HUZZAS MULTI CLIENT 3D MARINE SEISMIC SURVEY

ENVIRONMENT PLAN SUMMARY

TGS

November 2013

HUZZAS MULTI CLIENT 3D MARINE SEISMIC SURVEY, ENVIRONMENT PLAN SUMMARY

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1 INTRODUCTION

The geophysical company TGS proposes to undertake a multi-client three-dimensional (MC3D) marine seismic survey (MSS) called Huzzas (HZ-13), south of the Exmouth Plateau within the northern Carnarvon Basin offshore from Western Australia (WA) (**Figure 1**).

The HZ-13 MC3D MSS is scheduled to occur between December 2013 and May 2014, with a total duration of approximately 128 days. The water depths within the operational area range from approximately 30 m to 500 m.

The HZ-13 MC3D MSS will follow the same technical methods and procedures as other seismic surveys conducted in Australian marine waters. No unique or unusual equipment or operations are proposed.

This document provides a summary of the Environment Plan (EP) that was accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) as part of the requirements under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Environment Regulations). This EP summary has been prepared as per the requirements of Regulation 11 (7) and (8) of the Environment Regulations.

2 LOCATION OF THE ACTIVITY

The HZ-13 MC3D MSS operational area comprises 5,862 km^2 and lies within Commonwealth and State waters (**Figure 1**). The area defined as the 'operational area' is the physical area used for full power data acquisition within the survey area plus additional area for sail line run outs (required to obtain full fold coverage), soft-start procedures and vessel manoeuvring.

The operational area intersects petroleum permit blocks WA-43-L, WA-22-L, WA-44-R, W-13-18, WA-155-P(1), WA-155-P(2) WA-41-R, WA-486-P, WA-12-L, WA-10-L, WA-320-P, WA-456-P, WA-455-P, WA-25-L, WA-358-P, WA-290-P, WA-13-L, WA-450-P, WA-49-R, WA-483-P, WA-476-P, TP/23, TP/25, WA-35-L, WA-45-L,WA-37-L,WA-255-P, WA-214-P and T 13-1.

The exact coordinates of the surveyed area may change in the lead up to the survey (in light of client / commercial factors) so the purpose of providing an operational area is to show the outer extent of the area within which the survey may be conducted, including line run outs.

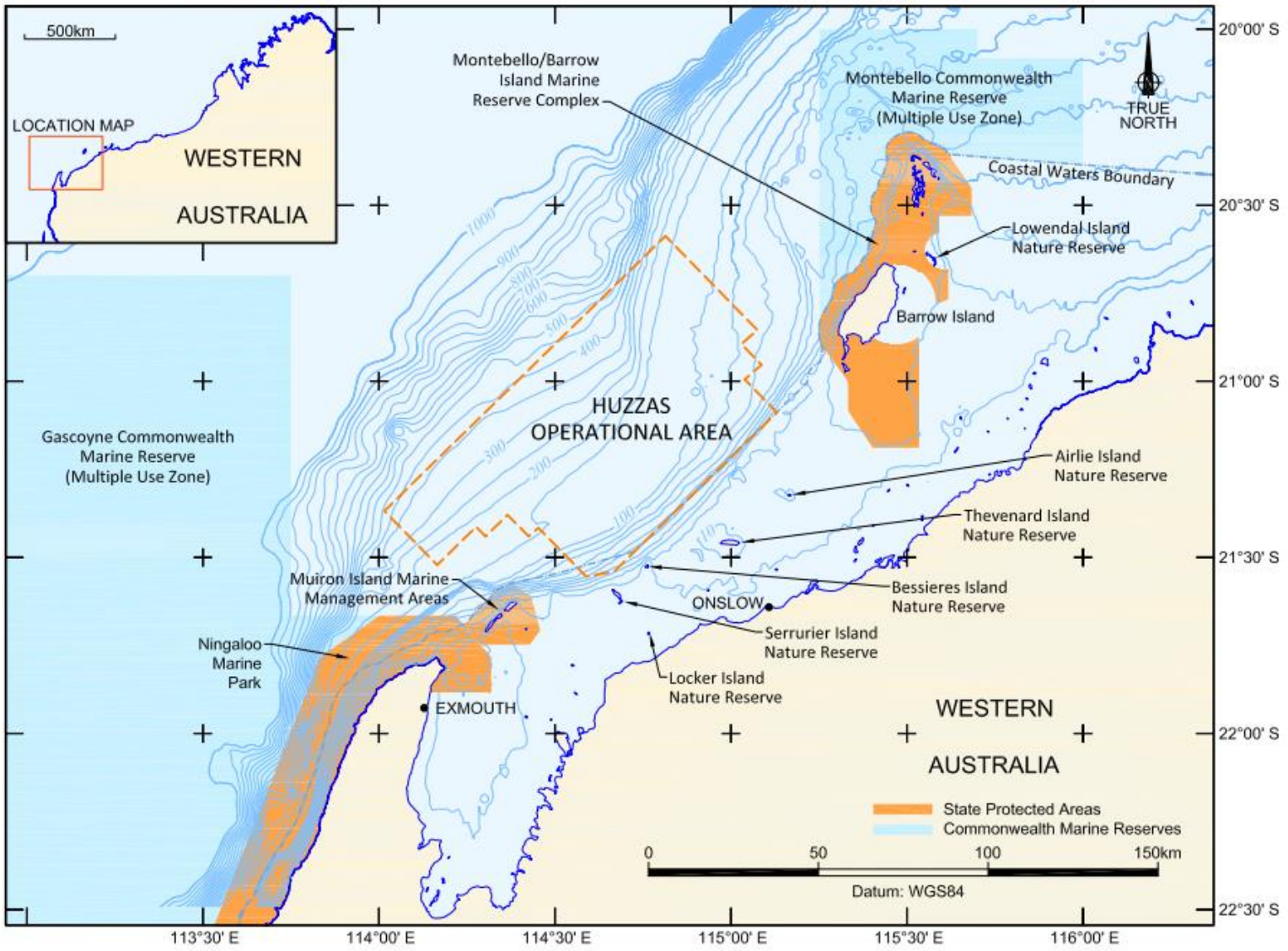
Boundary coordinates for the operational area are provided in **Table 1**.

Table 1: Co-ordinates for the HZ-13 operational area

Longitude	Latitude
114.8138754	-20.58733899
115.0753119	-20.85470804
115.0295099	-20.89421945
115.08704	-20.95310347
115.0391446	-20.99439869
115.1305689	-21.08788911
114.7285102	-21.4809714
114.5768772	-21.54177143
114.4532048	-21.41589336
114.4252723	-21.43994645
114.3653754	-21.37886497
114.3031422	-21.44036465
114.2763645	-21.41301544
114.1654904	-21.52135929
114.0156687	-21.36807367

Datum: GDA94

Figure 1: Location of the HZ-13 MC3D MSS operational area, with relevant Marine Protected Areas



3 DESCRIPTION OF THE ACTIVITY

3.1 Survey Parameters

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

During the proposed activities, the survey vessel will traverse a series of pre-determined sail lines within the survey 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 a maximum of 14 seismic cables, with a maximum length of ~7 km. The seismic cables are towed side by side and the spacing will be 75 m between each seismic cable. The seismic energy source tow depth will be 6 m (+/- 0.5 m) and the cable tow depth will be 9 - 15 m (+/- 1 m). The operating pressure for the seismic energy source will be approximately 2,000 psi and will consist of two sub-arrays, each with a maximum volume of approximately 3,500 cui.

The sub-arrays will be fired alternately, with a shotpoint interval of 18.75 m horizontal distance. The source produces sound pulses (within a few metres in the order of ~262 dB re 1µPa sound pressure level – SPL) at frequencies extending up to approximately 210 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.

3.2 Survey Vessels

TGS proposes to conduct the HZ-13 MSS using a purpose-built seismic survey vessel. At least one support vessel will escort the survey vessel at all times to maintain a safe distance between the survey array and other vessels, and also to manage interactions with shipping and fishing activities, if required. The support vessels will also re-supply the survey vessel with logistical supplies, including refuelling as necessary.

4 DESCRIPTION OF THE ENVIRONMENT

4.1 Regional setting

The proposed HZ-13 MC3D operational area lies within Commonwealth and State marine waters of the North West Shelf (NWS) in the North-west Marine Region (NWMR). While the operational area covers water depths between 30 and 500 m only, the NWS includes shallower water (up to shorelines) and is scattered with islands, the largest of which is Barrow Island. There are no islands or emergent land within the operational area. At its nearest point, the operational area is located approximately 62 km north-west of the Montebello Islands, 24 km west of Barrow Island and Lowendal Islands (including Varanus Island), 16 km north of Thevenard Island, 6 km north of Bessieres and Serrurier islands, 20 km north from Muiron Islands and 76 north of the North West Cape.

The NWS gradually slopes from the coast to the shelf break, but displays a number of seafloor features including several terraces and steps, the most prominent of which occurs at a water depth of approximately 125 m and is believed to be an important migratory pathway for cetaceans and other pelagic species such as the whale shark (DSEWPaC 2008). Inshore areas of the NWMR have predominantly sandy sediments, with mostly muddy sediments occurring offshore from the 200 m isobath (DSEWPaC, 2012).

4.2 Physical Environment

The NWMR 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. In summer, mean daily temperatures range between 20°C and 34°C. During winter, mean daily temperatures range between 17°C and 26°C (Chevron Australia, 2008). Relative humidity at Barrow Island ranges from 61% in the winter months (September) to 70% in the summer (February) (BoM, 2012).

Rainfall on Barrow Island varies significantly each year and is dependent on rain-bearing low-pressure systems, thunderstorm activity, and the passage of tropical cyclones (which generally occur from November to April). Average annual rainfall at Barrow Island is 306 mm with most rain (85%) occurring between January and July (BoM, 2012). The cyclone season is November to April with the majority of cyclones moving down the north-west coast between 40-400 km offshore and at an average speed of 16 km per hour. An average of five tropical cyclones per year occur in the Pilbara Region (BoM, 2011), with an average of two per year passing through the Barrow Island area (Chevron Australia, 2005). Winds are predominantly WSW from October to April and ESE from May to September. Average 10 minute wind speed in non-cyclonic conditions is 6 ms^{-1} with a 5% exceedence value of 12 ms^{-1}.

Offshore surface water temperatures range between approximately 20°C in winter and 31°C in summer (Chevron Australia, 2005). Water circulation in the region is influenced by the southward-flowing Leeuwin Current and the Indonesian Throughflow (Chevron Australia, 2010). 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. The Leeuwin Current is strongest during autumn and winter. Circulation of Indonesian Throughflow (ITF) waters into the NWMR (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. Astronomical tides on the NWMR are semidiurnal and generally quite large, ranging from 0.95 m near Exmouth to more than 3 m on the inner shelf near Broome.

Water clarity in the region varies according to water movement and sediment type (Chevron Australia, 2011). The shallow, nearshore coastal waters off the west coast of Barrow Island generally have low levels of turbidity and concentrations of suspended sediments (<5 mg/L), which is indicative of clear water environments. Little salinity stratification occurs between the surface and bottom waters in this area (Chevron Australia, 2010) with salinity ranging from 35.08 to 37.75 ppt.

4.3 Biological Environment

4.3.1 Biological Productivity

It is believed that overall biological productivity above the Exmouth Plateau and slope is generally low. However, the Exmouth Plateau acts as a physical obstacle, forcing deeper, cooler and more nutrient-rich waters onto the plateau. Detritus falling from the pelagic environment to the seabed plays a key role in nutrient cycling from pelagic to benthic environments (Brewer *et al.*, 2007).

4.3.2 Biological Communities

The NWMR 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 areas (Brewer *et al.*, 2007).

Despite the relatively 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 may 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 (DSEWPaC, 2012).

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 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 (DSEWPaC, 2012).

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. 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 described above (DSEWPaC, 2012).

4.3.3 Protected Marine Fauna

A review of the EPBC Act database (Protected Matters search tool) identified 15 threatened species, 11 of which are also migratory, and an additional 12 species listed as migratory only (see **Table 2**). These include:

- Nine migratory cetaceans, of which three are threatened:
  - Migration periods of two threatened species, the humpback and blue whale, may overlap in timing with the survey. However, given the distances between known migratory pathways and the survey areas, encounter rates are expected to be low.
  - Encounters of southern right whales (the third of the threatened species) are not expected.
  - Encounter rates of migratory-only species are also expected to be low.
- Six species of threatened marine reptiles; five turtles and one sea snake, of which five (all turtles) are migratory:
  - Marine reptile species may be present in the operational area however, individuals are expected to be transitory only and encounter rates are considered low.
- Six species of threatened and/or migratory shark:
  - Species may transit through the survey area, although encounter probability is expected to be low.
- Five species of threatened and/or migratory seabirds:
  - Species may occur within the survey area, however, individuals are likely to be transitory only.
- One migratory species of sirenian:
  - Encounters of dugong are predicted to be low as a result of the lack of preferred foraging/feeding habitat in the operational area.

The operational area for the proposed HZ-13 MC3D MSS is not considered habitat that is critical to the survival of any listed species due to their widespread distribution outside of the operational area. Similarly, there are no EPBC Act-listed threatened ecological communities (TECs) in the vicinity of the survey area.

Table 2: Protected marine fauna and likely occurrence in the survey area

Scientific Name	Common Name	Status	Type of Presence
Cetaceans			
Balaenoptera musculus	Blue Whale	Endangered, Migratory	Species or species habitat may occur within area
Eubalaena australis	Southern Right Whale	Endangered, Migratory	Species or species habitat likely to occur within area
Megaptera novaeangliae	Humpback Whale	Vulnerable, Migratory	Congregation or aggregation known to occur within area
Balaenoptera bonaerensis	Antarctic Minke Whale	Migratory	Species or species habitat may occur within area
Balaenoptera edeni	Bryde's Whale	Migratory	Species or species habitat may occur within area
Orcinus orca	Killer Whale	Migratory	Species or species habitat may occur within area
Physeter macrocephalus	Sperm Whale	Migratory	Species or species habitat may occur within area
Sousa chinensis	Indo-Pacific Humpback Dolphin	Migratory	Species or species habitat may occur within area
Tursiops aduncus	Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)	Migratory	Species or species habitat likely to occur within area
Sharks			
Rhincodon typus	Whale Shark	Vulnerable Migratory	Foraging, feeding or related behaviour known to occur within area
Carcharias taurus	Grey Nurse Shark (west coast population)	Vulnerable	Species or species habitat may occur within area
Carcharodon carcharias	Great White Shark	Vulnerable Migratory	Species or species habitat may occur within area
Pristis clavata	Dwarf Sawfish, Queensland Sawfish	Vulnerable	Species or species habitat likely to occur within area
Isurus oxyrinchus	Shortfin Mako, Mako Shark	Migratory	Species or species habitat likely to occur within area
Isurus paucus	Longfin Mako	Migratory	Species or species habitat likely to occur within area
Marine reptiles			
Caretta caretta	Loggerhead Turtle	Endangered Migratory	Species or species habitat known to occur within area
Chelonia mydas	Green Turtle	Vulnerable Migratory	Congregation or aggregation known to occur within area

Dermochelys coriacea	Leatherback Turtle	Endangered Migratory	Species or species habitat known to occur within area
Eretmochelys imbricata	Hawksbill Turtle	Vulnerable Migratory	Congregation or aggregation known to occur within area
Natator depressus	Flatback Turtle	Vulnerable Migratory	Congregation or aggregation known to occur within area
Aipysurus apraefrontalis	Short-nosed Seasnake	Critically Endangered	Species or species habitat likely to occur within area
Birds			
Macronectes giganteus	Southern Giant-Petrel	Endangered, Migratory	Species or species habitat may occur within area
Pterodroma mollis	Soft-plumaged Petrel	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes	Flesh-footed Shearwater	Migratory	Species or species habitat may occur within area
Sterna bengalensis	Lesser Crested Tern	Migratory	Breeding known to occur within area
Sterna dougallii	Roseate Tern	Migratory	Foraging, feeding or related behaviour likely to occur within area
Sirenians			
Dugong dugon	Dugong	Migratory	Species or species habitat known to occur within area

4.4 Socio-economic Environment

4.4.1 Commercial Fisheries

Both the offshore and coastal waters in the Pilbara support a valuable and diverse commercial fishing industry. Several commercial fisheries operate out of Exmouth, Onslow, Port Samson and Dampier and overlap or are adjacent with eth HZ-13 MC3D MSS operational area. The fisheries are managed by either the WA Department of Fisheries (State) or the Australian Fisheries Management Authority (Commonwealth).

State Fisheries

- North Coast Prawn Managed Fisheries;
- Mackerel Managed Fishery;
- Northern Shark Fishery
- Exmouth Gulf Prawn Managed Fishery;
- Gascoyne Demersal Scalefish Fishery;
- Pilbara Demersal Scalefish Fisheries;
- Pearl Oyster Managed Fishery;
- Beche-de-mer Fishery;
- Marine Aquarium Fish Managed Fishery; and
- Specimen Shell Managed Fishery.

Commonwealth Fisheries

- North West Slope Trawl Fishery (north of permit area);
- Western Skipjack Fishery;
- Western Tuna and Billfish Fishery;
- Southern Bluefin Tuna Fishery; and
- Western Deepwater Trawl Fishery.

Of these fisheries, only the North West Slope Trawl Fishery and Western Deepwater Trawl Fishery (Commonwealth), and North Coast Prawn Managed Fisheries and Mackerel Managed Fishery (State), are active in the HZ-13 operational area.

Whilst the HZ-13 MC3D MSS operational area is located within the area of the Western Deepwater Trawl Fishery, it is apparent that most of the effort and catch within the fishery occurs in waters well to the south of the operational area—especially to the west and north-west of Shark Bay. No fishing activity in the Western Deepwater Trawl Fishery occurred in the HZ-13 MC3D MSS operational area during 2009-2010.

Likewise, the HZ-13 MC3D MSS operational area is located within the area of the North West Slope Trawl Fishery, the majority of effort and catch occurs to the north-west of the operational area, particularly north of Barrow Island, and around Mermaid reef and Rowley shoals.

4.4.2 Petroleum Exploration and Production

Various petroleum exploration and development activities have occurred within and surrounding the operational area.

Exploration permits to be covered 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. Four exploration wells (Leyden 1, 1a, 1b and 1a St1) were drilled by BHP Petroleum in 1996 in open acreage adjacent to permit WA-392-P (Geoscience Australia, 2013). The operational area is located west of the

Gorgon gas field and northeast of Ngujima Yin FPSO (Woodside) and Pyrenees field and FPSO (BHPB). The Coniston Drill Centre, Novara Drill Centre and the Van Gogh FPSO (Apache) are located within the proposed operational area. The Woollybutt FPSO (ENI) and the Griffin Venture FPSO (BHPB) were located within the operational area but are no longer on location. However, some subsea infrastructure remains at these locations.

4.4.3 Shipping

Under the Commonwealth Navigation Act 1912, all vessels operating in Australian waters are required to report their location on a daily basis to the Rescue Coordination Centre in Canberra. This Australian Ship Reporting System (AUSREP) is an integral part of the Australian Maritime Search and Rescue system and is operated by Australian Maritime Safety Authority (AMSA) through the Rescue Coordination Centre.

The operational area is not within a commercial shipping route although some slow moving vessel traffic could be expected around Thevenard Island, Onslow and those using Mary Anne Passage in and around Barrow Island. Local vessel movement is likely to be associated with the petroleum industry (Vincent, Van Gough, Griffin, Pyrenees and Woollybutt field developments) and to a lesser degree, commercial fishing.

4.4.4 Marine Parks and Reserves

The HZ-13 MC3D MSS operational area is located 28 km east of the Gascoyne Commonwealth Marine Reserve (CMR), 19 km north east of the Ningaloo CMR, 16 km north east of the Ningaloo State Marine Park, 16 km north of the Muiron Island Marine Management Area (MMA), and 18 km to Montebello/Barrow Island Marine Reserve Complex and 19 km to Montebello CMR both in an easterly direction (DSEWPaC, 2013).

The Gascoyne CMR is 28 km west of the operational area and comprises three different zones; Marine National Park (IUCN II), Habitat Protection Zone (IUCN IV) and Multiple Use Zone (IUCN VI). Mining operations, including oil and gas activities, are allowable in Multiple Use Zones.

The Ningaloo CMR includes shallow shelf environments providing protection for shelf and slope habitats, as well as pinnacle and terrace seafloor features. The Ningaloo State Marine Park is an important whale shark aggregation area with peak numbers appearing from late March to early May following the mass spawning of coral.

The Muiron Islands Marine Management Area (MMA), which is situated to the north-east and immediately adjacent to Ningaloo Marine Park, is located approximately 16 km south of the operational area. The park supports important coral reef habitat and associated diverse fish fauna, and is an important breeding site for the loggerhead turtle.

The State-managed Montebello/Barrow Islands Marine Conservation Reserves Complex (MCR) comprises three separately vested reserves, namely the Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island MMA, which were gazetted in 2004. These areas support important turtle nesting sites and wading shorebirds and foraging and nesting seabirds are also common on the islands. Adjacent to the Montebello State Marine Park, the Montebello CMR covers an area of 3,413 km^2 in Commonwealth waters. The area is important for foraging migratory seabirds, whale sharks and marine turtles, and includes part of the migratory pathway of the protected humpback whale. The Barrow Island Marine Park and Barrow Island MMA adjoin Barrow Island. The Barrow Island Marine Park, which is a significant breeding and nesting area for marine turtles, also incorporates significant coral reef areas.

4.4.5 Defence Activities

The operational area overlaps with a Military Exercise Area (MEO) (the West Australia Exercise Area). These areas are used by the RAAF and the RAN for all military operations including live weapons and missile firings. Restricted airspace is approved for navy and air weapons firing into Lancelin Training Area. Undertaking seismic surveys could impact upon naval and air force weapons practices.

TGS has included defence stakeholders in their stakeholder engagement program to minimise impact and/or interaction between defence and seismic survey activities. The consultation has revealed no potentially conflicting activities during the time of the proposed survey.

5 IDENTIFICATION AND ASSESSMENT OF ENVIRONMENTAL RISKS AND IMPACTS

An Environmental Risk Assessment (ERA) has been undertaken to compile the potential environmental risks associated with the HZ-13 MC3D MSS to ensure they are reduced to As Low As Reasonably Practicable (ALARP) and will be of an acceptable level consistent with TGS's standards. The key environmental hazards and control measures to be applied to the HZ-13 MC3D MSS are highlighted in **Table 3** below.

A summary of the key sources of environmental risk and impact 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 cables, cable 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;
- vessel collisions resulting in fuel and oil spills, and/or damage to benthic habitats;
- interactions with commercial fishing, shipping and defence activities; and
- operation of the survey and support vessels within, or in the vicinity of, protected and heritage areas.

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

- disturbance to marine fauna including cetaceans, 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, grey water, bilge water and other putrescible wastes (i.e. foodscraps);
- marine pollution from accidental discharges including spills of hydrocarbons and hazardous materials;
- disturbance to social and community values due to interactions with commercial fishing vessels, shipping and military aircraft; and
- disturbance to heritage and conservation values due to operation of vessels within, or in the vicinity of, protected areas.

The environmental aspects of the HZ-13 MC3D MSS that have the potential to cause significant environmental effects have been determined through an evaluation of the proposed activity, the surrounding environment including specific sensitivities and values, and legislative requirements. These environmental aspects are:

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

Implemented control measures documented in **Table 3** ensure that the environmental risks associated with these impacts are reduced and 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 potential environmental impacts.

Table 3: Summary of the environmental risk assessment for the HZ-13 MC3D MSS

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
Disturbance to marine fauna	Discharge of underwater seismic pulses	Behavioural and physiological effects on fish	• Use of soft-starts on every start up • EPBC Act Policy Statement 2.1 – Part A Standard Management Procedures • Application of 2 km low power zone • Use of two MFOs • Recording and reporting of marine fauna sightings, including cetaceans, turtles and whale sharks • Whale shark observations and shutdowns • Timing survey to avoid peak humpback whale migration • Racetrack progression survey design and timing to reduce impacts on internesting turtles and aggregating whale sharks • Outside humpback whale migration (i.e. from December - May)	Low
		Behavioural and physiological effects on cetaceans		Low
		Behavioural effects and physiological on marine turtles		Low
		Physiological effects on benthic invertebrates		Low
		Physiological effects on plankton		Low
	Light generation from vessels	Behavioural effects on marine fauna	• Minimisation of survey and support vessel external lighting to levels required for navigation, vessel safety and safety of deck operations	Low
	Vessel interactions	Behavioural and physiological effects on marine fauna	• Australian National Guidelines for Whale and Dolphin Watching • Vessel Environmental Management Procedures • Guidelines for Extrication of Maritime Turtles • Recording and reporting of any vessel interactions with marine fauna • Specific vessel-whale interaction procedures for non-acoustic energy source operations	Low
Disturbance to benthic habitats	Deployment and retrieval of anchors	Localised physical damage to benthic habitats	• No anchoring within operational area, except in emergency situations • Anchoring in shallow waters shallower waters near the Pilbara coastline will only occur in emergency situations • All measures will be taken to avoid areas of sensitive habitat	Low
	Vessel grounding	Physical damage to benthic habitats	• Vessel Bridge Routines – Navigation in Critical Waters • Vessel Collision, Grounding, Hull Damage Procedures • Vessel Environmental Management Procedures • Survey and support vessels will use approved navigation systems and depth	Low

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
			sounders • Standard maritime safety / navigation procedures	
	Equipment damage, dragging or loss	Localised physical damage to benthic habitats	• Vessel Environmental Management Procedures • Vessel Back Deck Operations – Deployment and Recovery of Cables • Vessel Back Deck Operations – Cable Maintenance Using the Workboat • Use of survey and support vessels with experienced operators and crew • Lost in-water equipment will be recovered, where possible • Recording / reporting of incidents involving loss of equipment (e.g. cable loss)	Low
Reduced air quality from atmospheric emissions	Operation of machinery and vessels powered by internal combustion engines	Localised reduction air quality Greenhouse gas emissions	• Compliance with PSPPS Act and Marine Orders - Part 97: Marine pollution prevention - air pollution • Optimisation of fuel use to increase efficiency and minimise emissions • Use of low sulphur diesel fuel (if/when available) • Implementation of a preventive maintenance system (PMS)	Low
Introduction of invasive marine species (IMS)	Discharge of ballast water from vessels	Introduction and establishment of IMS and displacement of native marine species	• No routine discharge of ballast water from survey or support vessels • Australian Ballast Water Management Requirements (if/when required)	Low
	Biofouling of vessel hulls and other niches	Introduction and establishment of IMS and displacement of native marine species	• All necessary AQIS clearances to operate unrestricted anywhere in Australian waters • Hull inspection / cleaning • Reporting of known or suspected introduced species to FishWatch	Low
Marine pollution from routine discharges	Discharge of sewage, grey water and putrescible wastes	Localised reduction in water quality due to nutrient enrichment	• Compliance with PSPPS Act and Marine Orders - Part 96: Marine Pollution Prevention - Sewage • Vessel Environmental Management Procedures • Vessel Bridge Routines – Chief Engineer's Standing Order • Vessel Waste Disposal Procedures • Maceration / disinfection of sewage and putrescible wastes prior to disposal • Discharge of non-communited / disinfected sewage only at distance of >12 nm from nearest land • Discharge of communited / disinfected sewage only at distance of >3 nm from nearest land	Low

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
			• If support vessel is unable to treat/store grey water (i.e. wastewater from sinks and showers) biodegradable soaps and detergents will be used (where possible) • Vessel Waste Log will be maintained to record waste management practices	
	Discharge of bilge water	Localised reduction in water quality	• Compliance with PSPPS Act and Marine Orders - Part 91: Marine Pollution Prevention - Oil • Vessel Environmental Management Procedures • Vessel Bridge Routines – Chief Engineer's Standing Order • Containment and onshore disposal of bilge water contaminated with hydrocarbons, except if the oil content is <15 ppm • Containment and onshore disposal of bilge water contaminated with chemicals, except if chemical has a low toxicity	Low
	Discharge of other wastes i.e. domestic or hazardous wastes	Toxic effects on marine fauna and flora Reduction in water quality Physical impacts on marine fauna i.e. from plastics	• Compliance with PSPPS Act and Marine Orders - Part 95: Marine Pollution Prevention - Garbage • Vessel Environmental Management Procedures • Vessel Waste Disposal Procedures • Survey vessel Garbage Management Plan • No discharge of plastics or plastic products of any kind from survey and support vessels • No discharge of domestic wastes or maintenance wastes from survey and support vessels • All waste receptacles aboard survey and support vessels will be covered with tightly fitting, secure lids • 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 • 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 • Vessel Waste Log will be maintained to record quantities of wastes transported onshore, and detailed records of waste accidentally discharged	Low

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
Marine pollution from accidental discharges	Hazardous materials	Toxic effects on marine fauna and flora Localised reduction in water quality	• Compliance with PSPPS Act and Marine Orders - Part 94: Marine Pollution Prevention - Packaged Harmful Substances • Vessel Environmental Management Procedures • Vessel Waste Disposal Procedures • 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 • Tested / implemented Shipboard Oil Pollution Emergency Plan (SOPEP) for both survey and support vessels • Material Safety Data Sheet (MSDS) readily available for all hazardous substances aboard survey and support vessels • Spill response bins/kits will be located in close proximity to hydrocarbon storage areas for prompt response in the event of a spill or leak. Kits checked for their adequacy and replenished as necessary. Personnel trained in use of this equipment	Medium
	Oil and chemical spills	Toxic effects on marine fauna and flora Reduction in water quality	• Adherence to the requirements of the Navigation Act 1912, and specifically Marine Orders – Part 30: Prevention of collisions • Adherence to the requirements of COLREGS • Vessel contractor's Environmental Management Procedures • Vessel contractor's Deck and Engine Maintenance General Procedures • Vessel contractor's Planned Maintenance System • Adherence to Vessel contractor's Deck and Engine Maintenance General Procedures and Planned Maintenance System • Adherence to the requirements of Vessel Back Deck Operations – Deployment and Recovery of Cables. • Adherence to the requirements of Vessel Back Deck Operations – Cable Maintenance Using the Workboat.	Medium
	Vessel collisions, grounding, sinking and spill during refuelling	Physical damage to benthic habitats Toxic effects on marine fauna and flora Reduction in water quality	• Adherence to the requirements of the Navigation Act 1912, and specifically Marine Orders - Part 30: Prevention of collisions • Adherence to the requirements of COLREGS • Vessel Collision, Grounding, Hull Damage Procedures	Medium

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
			• Support Vessels Procedures • Refuelling procedures (including supervision and shut off) • Survey and support vessels will use approved navigation systems and depth sounders • Standard maritime safety / navigation procedures • Hydrocarbons located above deck will be stored with some form of secondary containment to contain leaks or spills • Pre-approval of refuelling by TGS' Vessel Operations Manager • The survey vessel has an implemented and tested SOPEP • All cargo will be pre-slung • Refuelling will only be carried out in daylight hours and within weather limit guidelines and in daylight hours • Recently certified transfer hoses and fittings	
Oil spill response	Implementation of oil spill response strategies	Disturbance to habitats and fauna Toxicity to marine fauna and flora Additional vessel presence (noise, emissions, discharges, collision risk)	• SOPEP in place • Consultation log detailing MAO discussions with AMSA and DoT relating to interfaces between SOPEP/AMSA NATPLAN, WestPlan MOP and DoT MOSCP • Consultation log detailing discussions with AMSA and DoT to ensure all aspectes of oil spill response are accounted for. • Oil spill reports demonstrating reporting of spills to AMSA and DoT • Vessel records of oil spill drills carried out • Assessment of implementation of SOPEP, AMSA NATPLAN, WestPlan MOP and DoT MOSCP • Insurance policies to cover costs of environmental monitoring or clean up post spill	Low
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	• Adherence to the requirements of the Navigation Act 1912, and specifically Marine Orders - Part 30: Prevention of collisions • Adherence to the requirements of COLREGS • Notification of activity details to relevant fisheries stakeholders prior to survey commencement • Support Vessels Procedures	Low

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
		from survey vessels	• Vessel Back Deck Operations – Deployment and Recovery of Cables • Vessel Back Deck Operations – Cable Maintenance Using the Workboat • Vessel Collision, Grounding, Hull Damage Procedures • Use of a support vessel to manage vessel interactions • Use of standard maritime safety procedures • 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. Display of appropriate navigational beacons and lights, radar watch, radio contact • In-water equipment lost will be recovered (where possible). Detailed records will be maintained of equipment lost overboard • Recreational fishing from the survey and support vessels will be prohibited	
	Interaction with shipping	Disruption to shipping activities	• Adherence to the requirements of the Navigation Act 1912, and specifically Marine Orders - Part 30: Prevention of collisions • Adherence to the requirements of COLREGS • Consultation with AMSA prior to the survey commencing to determine the level of commercial shipping in the vicinity of the operational area • Support Vessels Procedures • Vessel Back Deck Operations – Deployment and Recovery of Cables • Vessel Back Deck Operations – Cable Maintenance Using the Workboat • Vessel Collision, Grounding, Hull Damage Procedures • Use of a support vessel to manage vessel interactions • Use of standard maritime safety procedures • Compliance with AMSA administered marine safety regulations and marine notification requirements • Strict adherence to equipment handling and acquisition procedures • Shipping alerted of vessels presence and extent of towed array. Establishment of a	Low

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
			vessel exclusion zone around the survey vessel. Display of appropriate navigational beacons and lights, radar watch, radio contact • In-water equipment lost will be recovered (where possible). Detailed records will be maintained of equipment lost overboard • Seismic acquisition will only occur outside areas with substantial vessel movements (e.g. recognised shipping routes)	
	Interaction with defence activities	Disruption to aircraft participating in defence activities within the Learmonth Airspace	• Consultation with Department of Defence prior to the survey commencing to determine if there are any planned activities within the Learmonth Airspace that will coincide with the survey and proposed helicopter movements from Learmonth airport • Department of Defence will be advised of any aviation activity 2 -3 weeks prior to their commencement.	Low
	Interaction with existing oil and gas activity	Disruption to activities of existing oil and gas activities Potential collision risk of vessels Equipment damage (seismic cables)	• Adherence to the requirements of the Navigation Act 1912, and specifically Marine Orders - Part 30: Prevention of collisions • Adherence to the requirements of COLREGS • Support Vessels Procedures • Vessel Back Deck Operations – Deployment and Recovery of Cables • Vessel Back Deck Operations – Cable Maintenance Using the Workboat • Vessel Collision, Grounding, Hull Damage Procedures • Use of a support vessel to manage vessel interactions • Use of standard maritime safety procedures • Compliance with AMSA administered marine safety regulations and marine notification requirements • Strict adherence to equipment handling and acquisition procedures • Establishment of a vessel exclusion zone around the survey vessel. • Display of appropriate navigational beacons and lights, radar watch, radio contact • In-water equipment lost will be recovered (where possible). Detailed records will be maintained of equipment lost overboard • Consultation with oil and gas operators active within the operational area to determine further potential control measures.	Medium

Impact category	Environmental aspect	Potential environmental impacts	Management controls	Residual Risk
	Interaction with tourism	Disruption to recreational activities (e.g. fishing)	• Adherence to the requirements of the Navigation Act 1912, and specifically Marine Orders - Part 30: Prevention of collisions • Adherence to the requirements of COLREGS • Support Vessels Procedures • Vessel Back Deck Operations – Deployment and Recovery of Cables • Vessel Back Deck Operations – Cable Maintenance Using the Workboat • Vessel Collision, Grounding, Hull Damage Procedures • Use of a support vessel to manage vessel interactions • Use of standard maritime safety procedures • 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. Display of appropriate navigational beacons and lights, radar watch, radio contact • In-water equipment lost will be recovered (where possible). Detailed records will be maintained of equipment lost overboard • Recreational fishing from the survey and support vessels will be prohibited • Consultation with relevant representative bodies	Low
Disturbance to heritage and conservation values	Operation of vessels within protected and heritage areas	Disturbance to heritage and conservation values	• Implementation of the performance objectives, standards and measurement criteria described in this EP • Ensuring that all contractor personnel are aware of and comply with the accepted EP	Low

6 MANAGEMENT APPROACH

The HZ-13 MC3D MSS will be managed in compliance with the EP as accepted by NOPSEMA under the Environment Regulations, other relevant environmental legislation and TGS's corporate policies. The objective of the EP is to ensure that potential adverse impacts on the environment associated with the HZ-13 MC3D MSS, during both routine and non-routine operations, are identified, and will be reduced to ALARP and will be of an acceptable level.

The design and execution of the HZ-13 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 HSE&Q Management System. The seismic programme will be supported by a project-specific HSE Plan (that includes Emergency Response (ER) procedures), the survey vessel operator's Emergency Response Procedures, 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.

The EP includes specific performance objectives and standards, and identifies the key controls and mitigation measures (**Table 3**) to be implemented to achieve the performance objectives. These various commitments are communicated to all personnel involved in the HZ-13 MC3D MSS. The implementation strategy detailed in the EP identifies the roles/responsibilities and competency/training requirements for all personnel (TGS and contractors) in relation to implementing controls, managing non-conformance, emergency response and meeting reporting requirements during the survey. The EP also details the types of auditing that will be undertaken and the reporting requirements for environmental incidents, and reporting for overall compliance of the MSS.

The vessel master(s) will be responsible for the day to day operation of the survey vessel, including any potential emergency situation. In the event of a fuel or oil spill to sea, the vessel Shipboard Oil Pollution Emergency Plan (SOPEP) will be activated, supported as required by applicable established, statutory (WA State and Commonwealth) Oil Spill Contingency Plans.

7 CONSULTATION

Consultation with stakeholder groups, primarily within the commercial fishing industry, concerning TGS's proposed HZ-13 MC3D MSS began on the 10th June 2013. In total, 38 organisations were contacted, in addition to all licence holders of identified State fisheries.

TGS received feedback on the proposed activity from a range of stakeholders, including government agencies and commercial fisheries. During the consultation process, where stakeholders have raised queries, TGS has conducted additional meetings and provided additional information in response to the stakeholder queries. The consultation process has allowed for the development of a communication and engagement strategy for each relevant stakeholder through which TGS will maintain communication with identified stakeholders to ensure they are informed of relevant aspects of the survey or changes that may affect them.

7.1 Pre-survey consultation

Prior to commencement of the survey, TGS 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 HZ-13 MC3D operational area. The primary objective of this consultation will be to ascertain if there are any other seismic surveys proposed for areas adjacent to the survey area, over the same time period. In addition, Notices to Mariners covering survey activities will be issued via the Australian Hydrographic Service (notified 14 days prior to activity commencing).

8 CONTACT DETAILS

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