EXMOUTH PLATEAU NORTHERN EXTENSION MC3D MARINE SEISMIC SURVEY
ENVIRONMENT PLAN: PUBLIC SUMMARY

This summary of the Environment Plan for the TGS Exmouth Plateau Northern Extension MC3D marine seismic survey, which will be acquired on the Exmouth Plateau within the northern Carnarvon Basin offshore from Western Australia (WA), has been submitted to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), to comply with sub-regulations 11(7) and 11(8) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.

INTRODUCTION

The geophysical company TGS proposes to undertake a multi-client, three-dimensional (3D) marine seismic survey (Exmouth Plateau Northern Extension MC3D MSS), on the Exmouth Plateau within the northern Carnarvon Basin offshore from WA (Figure 1). The Exmouth Plateau Northern Extension MC3D MSS will be comprised of approximately 2,100 square kilometres (km²) of 3D seismic acquisition in Exploration Permits WA-347-P, WA-348-P and adjacent open acreage areas.

COORDINATES OF THE PROPOSED ACTIVITY

Boundary coordinates for the survey area (see Figure 1) are provided in Table 1 below.

Table 1: Exmouth Plateau Northern Extension MC3D MSS survey area

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Datum: GDA94

At the closest point, the Exmouth Plateau Northern Extension MC3D survey area is situated at a minimum distance of approximately 325 km to the north of North-west (NW) Cape and the Muiron Islands, and approximately 217 km due north-west of the Montebello Islands. The survey area is situated at a minimum distance of approximately 250 km north-west of Barrow Island (Figure 1).

The Exmouth Plateau Northern Extension MC3D survey will take place on the Exmouth Plateau, which is characterised by continental slope waters ranging from 800-3,500 m. Water depths in the survey area range from approximately 1,250-1,700 m, with shallowest water depths situated along the southern boundary of the survey area (Figure 2).
Figure 1: Location map – Exmouth Plateau Northern Extension Multi Client 3D marine seismic survey

Survey area 2,100 km²

Exmouth Plateau Northern Extension Multi Client 3D marine seismic survey area 2,100 km²
Figure 2: Exmouth Plateau Northern Extension MC3D MSS area, with bathymetry and permit areas.
DESCRIPTION OF THE PROPOSED ACTIVITY

The Exmouth Plateau Northern Extension MC3D MSS is scheduled to occur in the period between mid-February and the end of March 2012 and is expected to be of approximately 45 days duration.

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

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

The seismic array will comprise of a maximum of eight solid streamers, with a maximum length of 6 km. Streamer spacing will be 150 m, and line spacing will be 750 m. The source (airgun array) tow depth will be 6 m (+/- 1 m) and the streamer tow depth will be 9 m (+/- 1 m). The operating pressure for the airgun array will be approximately 2,000 psi. The airgun array will consist of two sub-arrays, each with a maximum volume of approximately 4,000 cui. These sub-arrays will be fired alternately, with a shotpoint interval of 25.0 m vertical distance. The source produces sound pulses (within a few metres in the order of 265-275 dB re 1μPa sound pressure level – SPL) at frequencies extending up to approximately 100 Hz. These sound pulses decrease to levels in the order of 201 dB re 1μPa (SPL) within 1 km of the source and approximately 181 dB re 1μPa (SPL) within 10 km, dependent on the sound propagation characteristics of the area.

TGS proposes to conduct the Exmouth Plateau Northern Extension MC3D MSS using the purpose-built seismic survey vessel M/V Geo Atlantic, which has a complement of approximately 80 crew. The Geo Atlantic is owned by GC Rieber Shipping Ltd and operated by the geophysical acquisition company Fugro-Geoteam AS. The vessel has all necessary certification/registration and is fully compliant with all relevant MARPOL and SOLAS convention requirements for a vessel of its size and purpose. The Geo Atlantic has an implemented and tested Shipboard Oil Pollution Emergency Plan (SOPEP), in accordance with Regulation 37 of Annex I of MARPOL 73/78.

The Geo Atlantic will travel within the survey area at an average speed of 4.5 knots (approximately 8.3 km per hour).

A support vessel, the M/V Cassandra VI, will accompany the seismic survey vessel to maintain a safe distance between the survey array and other vessels, and also to manage interactions with shipping and fishing activities, if required. The Cassandra VI is owned and operated by Offshore Marine Services. The support vessel will also re-supply the survey vessel with fuel and other logistical supplies. The support vessel will have a crew of approximately 15 personnel. The Cassandra VI has an implemented and tested SOPEP.

During the survey, it is likely that the Geo Atlantic will be refuelled at sea using the Cassandra VI, either within or immediately adjacent to the survey area. At sea refuelling will only take place during daylight hours, and will not take place within a distance of 25 km from any emergent land or shallow water features.
DESCRIPTION OF THE RECEIVING ENVIRONMENT

The proposed Exmouth Plateau Northern Extension MC3D survey area 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, covers 16.7% of the total area of the NWMR 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 in the Exmouth Plateau.

Physical Environment

The North West Shelf (NWS) is subject to an arid (mainly summer rain) subtropical climate with tropical cyclone activity from November to April. The summer and winter seasons fall into the periods September-March and May-July 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 south-east 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 June.

Circulation of 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 (as described earlier). It can take up to a year for ITF waters to recirculate via these pathways into the bioregion. As a result, the properties of these waters are modified by the time they reach the Northwest Province, but retain their overriding oligotrophic characteristics.

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 NW Cape. The generally southward moving surface waters consolidate along the narrow shelf break and become the Leeuwin Current. The Leeuwin Current flows south along the shelf break and is shallow (less than 300 m deep) and narrow (50–100 km wide). 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 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 this bioregion brings the opposing flows of the Leeuwin and Ningaloo currents into close proximity, creating an area of enhanced mixing.

Other seasonal influences on the oceanography of the Northwestern Province include an increase in cyclone incidence and intensity during summer, as well as in increase in internal wave activity around Exmouth Plateau and its associated canyons. 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.

The Exmouth Plateau (in water depths of 800–3,500 m) is a significant geomorphic feature in the NWMR. It has a relatively uneven seabed and may include pinnacles. The sediments are assumed 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). On the northern section of the plateau is a gully margin and escarpments incised by canyon systems. They are thought to extend onto the saddle between the plateau and mainland Australia. These are recognised as a distinct feature, but little is known of their ecology and geomorphology.
Biological Environment

It is believed that overall biological productivity above the Exmouth Plateau and slope is generally low, because of the overriding influence of the oligotrophic tropical waters. 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 (if at all) is unknown.

The Exmouth Plateau is also likely 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, indicating an area of high biological productivity. However, little specific information is available on the biological communities of the Exmouth Plateau and associated slope.

Despite the present poor knowledge of the benthic communities on the Exmouth Plateau, information on sediments in the bioregion indicates that benthic communities are likely to include filter feeders and epifauna. Soft-bottom environments are likely to support patchy distributions of mobile epibenthos, such as sea cucumbers, ophiuroids, echinoderms, polychaetes and sea-pens. The biological communities within canyons in the bioregion are also poorly understood. The canyons in this bioregion probably channel currents onto the plateau, driving upwelling in the canyon heads. These are associated with 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. A number of migratory species have been recorded in this bioregion including whale sharks, cetaceans and marine turtles (e.g. loggerheads, leatherback and olive ridley turtles) are known to traverse the bioregion. All are 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 Key Ecological Feature (KEF) of the NWMR, because it is an area of enhanced biological productivity that supports a range of species. Listed migratory white-tailed tropic birds are known to forage within this area.

The upper and middle parts of the continental slope in this bioregion have important demersal fish communities, which display a high degree of endemism compared with other areas of slope in the Australian EEZ. In particular, the continental slope between NW Cape and the Montebello Trough supports over 508 fish species, of which 76 are endemic. The high numbers of species found here is believed 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.

Protected Marine Fauna

A review of the Environment Protection and Biodiversity Conservation Act 1999 (EPBC) database (Protected Matters search tool) held by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) was conducted for a polygon encompassing the survey area. From the Protected Matters search, it is apparent that seven listed Threatened species may occur, or relate to, the survey area:

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

The survey area for the proposed Exmouth Plateau Northern Extension MC3D MSS is not considered a habitat that is critical to the survival of any listed species. Similarly, there are no EPBC Act-listed threatened ecological communities (TECs) in the vicinity of the survey area.

Whales and Dolphins
The EPBC Act database lists 22 cetacean species that may occur in, and adjacent to, the survey area of the Exmouth Plateau Northern Extension MC3D MSS, all of which are protected under the Act; one of which is also classified as Endangered, one as Vulnerable and six as Migratory species.

The humpback whale is the most commonly sighted whale in north WA waters. The species has been observed seasonally to complete their northern migration in the Camden Sound area of the west Kimberley, after feeding in Antarctic waters during the summer months. It is likely that the whales follow a predictable migratory path and migrate both north and south within the continental shelf boundary (200 m bathymetry) (Figure 3). However, on the southbound migration it is likely that most individuals, and particularly cow/calf pairs, will stay closer to the coast than the northern migratory path. This is confirmed by recent satellite tracking of southbound female humpback whales in the Kimberley region.

Figure 3: Humpback whale migratory routes past the survey area

Given the proposed timing and duration of the Exmouth Plateau Northern Extension MC3D (mid-February to end of March 2012) it is apparent that the survey will be completed well prior to the commencement of the 2012 humpback whale migration season. Therefore, it is unlikely that any humpback whales will be encountered during the survey.
Other rare species of whale include the blue whale, which may be present in, or adjacent to, the survey area 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.

The survey area does not include any known blue whale feeding, breeding or resting areas. In the NWMP pygmy blue whales migrate along the 500 m to 1,000 m depth contour on the edge of the slope, and are likely to be feeding on ephemeral krill aggregations. The northward component of this migration takes place from May to mid-August, with a peak in July-August, and the southward component occurs from late October to November-December, with a few isolated individuals moving south in January. The migration appears to be centred on the 500 m depth contour. Consequently, it is unlikely that blue whales will be encountered in the survey area given the proposed survey timing (mid-February to the end of March 2012).

Offshore waters of the NWMP once supported substantial populations of sperm whales. The presence of sperm whales as evidenced by 19th Century whaling industry data suggests occasional bursts in production, which may be associated with variations in slope (such as canyon heads) and may support species at a number of trophic levels. The deep waters above the gully/saddle on the inner edge of the Exmouth Plateau are thought to be important for sperm whales which may feed in the region (based on the 19th Century whaling industry data). The reasons for this aggregation are not known. Other cetaceans are also believed to use north flowing currents through the deep gully/saddle to assist in their northward migration, similar the northward flowing offshoot of the Eastern Gyral Current.

There are no known breeding, calving or feeding grounds for any listed threatened or migratory whale species within, or in the immediate vicinity of the Exmouth Plateau Northern Extension MC3D survey area.

**Marine Reptiles**

Five marine turtle species may occur in the survey area - green turtle, leatherback turtle, hawksbill turtle, loggerhead, and flatback turtle. Green turtles feed on macroalgae and are by far the most common turtle seen in nearshore waters. Loggerhead turtles are carnivorous, feeding mainly on molluscs and crustaceans. Hawksbill turtles feed mainly on sponges and are more often found in deeper waters of the NWMP. Green, flatback and loggerhead turtles all breed from September to March, while the hawksbill turtle breeds from July to March. The reefal habitats in the photic zone are key feeding habitats for green and hawksbill turtles.

The leatherback turtle is a pelagic feeder, found in tropical, subtropical and temperate waters throughout the world. Nesting is mainly confined to tropical beaches although some nesting occurs on subtropical beaches. No major nesting has been recorded in Australia, although scattered isolated nesting (1-3 nests per annum) occurs in southern Queensland and the Northern Territory. It is unlikely to be encountered within the survey area and adjacent waters.

Recent Position Tracking Terminal (PTT) observations of flatback turtles have recorded their presence in the Exmouth Plateau sub-system. Overall, is unlikely that significant numbers of marine turtles will be encountered during the seismic acquisition throughout most of the survey area, given the water depths and lack of shallow submerged features.

**Sharks and Ray-finned Fishes**

The whale shark is listed as Vulnerable and Migratory under the EPBC Act. Although there are no records of the whale shark’s presence in the survey area there have been sightings in the region, and they are known to occur in both tropical and temperate waters and are normally oceanic and cosmopolitan in their distribution. The tracks of two whale sharks tagged at Ningaloo Reef in 2005 passed through the Northwest Province, one west and the other east of the Exmouth Plateau Northern Extension MC3D survey area (see Figure 4). It is possible that they may be encountered during the proposed survey.
Seabirds
Based on the results of two survey cruises and other unpublished records, 18 species of seabirds have been recorded over North-West Shelf (NWS) waters. These included a number of species of petrel, shearwater, tropicbird, frigatebird, booby and tern, as well as the silver gull. Of these, eight species occur year round and the remaining 10 are seasonal visitors. From these surveys, it was noted that seabird distributions in tropical waters were generally patchy except near islands. Apache commissions annual surveys of the avifauna around its operating facilities on the NWS, resulting in a significant amount of data for the area around the Barrow, Lowendal and Montebello islands groups, about 250 km to the southeast of the Exmouth Plateau Northern Extension MC3D survey area. In 2006, 40 species of seabirds were recorded around the Lowendal Islands (89 recorded in total). Seventy species of seabird have been recorded at the Montebello Islands and 112 species at Barrow Island. In and around the Exmouth Gulf and further offshore, there is less quantitative data available.

Socio-Economic Environment
Commercial Fisheries
The Exmouth Plateau Northern Extension MC3D survey area is located in waters that constitute part of four Commonwealth managed commercial fisheries:

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

These fisheries are managed by the Australian Fisheries Management Authority (AFMA). Of these four fisheries, only the NWSTF is active in the deeper continental slope waters off the NWS.

The NWSTF operates off north-western Australia from 114°E to 125°E, roughly between the 200 m isobath and the outer boundary of the Australian Fishing Zone. The NWSTF has traditionally targeted scampi and deepwater prawns. However, in recent years, Australian scampi has been the main target of the fishery.
Demersal trawl gear is used in the NWSTF. Fishing for scampi occurs over soft, muddy sediments or sandy habitats, typically at depths of 350–600 m on the continental slope. Two vessels were active in the fishery in 2009–10, with Australian scampi being the main target. In the past, vessels based in the Northern Prawn Fishery have fished opportunistically in the NWSTF, but this has not been the case in the past three years. Recent effort in the fishery has been dominated by a small number of vessels based in WA.

Whilst the Exmouth Plateau Northern Extension MC3D survey area overlaps a small part the western area fished by the two vessels operating in the NWSTF in 2009-2010 (see Figure 5), it is apparent that most of the effort and catch within the fishery occurs in shallower, upper slope waters (350–600 m) well to the east of the survey area—especially to the south-west and north-east of the Rowley Shoals.

In the past 12 months, concerns have been expressed by operators within the NWSTF about the potential effects of 3D seismic surveys on catch levels of scampi and prawns, and interference from seismic acquisition activities on trawling operations.

**Figure 5:** Relative fishing intensity in the NWSTF, 2005–06 to 2009–10

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**Petroleum Exploration and Production**

Exploration permits WA-347-P and WA-348-P and adjacent open acreage areas have been subject to a relatively low level of petroleum exploration activities (seismic surveys and exploration drilling) over the past 30 years or so. There have been two exploration wells drilled in the vicinity of the survey area in the past—Belicoso-1 drilled by Woodside in WA-347-P in 2007; and Dalia South-1 drilled by Woodside in WA-348-P in 2010.

At present, there are no discovered oil or gas fields and petroleum production facilities located within or adjacent to the survey area.
**Shipping**
Although there are no defined shipping lanes in the NW Cape region, clear shipping routes emerge when Australian Ship Reporting System (AUSREP) data is analysed. Under the *Navigation Act 1912* (Commonwealth), all vessels operating in Australian waters are required to report their location on a daily basis to the Rescue Coordination Centre (RCC Australia). AUSREP is an integral part of the Maritime Search and Rescue (SAR) system in Australia, and is operated by the AMSA through the RCC Australia.

Data obtained from the Australian Marine Spatial Information System (AMSIS) for 2006-2007 indicates a clear north-south shipping route running parallel to the Cape Range Peninsula and then heading north from west of the NW Cape—this is the shipping route between the Australian west coast and Lombok Strait. In 1999-2000, about 657 vessels used this route. Another shipping route parallels the coast between the NW Cape and the port of Dampier, with significantly fewer vessels using this on an annual basis (less than 150 annually). The offshore shipping route (Australian west coast to Lombok Strait) overlaps the survey area to some degree.

**Tourism**
Due to the deepwater location of the survey area and distance to coastal areas of the Pilbara there are no recreational activities undertaken in the area.

**Cultural Heritage**
There are no known indigenous cultural heritage values or issues for the waters and seabed within and immediately adjacent to the Exmouth Plateau Northern Extension MC3D survey area. Similarly, there are no current or pending Native Title Determinations for the waters and seabed within and immediately adjacent to the survey area.

There are no known historic shipwreck sites within or immediately adjacent to the Exmouth Plateau Northern Extension MC3D survey area.

**National Heritage**
There are no places listed on the Commonwealth Heritage List or the Register of National Estate within or adjacent to the Exmouth Plateau Northern Extension MC3D survey area.

**Marine Parks and Reserves**
The nearest Commonwealth marine reserve to the Exmouth Plateau Northern Extension MC3D survey area is the Commonwealth waters component of Ningaloo Marine Park, which is located approximately 315 km south of the southern boundary of the survey area. At the closest point, the boundary of the State waters component of Ningaloo Marine Park is located approximately 325 km south of the survey area.

The survey area is situated to the north of the proposed Gascoyne Commonwealth marine reserve. This proposed marine reserve includes part of the Exmouth Plateau—a KEF of the NWMR.

**Other Protected Areas**
There are no listed World Heritage Properties within, or adjacent to, the proposed survey area.

There are no listed Ramsar wetlands within, or adjacent to, the proposed Exmouth Plateau Northern Extension MC3D survey area. The nearest listed Ramsar site is Eighty Mile Beach, which is located at least 620 km east of the survey area.

**Defence Activities**
There are no military exercise areas covering the seabed, waters or airspace within/above and adjacent to the Exmouth Plateau Northern Extension MC3D MSS area.
MAJOR ENVIRONMENTAL HAZARDS AND CONTROLS

An Environmental Risk Assessment (ERA) has been undertaken to understand and manage the environmental risks associated with the Exmouth Plateau Northern Extension MC3D MSS to a level that minimises impacts on the environment and meets the objectives of the survey. The ERA methodology applied is consistent with the Australian/New Zealand Standard AS/NZS ISO 31000:2009 Risk management and Handbook 203:2006 Environmental risk management – Principles and process.

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

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

- discharge of underwater seismic pulses;
- light generation from vessels;
- interactions of vessels with marine fauna;
- anchoring or grounding of vessels used for the activity;
- dragging or loss of streamers, streamer fluid and associated equipment;
- emissions to atmosphere from vessels;
- discharge of ballast water and vessel biological fouling;
- routine discharge of wastewater and waste to ocean from survey and support vessels;
- accidental discharge of hydrocarbons and chemicals to ocean from survey and support vessels; and
- interactions with commercial fishing and shipping activities.

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

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

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

The design and execution of the proposed Exmouth Plateau Northern Extension MC3D MSS will be conducted under the framework of the TGS Environmental Policy, TGS Health, Safety and Environmental (HSE) Management System, and the survey vessel operator (Fugro-Geoteam) HSE Management System. The seismic programme will be supported by a project-specific HSE Plan (that includes Emergency Response (ER) procedures), Fugro's Offshore Emergency Response Procedure, and a TGS Emergency Preparedness Bridging Document (incorporated within the HSE Plan). To ensure TGS's environmental objectives and management standards are achieved, the survey vessel operator will be required to comply with all relevant requirements of TGS's HSE systems/policies and standards.

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

Under the framework of the HSE and ER documentation discussed above, a series of work instructions, procedures and plans will be used for the Exmouth Plateau Northern Extension MC3D survey 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 Fugro-Geoteam, as well as documents written specifically for the proposed survey.

TGS is responsible for ensuring that the proposed Exmouth Plateau Northern Extension MC3D MSS is managed in accordance with the Implementation Strategy and the TGS HSE Management System.

Given the control measures that will be implemented for all environmental aspects of the survey, the risk of significant adverse environmental effects from the proposed Exmouth Plateau Northern Extension MC3D MSS has been assessed as low for all aspects, apart from discharge of hazardous materials, fuel and oil spills and vessel collisions, which have been assessed as medium.

The implementation of specific whale monitoring and encounter procedures will be used to minimise the potential for any adverse effects to whales. These procedures comply fully with the Australian Commonwealth Government Guidelines: EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales (September 2008).

Two dedicated, expert Marine Fauna Observers (MFOs) will be aboard the Geo Atlantic for duration of the Exmouth Plateau Northern Extension MC3D survey. The key role of the MFOs will be to visually monitor the waters around the survey vessel for the presence of cetaceans during daylight hours. The MFOs will be responsible for recording any cetacean sightings during the survey on the appropriate sightings forms, using the ‘Cetacean Sightings Application’ software provided by the Australian Marine Mammal Centre (AMMC) at the Australian Antarctic Division. Sighting records will be sent to the TGS Environmental Adviser by the Client Representative, and reported to the AMMC. The MFOs will also be responsible for ensuring that the interaction procedures are implemented and followed correctly during survey activities.

The survey will be conducted in water depths of 1,250-1,700 m away from any shallow water habitat areas that may be important for turtle feeding. The survey area is located at least 215 km away from any beaches and adjacent shallow waters that are important for turtle nesting, hatching and breeding. The survey area is not located close to any locations important for seabird breeding.

The survey is unlikely to have any significant effects on benthic communities due to the water depths across the operational area (1,250-1,700 m). Anchoring of the survey or support vessel will only occur in emergency circumstances and both vessels are fitted with highly sophisticated position fixing equipment. At sea refuelling of the Geo Atlantic 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.
CONSULTATION PLAN

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

- A Raptis and Sons
- Austral Fisheries Pty Ltd
- Australian Fisheries Management Authority (AFMA)
- Australian Hydrographic Office (AHO)
- Australian Maritime Safety Authority (AMSA)
- Border Protection Command (BPC)
- Centre for Whale Research (CWR)
- Coastwatch
- Commonwealth Fisheries Association (CFA)
- Department of Broadband, Communications and the Digital Economy (DBCDE)
- Department of Defence (Directorate of Property Acquisition, Mining and Native Title)
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC)
- Geoscience Australia (GA)
- MG Kailis
- National Native Title Tribunal (NNTT)
- Northern Fishing Companies Association (NFCA)
- Shark Bay Seafoods
- TunaWest
- Western Australian Department of Fisheries (DoF)
- Western Australian Fishing Industry Council (WAFIC)
- Western Australian Northern Trawl Owners Association (WANTOA)
- WestMore Seafoods

Consultation with all of the stakeholders listed above, plus any others identified during the consultation process, will continue during and after the survey, if necessary.
Table 2: Summary of environmental risks and management approach for key aspects of the Exmouth Plateau Northern Extension MC3D MSS

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<th>Residual risk level</th>
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</thead>
</table>
| Disturbance to marine fauna                  | Cetaceans - behavioural reactions (avoidance, diving, increased dive times)       | • Adherence to EPBC Act Policy Statement 2.1 and the following additional mitigation measures:  
  ➢ precaution zones (observation zone: 3 km+; low power zone: 2 km; and shutdown zone: 500 m)  
  ➢ two dedicated MFOs on survey vessel  
  ➢ application of vessel-whale interaction procedures for non-acoustic energy source operations  
  • Detailed reports of all cetacean sightings will be recorded using the DSEWPaC Cetacean Sightings Application  
  • External lighting of vessels will be minimized to that required for navigation, vessel safety and safety of deck operations, except in the case of emergency  
  • Survey will be conducted in water depths of 1,250-1,700 m away from any shallow water habitat areas important for turtle feeding  
  • Survey area is located at least 215 km away from any beaches and adjacent shallow waters important for turtle nesting, hatching and breeding  
  • Survey area is not located close to any locations important for seabird breeding  
  • Survey will not be operating over critical habitat for feeding, spawning, breeding or migrating fish populations | Low                 |
| Disturbance to benthic habitats              | Small localised disturbance to epibiota in event of loss of equipment             | • Survey will be conducted in water depths of 1,250-1,700 m away from any shallow water areas  
  • No anchoring of the either survey or support vessel will take place during survey unless in an emergency  
  • All reasonable efforts taken to retrieve lost equipment  
  • Recording and reporting of all items lost overboard | Low                 |
| Introduction of invasive marine species      | Introduction and establishment of invasive marine species with consequent impacts on benthic communities, fisheries etc. | • Vessels required for the proposed activity will not discharge ballast water  
  • Adherence the Australian Ballast Water Management Requirements, if necessary  
  • Both the survey and support vessels will have all the necessary AQIS clearances to operate unrestricted anywhere in Australian waters | Low                 |
| Marine pollution from routine discharges     | Localised temporary decrease in ambient water quality from discharge of sewage, grey water, putrescible wastes and bilge water | • All sewage and putrescible wastes will be handled and disposed of in accordance with MARPOL Annex IV  
  • Discharge of sewage and putrescibles waste will be of short duration with high dispersion and biodegradability  
  • Sewage and putrescible wastes macerated where possible prior to disposal  
  • All sewage and putrescible waste treatment systems and holding tanks are to be fully operational prior to survey commencement  
  • Relevant discharge requirements for treated and untreated sewage are adhered to (>3 nm from land for treated sewage; >12 nm from land for untreated sewage) | Low                 |
<table>
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<tr>
<th>Impact category</th>
<th>Potential impacts</th>
<th>Control and mitigation measures</th>
<th>Residual risk level</th>
</tr>
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</table>
| Marine pollution from accidental discharges | Acute toxicity effects on marine fauna, such as marine turtles, fishes and seabirds, from accidental discharges of hazardous materials | • Harmful Packaged Substances handled and disposed of in accordance with MARPOL Annex V  
• Garbage Management Plan in place detailing wastes generated and disposal requirements  
• No discharge of plastics or plastic products of any kind from vessels  
• All solid, liquid and hazardous wastes (other than sewage, grey water and putrescible wastes) will be incinerated or compacted (if possible) and stored in designated areas and sent ashore for recycling, disposal or treatment  
• Correct segregation of solid and hazardous wastes  
• Incinerators used are compliant with MARPOL and IMO requirements  
• All storage facilities and handling equipment will be in good working order and designed in such a way as to prevent and contain any spillage as far as practicable  
• Bilge water will be treated and disposed of in accordance with MARPOL Annex I | Medium |
| Acute toxicity effects on marine fauna from fuel and oil spills | Survey and support vessels will comply with MARPOL Annex I requirements to prevent oil pollution (e.g. SOPEP implemented and tested for survey and support vessels)  
• Spill response bins/kits located in close proximity to hydrocarbon storage areas and replenished if required  
• Identified personnel trained in the use of the equipment  
• Hydrocarbons located above deck will be stored with some form of secondary containment to contain leaks or spills  
• If refuelling at sea does take place its and will be subject to the Fugro Offshore Bunkering Instruction and additional requirements | Medium |
| Interaction with commercial fisheries and shipping activities | Interference to commercial fishing vessels and shipping operating within or near the survey area and surrounding waters  
Potential direct and indirect noise impacts on target species  
Restriction of access to fishing grounds, loss or damage to fishing gear | • Notification of activity details as required to relevant commercial fisheries management agencies, fishing industry bodies and individual companies  
• Consultation with AMSA prior to the survey commencing  
• Use of a support vessel to manage vessel interactions  
• Use of standard maritime safety procedures (Notice To Mariners (NTM) via the Australian Hydrographic Office; radio contact, display of appropriate navigational beacons and lights)  
• Compliance with AMSA administered marine safety regulations and marine notification requirements  
• Strict adherence to equipment handling and acquisition procedures  
• Fishermen and other mariners alerted of vessels presence and extent of towed array  
• Establishment of a vessel exclusion zone around the survey vessel  
• Where possible in-water equipment lost will be recovered  
• Detailed records of equipment lost overboard will be maintained | Low |
FURTHER DETAILS

For further information about the proposed TGS Exmouth Plateau Northern Extension MC3D MSS on the Exmouth Plateau within the northern Carnarvon Basin offshore from Western Australia, please contact:

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