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. The assessment of these additional control measures is include in the EP**.**

Table 4.3 - Summary of environment risk assessment for surveys undertaken within the Outer Exmouth MC3D MSS polygon

Hazard	Environmental aspect	Potential environmental impacts	Risk			
			Consequence of impact	Likelihood of the identified consequence	Residual risk level	Management strategy
Disturbance to marine fauna	Discharge of underwater seismic pulses	Behavioural and physiological effects on cetaceans, whale sharks, turtles and fish	Slight	Possible	**Low**	**M1**
		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**	**M2**
	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**	**M3**
Invasive marine species	Discharge of ballast water from vessels	Introduction and establishment of IMS and displacement of native marine species	Minor	Possible	**Low**	**M4**
	Biofouling of vessel hulls, other niches and immersible equipment		Minor	Possible	**Low**	
Marine pollution from routine discharges	Discharge of sewage, grey water and putrescible wastes	Localised reduction in water quality due to nutrient enrichment	Slight	Routine	**Low**	**M5**
	Discharge of bilge water	Acute toxicity effects on marine fauna and flora Localised reduction in water quality	Slight	Possible	**Low**	

Hazard	Environmental aspect	Potential environmental impacts	Risk			
			Consequence of impact	Likelihood of the identified consequence	Residual risk level	Management strategy
	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**	**M6**
	Fuel and oil spills		Moderate	Possible	**Medium**	
	Vessel collisions		Moderate	Unlikely	**Medium**	
Disturbance to social and community values	Interaction with commercial fisheries	Disruption to commercial fishing vessels Potential direct and indirect noise impacts on target species Restriction of access to fishing grounds, loss/damage to gear Recreational take of finfish species	Minor	Possible	**Low**	**M7**
	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**	

4.4. IMPLEMENTATION STRATEGY

4.4.1. Environmental Management Framework

The design and execution of the proposed Outer Exmouth MC3D MSS EP will be conducted under the framework of the PGS Environment Policy and HSE&Q Management System. The seismic programme will be supported by a bridging document between PGS and the contractor for the operation of the survey vessel(s). To ensure PGS's environmental management standards and performance outcomes are achieved, the contractor will be required to comply with all relevant requirements of PGS's HSE systems/policies and standards.

PGS and its contractor will apply a tiered approach to optimising the environmental performance of the project and ensuring that PGS's environmental management standards and performance outcomes are achieved. The approach involves identification of local and regional environmental sensitivities, prioritisation of risks, determination of appropriate practices and procedures to reduce those risks, and clear designation of roles and responsibilities for implementation.

A series of work instructions, procedures and plans will be used for surveys undertaken within the Outer Exmouth MC3D MSS polygon to ensure that appropriate management measures are applied as required to minimise the risk of environmental disturbance from operations. The work instructions, procedures and plans are documented within corporate systems/manuals developed by PGS as well as documents written specifically for marine seismic surveys undertaken within the Outer Exmouth MC3D MSS polygon. Many of the procedures apply to all vessels in the PGS fleet; however the associated work instructions are generally vessel specific.

The contractor specific documentation will be updated in accordance with the EP and other client requirements. The Project HSE&Q Plan, which compliments this EP, includes procedures for the following:

- emergency response;
- waste management;
- hazardous materials and handling; and
- fuel/oil spills.

The Implementation Strategy for this EP includes an outline of:

- Environmental management strategies.
- Roles and responsibilities.
- Training and competency.
- Monitoring.
- Auditing.
- Management of non-conformance.
- Record keeping.
- Emergency response and contingency planning.
- EP review.

4.4.2. Management Strategies

This section of the EP outlines the management strategies in place to ensure that the environmental impacts and risks associated with the activity are continuously reduced to ALARP, and to ensure compliance with all relevant legislation.

Environmental management strategies have been formulated to address the identified environmental hazards for the proposed surveys, categorised in the following groups:

- Disturbance to Marine Fauna.
- Disturbance to Benthic Habitats.
- Atmospheric Emissions.

- Invasive Marine Species.
- Marine Pollution from Routine Discharges.
- Marine Pollution from Accidental Discharges.
- Disturbance to Social and Community Values.

The environmental management strategies incorporate the environmental performance outcomes (EPO), environmental performance standards (EPS) and measurement criteria (MC) referred to in Division 2.3, Clause 13(4) of the Environment Regulations. The EPO defined in the environmental management strategies are based on the identified environmental aspects, associated environmental impacts and the assessed risks, corporate policies and performance commitments, and applicable regulatory requirements.

4.4.3. ALARP Demonstration

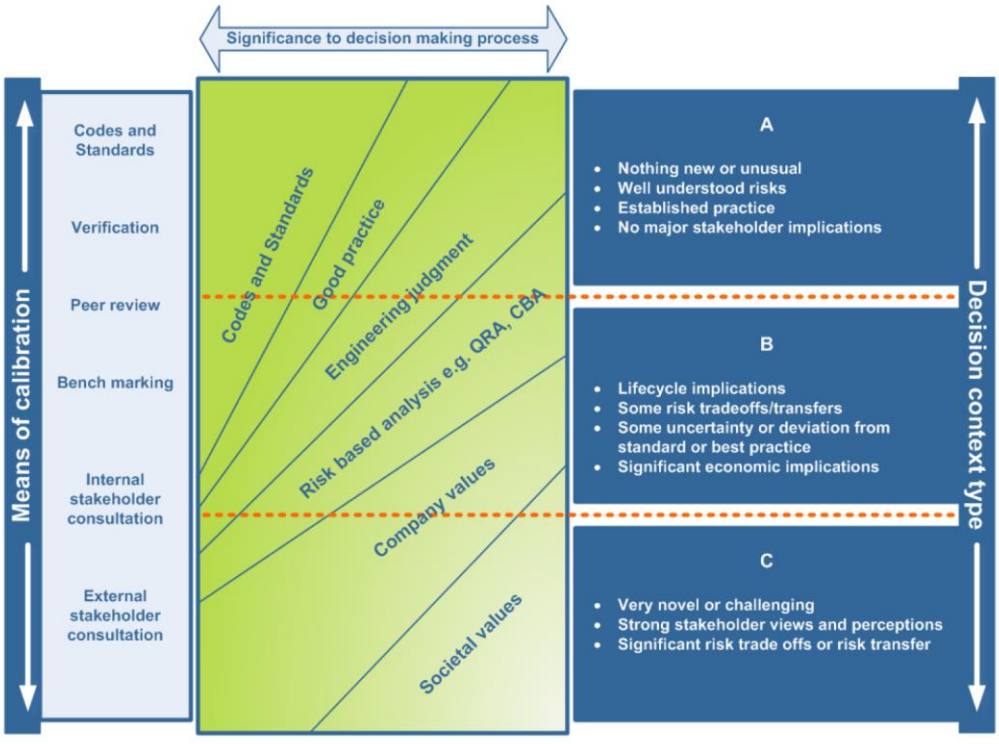
Regulation 10A(b) of the Environment Regulations requires a demonstration that environmental impacts are reduced to ALARP. Determining whether risks have been reduced to ALARP (as low as reasonably practicable) requires an understanding of the nature and cause of the risk to be avoided and the sacrifice (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 Guidelines on a Framework for Risk Related Decision Support (UKOOA 1999).

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 (CBA), or societal values).
- Judge which of these methods is best placed to determine whether the risks are tolerable and ALARP.

Figure 4.2 illustrates the UKOOA framework.

Figure 4.2 - Risk related decision support framework



Source: NOPSEMA (2011).

The UKOOA guidance (UKOOA 1999) 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 in **Table 4.3** of this EP is provided in **Table 4.4**.

Table 4.4 - 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 Outer Exmouth MC3D MSS polygon have been reduced to ALARP, the "decision context" for each of the risks identified in the Outer Exmouth MC3D MSS polygon ERA was reviewed. All of the risks associated with the survey (see **Table 4.3**) correspond to the description of Decision Context Type "A" (see **Figure 4.2**)—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.

The control measures described in **Table 5.1** have been assessed for practicability. All represent existing, recognised 'good practice', have been found to be practicable, and accordingly, will be implemented during surveys undertaken with the Outer Exmouth MC3D MSS polygon.

From the ERA process there were three environmental aspects assessed as having a Medium level of risk (accidental discharge of hazardous materials; accidental fuel and oil spills from the survey vessel(s); and vessel collisions resulting in fuel and oil spills). All three of these aspects are associated with one hazard (marine pollution from accidental discharges), which falls into the ALARP Zone (**Table 4.2**). 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. The assessment of these additional control measures are in shown in **Table 5.1**.

When formulating control measures for each environmental hazard, the 'Hierarchy of Controls' philosophy is applied. The Hierarchy of Controls is a system used in industry to minimise or eliminate exposure to hazards, and is part of PGS's HSE 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, and a description of the justification for this position is provided in the EP in a manner consistent with the Hierarchy of Controls, shown in **Table 4.5**.

Table 4.5 - 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).

4.4.4. Demonstration of Acceptability

Regulation 10A(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 4.6**.

Table 4.6 - Acceptability test

Test	Question	Acceptability demonstrated
Policy compliance	Is the proposed management of the impact or risk aligned with the PGS Environment 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 Environment 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, and 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 Outer Exmouth 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 Outer Exmouth Environment Plan in a manner consistent with the Acceptability test, shown in **Table 4.6**

5. SUMMARY OF THE CONTROL MEASURES FOR THE ACTIVITY

Table 5.1 - Summary of the control and mitigation and management measures for key aspects of the Outer Exmouth MC3D MSS

Impact Category	Potential Impacts	Control and Mitigation Measures	Residual Risk Level	Management Strategy

Disturbance to marine fauna	• Behavioural and physiological effects on cetaceans, whale sharks, turtles and fish (underwater seismic pulses)
	• Behavioural effects on dolphins, turtles, fish and seabirds (light emissions)
	• Behavioural and physical effects on cetaceans, whale sharks and turtles (vessel and towed equipment interactions)
		• Pre-survey planning so as to continue to manage impacts and risks of the activity to migrating pygmy blue whales
		• 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 MFO will be implemented for individual surveys undertaken within the pygmy blue whale BIA, during pygmy blue whale peak migration periods:
		  • 1 May to 30 June (northbound); and
		  • 1 October to 30 November (southbound).
		• Use of two MFO 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).
		• Vessel Master will ensure that external lighting of survey vessel(s) is minimised to that required for navigation, vessel safety, safety of deck operations, except in the case of an emergency
		• The survey will be conducted in water depths of ~840 m to ~4,900 m and away from any shallow water areas that may be important for marine turtle nesting, foraging.
		• Application of support vessel-marine fauna interaction procedures
		• Use of streamer tail buoys fitted with appropriate turtle guards, if required
		• Application of relevant PGS procedures and work instructions:
		  - PGS Environmental Management Procedures (941VES00)
		  - PGS soft start procedure for airguns (WOR-TECH-VES-134)
		  - PGS Guidelines for Extrication of Marine turtles for any incidents involving turtle entrapment in the tail buoys (953VES00 App 5)
			Low	**M1**

Disturbance to benthic habitats	• Localised physical damage to benthic habitats	• Anchoring in Outer Exmouth MC3D MSS polygon will not be undertaken due to water depths across the polygon (~840 - ~4,900 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) • Use of approved navigation systems and depth sounders	**Low**	**M2**

Impact Category	Potential Impacts	Control and Mitigation Measures	Residual Risk Level	Management Strategy
		• In-water equipment lost will be recovered • Streamers will not be towed at more than 50 m below the sea surface. Given the water depths across the polygon (~840 - ~4,900 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 (941VES00) - GS Bridge Routines - Anchoring and Anchor Watch Checklist (862VES00 App 4) - PGS Bridge Routines - Navigation in Critical Waters (862VES00 App 9) - PGS Close Approaches, Undershoots, Dead Heads, Shallow Waters Procedures (954VES00) - PGS Collision, Grounding, Hull Damage Procedures (806VES00) - PGS Back Deck Operations – Deployment and Recovery of Streamers (951VES06) - PGS Back Deck Operations – Streamer Maintenance Using the Workboat (953VES03)		
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 • Incinerator compliant with MARPOL Annex VI requirements • Vessel combustion equipment (including incinerator) compliant with MARPOL 73/78 Annex VI requirements • Implementation of Ship Energy Efficiency Management Plan (SEEMP) • Application of relevant PGS procedures and work instructions: - PGS Planned Maintenance System (872VES01) - PGS Bunker Delivery - Quantity & Quality Control (864VES01)	**Low**	**M3**
Introduction of invasive marine species	• Introduction and establishment of IMS and displacement of native marine species	• Adherence to Marine Orders – Part 98 • No routine discharge of ballast water from survey and support vessels • Adherence to Australian Ballast Water Management Requirements • Recent dry-dock, hull inspection/cleaning and AF coating application for survey and support vessels • AF coating meets IMO 2001 Convention requirements • Survey and support vessel will have worked only in Australian waters prior to commencement of survey • Survey and support vessels will have all necessary AQIS clearances to operate unrestricted anywhere in Australian waters • Application of relevant PGS procedures and work instructions: - PGS Ballast Water Management Plan (842VES00)	**Low**	**M4**
Marine pollution from routine discharges	• Localised reduction in water quality • Acute toxicity effects on marine fauna and flora	• Adherence to Marine Orders – Part 96 • All sewage and putrescible wastes handled and disposed of in accordance with MARPOL Annex IV requirements	**Low**	**M5**

Impact Category	Potential Impacts	Control and Mitigation Measures	Residual Risk Level	Management Strategy
	• Physical impacts on marine fauna i.e. from plastics	• 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) equipped with grinder/comminuter for maceration of sewage and putrescible wastes • Survey vessel(s) 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 • Application of bilge water treatment and discharge 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 • Adherence to Marine Orders – Part 95 • 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 by trained personnel • 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 (941VES00) - PGS Waste Disposal Garbage Record Book (841VES00) - PGS Hazardous materials and handling (872VES04)		

Impact Category	Potential Impacts	Control and Mitigation Measures	Residual Risk Level	Management Strategy
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 94 • 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 aboard the survey and support vessels • Application of relevant PGS procedures and work instructions: - PGS Environmental Management Procedures (941VES00) - PGS Hazardous Materials and Handling (872VES04) - PGS Guidance Notes for Support Vessel Masters and Crews (977VES00 app 1)	**Medium**	**M6**
	• Toxic effects on marine fauna and flor from fuel and oil spills • Localised reduction in water quality • Indirect effects on commercial fisheries	• Adherence to Marine Orders – Part 94 • 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 aboard the survey and support vessels • Adherence to Marine Orders – Part 21, Part 30, Part 59, Part 91, and COLREGS • SOPEP implemented and tested for survey vessel(s). 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 the survey vessel(s) during survey • 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 • Approval must be obtained from the Vessel Operations Manager before any at sea refuelling can proceed • Refuelling at sea subject to PGS Marine Operations Offshore Bunkering Procedures (864VES00) and PGS Bunker Delivery - Quantity & Quality Control (864VES01), 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 checked for integrity prior to use;	**Medium**	**M6**

Impact Category	Potential Impacts	Control and Mitigation Measures	Residual Risk Level	Management Strategy
		- 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 (941VES00) - PGS Hazardous Materials and Handling (872VES04) - PGS Guidance Notes for Support Vessel Masters and Crews (977VES00 app 1) - PGS Collision, Grounding, Hull Damage Procedures (806VES00) - PGS Oil Spill Response Procedure (843VES00) PGS Guidance Notes for Support Vessel Masters and Crews (977VES00 app 1)		
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 from survey and support vessels	• Adherence to Marine Orders – Part 21, Part 30, Part 59, and COLREGS • Relevant fisheries stakeholders notified of proposed activities in advance of survey operations commencing • 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 • Fishermen 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 • Application of relevant PGS procedures and work instructions: - PGS Back Deck Operations – Streamer Maintenance Using the Workboat (953VES03) - PGS Collision, Grounding, Hull Damage Procedures (806VES00)	**Low**	**M7**

Impact Category	Potential Impacts	Control and Mitigation Measures	Residual Risk Level	Management Strategy
		- PGS Back Deck Operations – Deployment and Recovery of Streamers (951VES06) - PGS Guidance Notes for Support Vessel Masters and Crews (977VES00 app 1)		
Interaction with shipping and military aircraft	• Disruption to shipping and defence/military exercises	• Adherence to Marine Orders – Part 21, Part 30, Part 59, and COLREGS • Consultation with AMSA (Nautical Advice) prior to survey commencing to determine level of commercial shipping in the vicinity of Outer Exmouth MC3D MSS polygon • Consultation with Department of Defence to determine if there are any planned activities within the RAAF Learmonth Defence Restricted Airspace that will coincide with individual surveys and proposed helicopter movements • Use of a support vessel to manage vessel interactions • Issuing of appropriate NTM by AHS • 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 • Application of relevant PGS procedures and work instructions: - PGS Back Deck Operations – Streamer Maintenance Using the Workboat (953VES03) - PGS Collision, Grounding, Hull Damage Procedures (806VES00) - PGS Back Deck Operations – Deployment and Recovery of Streamers (951VES06) - PGS Guidance Notes for Support Vessel Masters and Crews (977VES00 app 1)	**Low**	**M7**
Operation of vessels within protected and heritage areas	• Disturbance to heritage and conservation values	• Survey and support vessels will not enter waters of the Ningaloo Coast World Heritage Property and Muiron Islands Marine Management Area • Survey and support vessels will not enter waters of the Montebello Commonwealth Marine Reserve, and Barrow Island Marine Management Area. • All PGS and contractor personnel made aware of, and comply with, requirements of accepted EP	**Low**	**M7**

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

Environmental performance of all proposed surveys within the Outer Exmouth MC3D MSS polygon will be 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 the activity (in accordance with the PGS Environmental Audit Template (941VES00 App 1) to ensure that procedures and equipment for managing routine discharges and emissions are in place to ensure compliance with the EP.
- A summary of the key information, commitments, EPO, EPS and MC for the activity (ECR) will be distributed aboard the survey vessel(s), and implementation of the EPO and commitments will be monitored on a regular basis by the PGS Site Representative.

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

7.1. EMERGENCY RESPONSE PREPARATION

Survey specific Emergency Response Procedures (ERP) for surveys undertaken within the Outer Exmouth MC3D MSS polygon will be included in the Project HSE Plan for each survey proposed. The Project HSE Plan contains instructions for vessel emergency, medical emergency, search and rescue, reportable incidents, incident notification and contact information. In the event of an emergency of any type the survey vessel(s) Master will assume overall onsite command and act as the Emergency Response Coordinator (ERC). All persons aboard the vessel/s will be required to act under the ERC's directions. The survey vessel(s) will maintain communications with the PGS Operations Manager and/or other emergency services in the event of an emergency. Emergency response support can be provided by PGS if requested by the ERC.

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

7.2. FUEL, OIL AND OTHER HAZARDOUS MATERIAL SPILLS

Fuel and oil spills will be managed according to the oil spill arrangements and procedures outlined in the survey vessel(s) SOPEP, NATPLAN or WestPlan MOP / MOSCP (if activated by the relevant Combat Agency – AMSA or DoT) and ER procedures described in the Project HSE Plan.

The OPEP for surveys undertaken within the Outer Exmouth MC3D MSS polygon, taking into account the nature and scale of the activity and the potential spill risks involved comprises components of the survey vessel(s) SOPEP that manage the environmental impacts of a spill, supported as required by applicable established, statutory OSCPs. In summary, 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(s) 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 Environmental Emergencies (NATPLAN): Australian Maritime Safety Authority (AMSA) - deals with spills from the vessels which affect Commonwealth waters (AMSA 2014).
- WA State Emergency Management Plan for Marine Oil Pollution (WestPlan-MOP) and Department of Transport (DoT) Marine Oil Spill Contingency Plan (MOSCP) - deals with spills from the vessels which affect WA State waters.

Implementation and testing of the survey vessel(s) SOPEP, plus adherence to the additional spill response and reporting measures detailed in **Section 6.6.2** in the EP, will enable PGS to demonstrate that environmental risks from fuel and oil spills during the proposed survey have been reduced to ALARP.

As listed in the SOPEP, the survey vessel(s) carries spill containment and recovery kits with sufficient absorbent booms and materials to contain small to medium scale deck spills. The survey vessel(s) Master will be responsible for ensuring that these kits are appropriately stocked at all times. Minor spills will be managed through housekeeping practices and the use of absorbent materials. Deck spills will not be discharged into the ocean.

Depending on the location of the proposed MC MSS, the preferred strategy for diesel spills will be to allow small spills to disperse and evaporate naturally, and monitor the position and trajectory of any surface slicks. Physical break up (using propwash from the support vessel) by repeated transits through surface slicks may be considered as a response measure (to aid in dispersion, dilution and evaporation of hydrocarbons) but only after consultation with the PGS Operations Manager.

For fuel/oil spills in Commonwealth waters initial actions will be undertaken by the survey vessel(s) in accordance with the survey vessel(s) SOPEP, with subsequent actions determined in consultation with AMSA, under NATPLAN, having

regard to the potential impacts posed by the spill. For fuel/oil spills potentially entering WA State waters initial actions will be undertaken by the survey vessel(s) in accordance with the SOPEP, with subsequent actions determined in consultation with the DoT, under the WestPlan-MOP and MOSCP, having regard to the potential impacts posed by the spill.

Treatment measures addressing the generation of impacts associated with shoreline protection and clean-up are addressed in the DoT MOSCP and WestPlan-MOP which requires the provision of temporary storage, transportation and final disposal in compliance with Government disposal approvals. This is usually facilitated by the responsible State/Territory environment protection agencies (i.e. WA DPaW). The NATPLAN document *Management and Disposal of Oil Spill Debris* will be used by the combat agency (AMSA or DoT) to inform the management of diesel contaminated wastes.

Any fuel or oil spills will be reported using the incident reporting system outlined in **Table 7.11** and **Section 7** in the EP.

7.3. CYCLONE AND DANGEROUS WEATHER PREPARATION

Tropical cyclones and other severe weather events have the potential to cause damage to survey equipment, risk to the safety and health of survey personnel and potential to cause spills of hazardous materials into the environment from damaged vessels. The proposed timing and duration for the proposed surveys that will be undertaken within the Outer Exmouth MC3D MSS polygon have not been finalised. Therefore, it is possible some surveys will be undertaken during the usual season for cyclones in the northwest of Australia.

PGS has developed and implemented a cyclone contingency plan for all seismic surveys utilising its vessels, in accordance with PGS Extreme Weather Procedure (813VES00). This procedure will be applied during individual surveys undertaken within the Outer Exmouth MC3D MSS polygon, and incorporated into the Project HSEQ Plan for each survey undertaken. During the survey, the procedure will be implemented in the event of an approaching cyclone. The survey and support vessels will receive regular updates throughout the day via the Bureau of Meteorology (BOM) website (and from other websites), and if a cyclone looks to be forming within the region the vessels will leave the operational area for safer waters. Depending on the situation, the survey vessel(s) may also retrieve the seismic equipment and in a worst-case scenario proceed to the nearest port.

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

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

- Phase 1: Preparatory Consultation:
    - Stakeholders notified of the proposed Outer Exmouth MC3D MSS polygon.
- Phase 2: Pre-survey Consultation:
    - Stakeholders notified of individual surveys, including location within the Outer Exmouth MC3D MSS polygon, timing and duration.
- Phase 3: Ongoing Consultation:
    - Includes complying with requests from stakeholders for additional information, survey updates, etc.
- Phase 4: Post-survey Notifications:
    - Includes complying with requests from stakeholders for notification of the completion of individual surveys.

8.1. PHASE 1 - PREPARATORY CONSULTATION & PHASE 3

The following fisheries bodies and organisations were originally informed of the survey, via letters or emails sent on 17th December 2013 as part of Phase 1: Preparatory Consultation (see **Table 8.1**).

- A Raptis and 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);
- MG Kailis;
- Northern Fishing Companies Association (NFCA);
- Northern Wildcatch Seafood Australia (NWSA);
- Pearl Producers Association (PPA);
- Recfishwest; Tuna West Indian Ocean Tuna Association;
- WA Department of Fisheries (DoF);
- WA Fishing Industry Council (WAFIC);
- WA Seafood Exporters; and
- WestMore Seafoods.

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

- MMF - 30
- PLF - 7
- WCDSCF – 5

Thiry-seven separate individuals or entities holding licences were identified across the three 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 the 17th December 2013 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 activites, via letters or emails sent on 17th December, 2013.

- Australian Hydrographic Service (AHS);
- Australian Maritime Safety Authority (AMSA);
- Centre for Whale Research (CWR);
- Department of Defence (DoD);
- Department of the Environment (DoE); and
- WA Department of Mines and Petroleum (DMP).

An example of the letter sent to all stakeholders is included in the EP. The letter provides information concerning the location, timing and nature of the proposed activities, and provides contact details should stakeholders wish to seek further information.

8.2. PHASE 2 - PRE-SURVEY CONSULTATION

Prior to commencing any survey within the Outer Exmouth MC3D MSS polygon, PGS will contact relevant stakeholders to provide detailed information for the proposed activity, including the size, location and geographical coordinates for the Outer Exmouth MC3D MSS polygon, 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 with PGS any specific concerns or issues regarding the proposed survey.

Prior to the commencement of a proposed survey PGS will 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 Outer Exmouth MC3D MSS polygon. The primary objective of this consultation will be to ascertain if there are any other seismic surveys proposed for areas adjacent to the Outer Exmouth MC3D MSS polygon over the same time period. Concurrent surveys usually require a minimum separation distance of ~60 km between the two operating survey vessels to avoid noise interference with the received signals.

8.3. PHASE 3 – ONGOING CONSULTATION AND PHASE 4 – POST SURVEY NOTIFICATION

Consultation with stakeholders will be ongoing throughout the period the Outer Exmouth MC3D MSS EP is valid. PGS will comply with requests by stakeholders for additional information and requests for updates during individual surveys undertaken within the Outer Exmouth MC3D MSS polygon. On completion of individual surveys notification will be sent to the relevant stakeholders or those that request post survey notification (see **Table 8.1**).

Table 8.1 - Details of the stakeholder consultation plan for the Outer Exmouth MC3D MSS polygon

Organisation	Division	Contact	Objective	Method of Communication	Frequency	Timeframe
Commonwealth Fisheries						
A Raptis & Sons		Phil Robson	●During the planning of operations once specific survey areas have been identified to address any potential issues raised; ●To provide data on each individual survey such as size, location, coordinates, timing and duration, and seismic parameters used; ➢ navigation plots for importing into sea charts such as C-Map ➢ online login for fisheries licence holders who register with PGS to allow access to real time ship positions, to plan fishing and try to avoid unnecessary disruption and costs.; and ●To provide an update of the projects progress and inform of any future changes	●Email; and ●Website	●During planning of individual surveys; and ●Annually	●Minimum of **4 weeks** prior to the commencement of an individual survey being undertaken, if the Outer Exmouth MC3D MSS polygon overlaps the respective fishery that the organisation represents
Austral Fisheries	Southern Fleet Operations	Rhys Arangio				
Australian Fisheries Management Authority (AFMA)	Project Manager Petroleum	Giulia Porro				
	Environmental Policy Section	Paul Ryan				
Australian Longline Pty Ltd & Petuna Sealord	Managing Director	Les Scott				
Australian Southern Bluefin Tuna Industry Association (ASBTIA)						
Commonwealth Fisheries Association (CFA)	Chief Executive Officer	Trixi Madon				
MG Kailis Group	Compliance and Projects Manager	Stephen Hood				
Northern Fishing Companies Association (NFCA)		Andy Prendergast				
Pearl Producers Association	Executive Officer	Brett McCallum				
Tuna West Indian Ocean Tuna Association	IOTC Secretariat	Rondolph Payet				
WA Seafood Exporters	Fleet Manager	John Palmer				
WestMore Seafoods		Simon Little				
WA Department of Fisheries	Sustainability and Environment Aquatic Biodiversity	Online Submission	●During the planning of operations once specific survey areas have been identified to address any potential issues raised; ●To provide data on each individual survey such as size, location, coordinates, timing and duration, and seismic parameters used; and ●To provide an update of the projects progress and inform of any future changes	●Online submission	●During planning of ALL individual surveys; and ●Annually	●Minimum of **4 weeks** prior to the commencement of ALL individual surveys within the Outer Exmouth MC3D MSS polygon
Western Australian Fishing Industry Council (WAFIC)	Chief Executive Officer	John Harrison		●Email; and ●Website		

Organisation	Division	Contact	Objective	Method of Communication	Frequency	Timeframe
WA Department of Fisheries Licence Holders		Individual fishers (see **Section 7.10.1**)	●During the planning of operations once specific survey areas have been identified to address any potential issues raised; ●To provide data on each individual survey such as size, location, coordinates, timing and duration, and seismic parameters used; and ●To provide an update of the projects progress and inform of any future changes	●Letter; and ●Website	●During planning of ALL individual surveys; and ●Annually	●Minimum of **4 weeks** prior to the commencement of individual surveys, if the Outer Exmouth MC3D MSS polygon overlaps the respective fishery of the licence holder
Defence						
Australian Hydrographic Service (AHS)	Nautical Assessment Officer	Mark Bolger	●To enable AHS to issue a notice to mariners	●Email	●Prior to the commencement of ALL individual surveys within the Outer Exmouth MC3D MSS polygon	●Minimum of **3 weeks** Prior to the commencement of ALL individual surveys being undertaken
Directorate of Property Acquisition, Mining and Native Title	Property Management Branch - Infrastructure Division Defence Support & Reform Group (Estate Property Officer)	Chris Crowley	●During the planning of operations once specific survey areas have been identified to address any potential issues raised; and ●To provide data on each individual survey such as size, location, coordinates, timing and duration, and seismic parameters used	●Email	●During planning of individual surveys; and ●Prior to the commencement of ALL individual surveys within the Outer Exmouth MC3D MSS polygon	●Minimum of **14 days** Prior to the commencement of individual surveys being undertaken, if the Outer Exmouth MC3D MSS polygon overlaps defence restricted space areas.
	Infrastructure Division, Defence Support Group	Andrew Blythe				
Headquarters Air Command	RAAF Base Glenbrook	Debbie Fisher				
	RAAF Base Glenbrook	raaf.ais@defence.gov.au				
Environmental Management						
Centre for Whale Research	Managing Director	Curt Jenner	●During the planning of operations once specific survey areas have been identified to address any potential issues raised; and ●To provide data on each individual survey such as size, location, coordinates, timing and duration, and seismic parameters used	●Email; and ●Website	●During planning of individual surveys; and ●Annually	●Prior to the commencement of individual surveys, if the Outer Exmouth MC3D MSS polygon overlaps BIA's for cetaceans
Maritime Safety & Border Protection						

Organisation	Division	Contact	Objective	Method of Communication	Frequency	Timeframe
Australian Maritime Safety Authority (AMSA)	Nautical Advice	Alec Millett	●During the planning of operations once specific survey areas have been identified to address any potential issues raised; and ●To provide data on each individual survey such as size, location, coordinates, timing and duration, and seismic parameters used	●Email	●Prior to the commencement of ALL individual surveys within the Outer Exmouth MC3D MSS polygon	●Minimum of **3 weeks** Prior to the commencement of ALL individual surveys being undertaken
	SAR Operations, Emergency Response Division	Duty Search and Rescue Officer				
Australian Customs Services (Coastwatch)			●To provide data on each individual survey such as size, location, coordinates, timing and duration, and seismic parameters used	●Email	●Prior to the commencement of ALL individual surveys within the Outer Exmouth MC3D MSS polygon ●If any changes/developments occur	●Prior to the commencement of ALL individual surveys
Border Protection Command - Customs						
Petroleum						
Geophysical companies active in offshore seismic activities			●To ascertain if there are any other seismic surveys proposed for areas within and adjacent to the Outer Exmouth MC3D MSS polygon over the same time period	●Email; and ●via vessel's radio protocol's (COLREGS)	●During planning of individual surveys	●Prior to the commencement of ALL individual surveys ●Throughout survey operations for the entire duration of the project
Recreational Fisheries						
Broome Fishing Club	Club President		●During the planning of operations once specific survey areas have been identified to address any potential issues raised; ●To provide data on each individual survey such as size, location, coordinates, timing and duration, and seismic parameters used; and ●To provide an update of the projects progress and inform of any future changes	●Email; and ●Website	●During planning of individual surveys; and ●Annually	●Minimum of **4 weeks** prior to the commencement of ALL individual surveys within the Outer Exmouth MC3D MSS polygon
Mary Island Fishing Club (Derby)	Club President	Caz Fyson				
Recfishwest	Regional Policy Officer	Matt Gillett				
Western Australian Government						
Department of the Environment (DoE)	Director, Offshore Petroleum Section		●To assess whether each individual survey requires Referral is required under the EPBC Act 1999	●Email	●During planning of individual surveys	●Prior to the commencement of ALL individual surveys
National Offshore Petroleum Titles Administrator (NOPTA)			●To obtain the necessary titles (Access Authority [AA] and /or Special Prospecting Authority [{SPA] for the Outer Exmouth MC3D MSS polygon	●Email; and / or ●Letter	●During planning of individual surveys	●Prior to the commencement of ALL individual surveys

Organisation	Division	Contact	Objective	Method of Communication	Frequency	Timeframe
WA Department of Mines and Petroleum (DMP)	General Manager, Petroleum Environment Branch	Kim Anderson	●During the planning of operations once specific survey areas have been identified to address any potential issues raised; and ●To provide data on each individual survey such as size, location, coordinates, timing and duration, and seismic parameters used	●Email	●During planning of individual surveys	●Prior to the commencement of ALL individual surveys
	Petroleum Environment Branch, Environmental Officer	Stan Bowles				
WA Department of Transport (DoT)	Oil Spill Response Coordinator, Marine Pollution Branch	Matt Verney	●During the planning of operations once specific survey areas have been identified to address any potential issues raised; and ●To provide data on each individual survey such as size, location, coordinates, timing and duration, and seismic parameters used	●Email	●During planning of individual surveys	●Prior to the commencement of individual surveys that are adjacent to the WA State Waters boundary

8.4. MERITS OF THE STAKEHOLDER OBJECTIONS AND CLAIMS

An assessment of the merits of objections or claims about the adverse impact of the Outer Exmouth 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:** Concerns were raised from AMSA regarding shipping safety and interactions with international cargo traffic. AMSA advised PGS that the a very large volume of high net worth national and international cargo traffic will be experienced through the centre of the Outer Exmouth MC3D MSS including along the two dedicated and charted shipping fairways and around the southern section near Exmouth. AMSA commented that their main concern regarding the broad area is that it may dilute nautical safety advice for specific areas. AMSA will be contacted and advice will be sought prior to commencement of all individual multi-client 3D MS surveys to be undertaken within the Outer Exmouth MC3D MSS polygon. PGS will coordinate with AMSA regarding all individual surveys within the Outer Exmouth MC3D MSS polygon. The Department of Defence requested that PGS advise AHS with a minimum of 3 weeks prior to actual commencement and that such information is critical to marine safety and should be provided to reduce negative impacts on other maritime users. PGS will comply with the DoD requests. PGS will provide AHS with a minimum of one months' notice of intention to commence any particular phase once planning of individual phases/surveys are finalised.
- **Commercial Fishing:** The DoF recommended that PGS continues to consult with WAFIC, Recfishwest and individual licensed fishers regarding individual surveys within the Outer Exmouth MC3D MSS polygon. PGS has complied with this request. DoF also recommends that PGS continue to consult with the DoF and other stakeholders at least one month prior to the commencement of individual surveys within the Outer Exmouth polygon.
    - ***Impacts to Fish:*** Concerns were raised from stakeholders who were concerned about the impact of the Outer Exmouth MC3D MSS on fish spawning areas. However, to date DoF has not provided any specific locations of fish spawning grounds or nursery areas within the Outer Exmouth MC3D MSS polygon. Without this information PGS cannot practically devise a mitigation measure to avoid spawning locations or nursery areas. PGS will undertake further consultation with the DoF on individual surveys, should any significant and relevant changes in fisheries management occur.
    - **Biosecurity risk:** Concerns were raised by the DoF regarding the risk of the introduction of invasive marine species. The mitigation strategies recommended by DoF have been included in the management strategy to minimise the potential noise impacts on marine fauna. PGS has also initiated communications with WAFIC and Recfishwest, and also directly with individual licence holders as part of the stakeholder consultation process. The management strategy to minimise the likelihood of introduction of IMS of concern, includes hull and other niche cleaning of both the survey and support vessels prior to mobilisation of the vessels to Australian waters. Potential impacts to fisheries, fish and fish habitat are described in the EP in **Sections 6.1**, **6.2**, **6.4**, **6.5**, **6.6** and **6.7**. Strategies to mitigate or minimise these impacts are defined in these Sections and in **Tables 7.2**, **7.3**, **7.5**, **7.6**, **7.7** and **7.8** of the EP.
- **Cumulative Impacts**: Concerns were raised from the DoE regarding the impacts of cumulative surveys as the stakeholder letter does not identify the timing of individual surveys within the Outer Exmouth MC3D MSS polygon, and this may result in cumulative impacts to marine fauna for which additional safeguards may be required. DoE suggest that if the Outer Exmouth 3D Marine Seismic Survey is likely to have a significant impact on a matter of NES, or if safeguards are inadequate, the project should be referred for a decision under the EPBC Act. The referral process no longer applies to seismic surveys under the amended Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS) 28th February 2014. The Outer Exmouth MC3D MSS has not been referred.
- **Unexploded ordnance (UXO)**: The Department of Defence advised PGS that the Outer Exmouth MC3D MSS Polygon is within the Learmonth Air Weapons Range where live weapon firing occurs. DoD informed PGS that unexploded ordnance (UXO) may be present on and in the sea floor in the area that the proposed activities will be undertaken and that PGS must, therefore inform itself as to the risks associated with undertaking any activities in the survey area.

9. DETAILS OF THE TITLEHOLDERS NOMINATED PERSON FOR THE ACTIVITY

For further information about the proposed Outer Exmouth MC3D MSS in the Carnarvon Basin offshore from WA, please contact:

Terry Visser

MultiClient Manager – Asia Pacific
PGS

Email: Terry.Visser@pgs.com

PGS Australia Pty Ltd | Level 4, IBM Building
1060 Hay Street, West Perth
Western Australia, 6005, Australia | Tel: + 61 8 9320 9000
Fax: + 61 8 9320 9010 | ABN: 46 077 150 415
www.pgs.com