

# Summary Environmental Plan

Wavefield-Inseis Australia Pty Ltd

Warramunga 3D Seismic Survey

February 2009

## Introduction

Wavefield Inseis is proposing to undertake a three-dimensional (3D) seismic survey in Commonwealth waters offshore of Western Australia, approximately 74 km north west of the town of Exmouth. The Warramunga 3D Seismic Survey (hereafter referred to as 'the survey') will run for a period of 140 days from March 2009 to October 2009 over an area of 7,416 km<sup>2</sup>. The start and end times are principally driven by the availability of the vessel, the progress of the preceding surveys, and weather conditions. A specialised survey vessel, the MV Geowave Voyager, will undertake the survey.

The survey is located well offshore of the Pilbara Coast, northwest Western Australia, in the Indian Ocean. The nearest point of the mainland is the eastern side of the Exmouth peninsula, approximately 60 km southeast of the southeastern boundary of the survey area, and the nearest town is Exmouth, a further 13 km southeast. Wavefield Inseis propose to acquire 3D seismic data over an area of approximately 7,416 km<sup>2</sup>. The specific coordinates defining the boundaries of the survey area are given below.

The seismic program is scheduled to run for 140 days (70 of which are weather standby and technical downtime days) within the period March 2009 to October 2009. The precise timing of the survey is dependent on both the availability of the vessel and weather conditions. Seismic data will be acquired for approximately 50% of the time the vessel is at sea, the remaining time will be for line changes, weather standby and crew changes. During the survey time, survey operations will be conducted 24 hours a day.

Marine seismic surveys are undertaken to map the subsurface geology of an area and enable identification of potential petroleum reservoir rocks, such as sandstones. The survey will be conducted with a specialised vessel, the MV Geowave Voyager, using an acoustic source to produce acoustic pulses and hydrophone detectors to record the reflected energy impulses.

The acoustic source will consist of 28 Bolt LL airguns of up to 4,100 cubic inch capacity, operating alternately at approximately 9-second intervals. The source generates a pressure wave pulse that travels as a seismic signal down through the geological layers where it is reflected back and recorded by hydrophones. McCauley et al. (2000) undertook experiments using a 2,678 cubic inch array, and found at distances of 1km, 3km and 10km sound exposure levels would be 160 dB re 1Pa<sup>2</sup>.s, 145 dB re 1Pa<sup>2</sup>.s, and 125 dB re 1Pa<sup>2</sup>.s respectively. McCauley also found that these levels vary depending on the sound propagation characteristics of the area, such as water depth and seabed features, and decrease logarithmically with distance from the source (McCauley, 1994). As the acoustic source for the survey will have a larger array, sound exposure levels are expected to be greater than those recorded by McCauley.

The airguns will be towed at a depth of five to six metres. The vessel will move slowly at approximately 4.5 to 5 knots emitting short pulsed (less than 200 milliseconds low frequency (most spectral energy less than 500 Hz ) shots every nine seconds. A single hydrophone cable streamer will detect the reflected acoustic signals. The streamer will be approximately 7500 m long detecting 6,400 channels of acoustic reflection data along pre-determined survey transects. The direction of

the survey lines will facilitate data interpretation, taking into account sub surface geological features such as fault lines. The hydrophone cable streamers will travel approximately seven metres below the sea surface and be controlled by mechanical devices called 'birds' to maintain the travel depth, and prevent the equipment from making contact with the seabed.

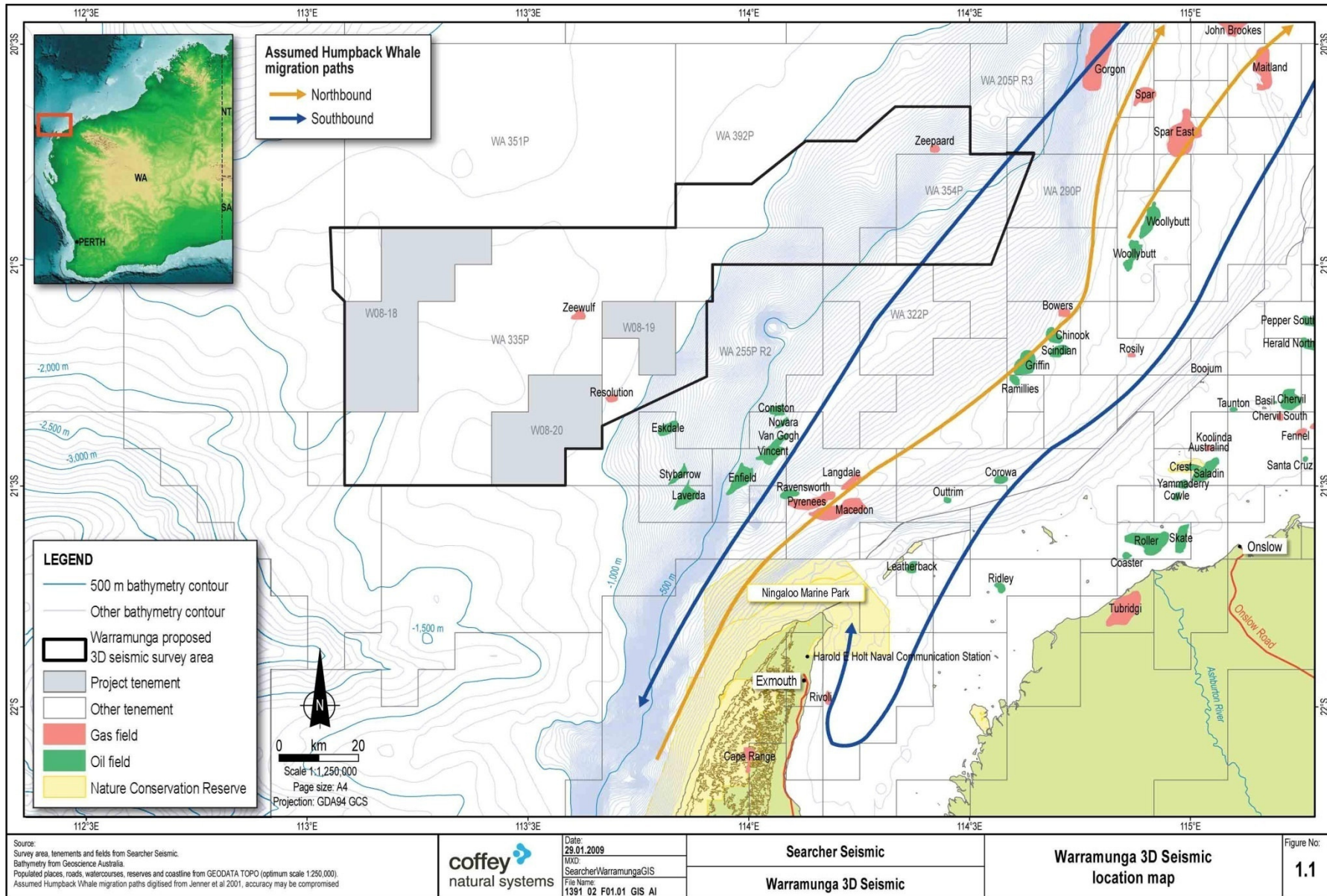
The survey lines will be acquired as a sparse grid, spaced 500 m apart. The average line length is approximately 83 km and the reflected seismic data will be recorded onboard the vessel on magnetic tape, which will be processed later onshore.

The vessel will be required to turn outside of the proposed survey areas at the completion of each transect pass, due to the required turning circle of the vessel with cables in tow and the need to obtain full seismic coverage of the survey areas.

Mobilisation will be from Dampier Port. Operational supply will occur from Dampier Port. The vessel will operate with 35-day crew changes via helicopter. Helicopter support will be provided by Bristow Helicopters, based out of Barrow Island. Wavefield Inseis personnel (including contractors) will adhere to Bristow and Barrow Island's policies and procedures during personnel transfer, and stringent quarantine procedures will be applied due to the Marine Park and Marine Management Area status of the island, in order to avoid introducing environmental risks. The main concern of helicopter use on Barrow Island is disturbance of nesting seabird colonies. Helicopter operations and access to Barrow Island will observe the Management Plan for the Montebello/Barrow Islands Marine Conservation Reserves 2007-2017 (DEC, 2007).

The specifications of the proposed seismic survey vessel, the MV Geowave Voyager, are listed in Table 4.3 below. At least one support vessel will provide port calls and supply deliveries to the seismic vessel, with an additional smaller vessel used for scouting for potential hazards, streamer cable maintenance and minor logistics. The support vessels are likely to be Australian, however, if foreign vessels are used, Wavefield Inseis will ensure that each vessel complies with all Australian Quarantine Inspection Service (AQIS) requirements, including quarantine inspections.

Due to the relatively long duration of the survey, vessel refuelling is required and will be performed at sea on at least two occasions.



## Coordinates of Survey

### Boundary coordinates of the Warramunga 3-D seismic survey area

Location Point	Decimal Coordinates (WGS 84)	
	Latitude	Longitude
Warramunga 3D seismic survey area.	-20.915278	113.084722
	-20.915278	113.834722
	-20.872649	113.834722
	-20.872649	114.023793
	-20.775518	114.023793
	-20.641325	114.15543
	-20.641325	114.501389
	-20.748611	114.501389
	-20.748611	114.645833
	-20.998611	114.549063
	-20.998611	113.918056
	-21.081944	113.918056
	-21.081944	113.905
	-21.252223	113.905
	-21.363889	113.668056
	-21.415278	113.668056
	-21.415278	113.584722
	-21.498611	113.584722
	-21.498611	113.084722
	-20.918056	113.084722
-20.915278	113.084722	

## Receiving Environment

The survey area is located in a Commonwealth marine area on the northern portion of Australia's western continental shelf – the northwest shelf. The water depth in the survey area ranges from 300 m to 1,500 m. The survey area is on the western corner of the Exmouth Plateau. Beyond the western edge of Exmouth Plateau is the Gascoyne Abyssal Plain. The seabed is generally devoid of small-scale features such as reef build-ups and narrow canyons.

## Benthic Species

### General

Due to the entire survey being proposed for deep water (i.e., in water depths greater than 100 m), the benthic assemblages in the survey area are expected to comprise predominantly soft-bottom infauna communities. However, information on the deeper waters of the northwest shelf and the Exmouth Plateau is scant.

Some of the more important factors determining the diversity and abundance of species in the benthic environment are the substrate of the ocean floor, the frequency and amplitude of wave action, and current direction, speed and depth (Living Planet Analysis, 1993).

### Infauna

Generally there is lower energy in deeper water that can disturb sediments, which are usually finer grained sands and silts with varying proportions of mud and shell fragments. This creates habitats suitable for burrowing organisms, particularly polychaete worms and smaller crustaceans. These areas are likely to be colonised by deep-water filter feeding organisms, such as soft corals, gorgonians, bryozoans, hydroids and sponges.

### Coral reefs

Coral reefs and coral-dominated benthic communities are common in rocky shallow water areas. The most common morphology of these reefs is a fringing formation adjacent to mainland rocky shores of emergent islands. The nearest coral reefs occur along the Ningaloo Reef tract, which is located 50 km to the southeast of the survey area and extends approximately 300 km further southward along the North West Cape. The Ningaloo Reef is Australia's major fringing reef system and is managed as a Marine Park. Detailed taxonomic surveys on shallow water coral reefs in the region typically report high biodiversity and fine-scale habitat complexity (Berry, 1993 in Heyward, et al. 2000). Coral spawning peaks between March and April and usually occurs 7 to 10 nights after the full moon.

The water depth within the survey area, 300 m to 1,500 m, precludes any significant habitat for coral. Coral reefs generally will not develop in water that is deeper than 50 m to 70 m, as reduced light availability limits photosynthesis.

### Marine Fauna

Tropical marine fauna of northwestern Australia has been noted as being remarkably uniform with the majority of species having a wide distribution across the Indo-West Pacific Region (Wilson and Poore, 1987). A coordinate search of the EPBC Act protected matters search tool, using the

coordinates listed in Table 4.1 plus a 5 km buffer, identified a total of 62 species of marine fauna that are protected under the EPBC Act, including 8 threatened species and 11 migratory species (DEWHA, 2009a). Further information on each major group of marine fauna is discussed below.

The proposed survey area is not situated in habitat that is critical to the survival of any listed species. Similarly there are no listed threatened ecological communities, as defined in the EPBC Act, in the vicinity of the survey area. There are some listed threatened species and listed migratory species that may be found within the region of the survey area. These species are likely to be transient through the permit area. The proposed survey will be planned to avoid cetacean annual migrations paths.

### Marine Reptiles

The seas of tropical Australia support a rich diversity of sea snake fauna with a strong endemic component, and have greater species diversity than any other region. Of the world total of approximately 55 species, 31 species are recorded in tropical Australia, and nearly 50% of these are endemic (GBRMPA, 2009). In all, 16 species have been recorded on the northwest shelf and surrounding regions with another seven presumed to occur.

Sea snakes are air-breathing reptiles, and most have shallow, benthic feeding patterns. Observations indicate that most sea snakes are found in depths rarely exceeding 30 m (Cogger, 1975). Some species are known to dive deeper than this, but non-pelagic species seldom, if ever, dive deeper than 100 m (Heatwole and Seymour, 1975).

The only known pelagic species is *Pelamis platurus*, which inhabits open water and is the only species known to feed at the surface. Consequently, they are not restricted to continental shelves or other shallow waters (Heatwole and Seymour, 1975). The most common foraging strategy employed by sea snakes is 'crevice foraging', followed by 'bottom cruising' (Heatwole, 1987).

Whilst sea snakes may be present in the seismic survey area, the water depth and lack of suitable habitat would preclude the majority of species.

A search of the DEWHA EPBC Act Database (DEWHA, 2008b) found 13 species of sea snake that have the potential to occur within the survey area. The 13 listed species of sea snake in the table below are widely distributed and given the water depth and lack of suitable habitat, it is highly unlikely that these species will be impacted by the survey. The seismic survey is not likely to have any lasting effects upon any local populations of these species, and does not involve any process that threatens the species or any significant populations of the species.

### Marine reptiles of national significance that may occur in the survey area

Category	Species	Common Name	Status
Sea snake	<i>Aipysurus laevis</i>	Olive Sea snake	L
	<i>Disteira kingii</i>	Spectacled Sea snake	L
	<i>Disteira major</i>	Olive-headed Sea snake	L
	<i>Ephalophis greyi</i>	North-western Mangrove Sea snake	L
	<i>Hydrophis elegans</i>	Elegant Sea snake	L
	<i>Pelamis platurus</i>	Yellow-bellied Sea snake	L
	<i>Emydocephalus annulatus</i>	Turtle-headed Sea snake	L
	<i>Hyophysis czeblukovi</i>	Fine-spined Sea snake	L
	<i>Acalyptophis peronii</i>	Horned Sea snake	L
	<i>Aipysurus apraefrontalis</i>	Short-nosed Sea snake	L
	<i>Aipysurus duboisii</i>	Dubois' Sea snake	L
	<i>Aipysurus eydouxii</i>	Spine-tailed Sea snake	L
	<i>Astrotia stokesii</i>	Stokes' Sea snake	L
Marine turtle	<i>Chelonia mydas</i>	Green Turtle	V, L
	<i>Dermochelys coriacea</i>	Leathery Turtle, Leatherback Turtle	E, L
	<i>Natator depressus</i>	Flatback Turtle	V, L

Key: V-vulnerable; E-endangered; L-listed.

NB: Consistent with a conservative approach, the EPBC Act Database search was performed using an additional 5 km buffer around the perimeter of the proposed survey area.

A search of the DEWHA EPBC Act Database found three species of marine turtle that have the potential to occur within the survey area – the green turtle, the leatherback (or leathery) turtle and the flatback turtle. Under the Commonwealth EPBC Act the green, leatherback and flatback turtles are listed as vulnerable. The green turtle is also listed under the Bonn Convention.

The distribution, abundance and activity of turtles vary widely across the northwest shelf and among the different species. For example, green turtles are herbivores and therefore concentrate over depths that support benthic plant life (less than 20 m deep). In contrast, flatback and leathery turtles are known to feed on mid-water plankton and benthic animals, and can forage in mid-shelf water depths (up to about 50 m). The regional sea turtle population is estimated to be over 49,000 animals.

Turtles are oceanic except at nesting time when they come ashore. The nesting season (depending on species) occurs generally from September to March (Pendoley, 2005). The timing of the proposed survey overlaps two of the five months in the turtle nesting season, with the nearest known turtle rookeries located on the Muiron Islands and the Exmouth Peninsula/Ningaloo Reef (predominantly on the western side), approximately 65 km and 50 km from the proposed survey area respectively.

Given the distance of the survey from turtle rookeries, it is unlikely that there will be any significant impacts to turtles associated with running this survey during the turtle nesting period. Possible interactions may occur with turtles transiting through the survey area or foraging for food within it. However it is unlikely such interactions will significantly impact turtles. McCauley et al, (2000) showed sea turtles actively avoid and move away from acoustic emissions. This avoidance response



is likely to preclude them from any impacts resulting from acoustic emissions associated with the seismic survey.

## Cetaceans

Based on a search of the DEWHA EPBC Act Database (DEWHA, 2008b), cetaceans of national significance that may be encountered within the survey area are listed below.

### Cetaceans of national significance that may occur in the survey area

Category	Species	Common Name	Status
Cetacean	<i>Balaenoptera musculus</i>	Blue Whale	E, M, C
	<i>Eubalaena australis</i>	Southern Right Whale	E, M, C
	<i>Megaptera novaeangliae</i>	Humpback Whale	V, M, C
	<i>Balaenoptera bonaerensis</i>	Antarctic Minke Whale, Dark-shoulder Minke Whale	M, C
	<i>Balaenoptera edeni</i>	Bryde's Whale	M, C
	<i>Orcinus orca</i>	Killer Whale	M, C
	<i>Physeter macrocephalus</i>	Sperm Whale	M, C
	<i>Balaenoptera acutorostrata</i>	Minke Whale	C
	<i>Feresa attenuata</i>	Pygmy Killer Whale	C
	<i>Globicephala macrorhynchus</i>	Short-finned Pilot Whale	C
	<i>Indopacetus pacificus</i>	Longman's Beaked Whale	C
	<i>Peponocephala electra</i>	<i>Melon-headed Whale</i>	C
	<i>Mesoplodon ginkgodens</i>	<i>Ginkgo-toothed Beaked Whale</i>	C
	<i>Kogia breviceps</i>	<i>Pygmy Sperm Whale</i>	C
	<i>Kogia simus</i>	<i>Dwarf Sperm Whale</i>	C

### Cetaceans of national significance that may occur in the survey area (cont'd)

Category	Species	Common Name	Status
Cetacean (cont'd)	<i>Mesoplodon densirostris</i>	Blainville's Beaked Whale, Dense-beaked Whale	C
	<i>Ziphius cavirostris</i>	Cuvier's Beaked Whale, Goose-beaked Whale	C
	<i>Pseudorca crassidens</i>	False Killer Whale	C
	<i>Delphinus delphis</i>	Common Dolphin	C
	<i>Stenella coeruleoalba</i>	Striped Dolphin	C
	<i>Stenella attenuata</i>	Spotted Dolphin	C
	<i>Lagenodelphis hosei</i>	Fraser's Dolphin	C
	<i>Steno bredanensis</i>	Rough-toothed Dolphin	C
	<i>Stenella longirostris</i>	Long-snouted Spinner Dolphin	C
	<i>Grampus griseus</i>	Risso's Dolphin	C
	<i>Tursiops truncatus s. str.</i>	Bottlenose Dolphin	C

Key: E-endangered; V-vulnerable; M-migratory; L-listed; C-Cetacean.

NB: Consistent with a conservative approach, the EPBC Act Database search was performed using an additional 5 km buffer around the perimeter of the proposed survey area.

Blue whales are the largest living mammals, and are listed as an endangered migratory species under the EPBC Act, as well as listed on the IUCN red-list of threatened species. Blue whales may be present in the seismic survey area during the Austral winter as a result of migration. Blue whales

have extensive migration patterns that are not known to follow any particular coastlines or oceanographic features (Bannister et al., 1996). During summer to autumn, true blue whales feed mainly, if not exclusively, in the Antarctic. There are currently no identified breeding grounds for blue whales in the Southern Hemisphere. The temperate feeding areas off Rottnest Island and in the Bonney Coast upwelling region are the only areas so far identified off the Australian coast where blue whales aggregate with some predictability. These areas are 1,175 km south and 3,200 km southeast of the survey area. No specific migration routes have been identified in the Australasian region. The likelihood of encounters with blue whales is extremely low.

Southern right whales are seasonally present on the Australian coast from about mid-May to mid-November, as they migrate between higher latitudes and mid latitudes. They are principally found around the southern coastline off southern Western Australia and far west South Australia, between Perth and Sydney (Bannister, 1979–2000). Sightings in more northern waters are rare. There have been some records from Exmouth, approximately 74 km south east of the survey area, however, this is considered the northern extent of this species. Major calving areas are located in Western Australia at Doubtful Island Bay and east of Israelite Bay, located 1,540 and 1,680 km southeast of the survey area (Bannister, 1990). The distribution of Southern Right Whales in Australian waters other than near to the coast is unknown. The likelihood of encounters with southern right whales is low.

The humpback whale is listed as a vulnerable migratory species under the EPBC Act and is known to migrate between the Antarctic waters and the Kimberly region of Western Australia. The peak of the northerly migration occurs around mid June to late July, while the southerly return migration peaks around late August to early September, with a peak of cow and calf pairs occurring in early to mid October (DoIR, 2003). The migratory whale route, where most whales are observed, occurs in deep waters, passing to the west and north of Serrurier Island, westward of Barrow Island and north of the Montebello Islands (Woodside, 2002). Humpback whales complete the northern migration in the Camden Sound area of the West Kimberley, approximately 700 km northeast of the seismic survey area. The Exmouth Gulf, 50 km southeast of the survey area, is a known resting area for calves (DoIR, 2003). Humpback whales tend to migrate in water depths of 20 m to 500 m with the majority of whales within the 50 m to 200 m isobaths based on DEWHA whale sighting reports over recent years (see Figure 1.1 water depth). The survey area is located in water depths between 300 m to 1,500 m, and will be conducted over 140 days between March and October 2009, with the second half of the survey (June to October) coinciding with the humpback whale migratory period and the eastern, shallower portion of the survey area overlapping the main migratory routes. To avoid interaction with the migrating whales, the survey program will be scheduled such that all seismic work on the shallower, eastern portion of the survey area is conducted outside of known humpback whale migration periods (June through to October). During the humpback whale migration period, survey work will be concentrated to the western portion of the survey area.

Sperm whales, while not listed as threatened in the EPBC protected matters search, are found in offshore pelagic waters. Sperm whales have been recorded from all Australian states (Bannister et al., 1996); however, the key localities for the sperm whale are between Cape Leeuwin and Esperance, Western Australia, close to edge of continental shelf (averaging 20 to 30 nautical miles offshore), south-west of Kangaroo Island, South Australia, off the Tasmanian west and south coasts, off New South Wales, including Wollongong, and off Stradbroke Island, Queensland (Bannister et al.,

1996). The closest of these areas, Cape Leeuwin, is 1,400 km south of the survey area. Individual sperm whales may be present transiting through the survey area due to their preference for continental shelf drop offs and deeper water habitats.

Both the Antarctic minke whale and killer whale have worldwide distributions. Both species undertake extensive migrations between cold water feeding grounds and warmer water breeding grounds, however, are less predictable than most other whale species and possibly do not migrate as far into warm waters as some of the known true migrants. Both of these species have a greater preference for cooler waters (MWR, 2007).

Unlike the other listed species, the Bryde's whale is more cosmopolitan in nature and is distributed widely throughout tropical and subtropical waters preferring the warmer waters to polar waters. The Bryde's whale diet consists mostly of fish and consequently they are more often sighted in shallower waters (WDCS, 2007).

Wavefield Inseis has committed to the implementation of management measures for vessels conducting seismic surveys in Australian waters as specified in EPBC Act Policy Statement 2.1 – interaction between offshore seismic exploration and whales (Appendix 1). These require:

- Soft start procedures and signals between seismic lines (all acquisition sequences to commence with a series of shots with gradually increasing sound intensities to warn and allow time for wildlife to move away).
- Daylight observation by a trained observer (marine mammal observer (MMO)).
- An adaptive management framework requiring survey modification or postponement based on observed cetacean behaviours and/or minimum distance triggers.
- Recording of whale sightings.

### Seabirds

Avifauna of the survey area will comprise seabirds with the nearest significant nesting areas to the survey area located on the Muiron Islands and at Barrow and Montebello Islands approximately 65 km southeast and 70 km east of the survey area respectively. The seabird assemblage of the Montebello/Barrow islands region comprises at least 67 species, including 25 species of migratory shorebirds and 20 resident shorebirds (DEC, 2007).

The foraging range of seabirds is uncertain however it has been reported that the preferred feeding range of the wedge-tailed shearwaters is 40 km to 120 km from the nesting colonies on mid-shelf islands such as the Montebello–Lowendal–Barrow group (Astron Environmental Pty Ltd, 1997 in Heyward, et al. 2000).

A significant number of migratory birds that pass through the northwest shelf region are listed on one or both of the China Australia Migratory Bird Agreement (CAMBA) and Japan Australia Migratory Bird Agreement (JAMBA).

A search of the EPBC Act protected matters search tool identified two threatened bird species that may overfly the survey area - the endangered Southern Giant-Petrel (*Macronectes giganteus*) and the vulnerable Soft-plumaged Petrel (*Pterodroma mollis*). The Southern Giant-Petrel is a migratory species. The proposed survey is unlikely to impact on avian species for the following reasons:

- The distance of the survey from nesting sites and feeding grounds (nearest nesting site, the Muiron Islands, is approximately 65 km away).
- The nature of the work proposed (slow moving vessel towing a large streamer that will not incidentally snare birds).

## Fishes and Invertebrates

### General

In general, the fishes offshore of northwestern Australia are typical of the Indo-Pacific region. The seas encompassing northern Australia and the tropics are inhabited by a diverse assemblage of fish species (Allen, 1997). Official counts are lacking, but an estimated 4,000 species occur in the region, or about 30% of the world's total marine fishes (Allen, 1997). The dominant groups across this region usually include such families as gobies, wrasses, damselfishes, groupers, moray eels, cardinalfishes, and surgeonfishes (Allen, 1997).

### Invertebrates

The major groups of invertebrates that are likely to be present are shown in the table below (Kailola et al, 1993). However the majority of species listed are located in much shallower waters east of the survey area.

#### Invertebrates likely to be found near the survey area

Species	Common Name	Spawning Period	Habitat	Depth Range (m)
<i>Photololigo sp</i>	Inshore squid	All year	Neritic, Oceanic	less than 300
<i>Sepioteuthis lessoniana</i>	Northern calamari	All year	Neritic, Oceanic	less than 300
<i>Penaeus esculentus</i>	Tiger prawn	All year	Neritic, Reefs	0 to 200
<i>Haliporoides sibogae</i>	Royal red prawn	Summer to winter	Oceanic	greater than 230
<i>Penaeus monodon</i>	Giant tiger prawn	Spring and autumn	Neritic	less than 110
<i>Panulirus cygnus</i>	Western rock lobster	Winter to summer	Neritic, Reefs	1 to 200
<i>Panulirus ornatus</i>	Ornate rock lobster	Spring to autumn	Neritic, Reefs	1 to 200

Source: (Kailola et al, 1993).

### Oceanic Fishes

The major groups of oceanic fishes likely to be found near the survey area are shown in the table below (Kailola et al, 1993). However the majority of species listed are located in much shallower waters east of the permit areas.

A search of the DEWHA EPBC Act Database did not identify any fishes as there is no suitable habitat in the deeper waters where the seismic survey will take place.

#### Oceanic fishes

Common Name (species #)	Spawning Period	Habitat	Depth Range (m)
Dusky and bronze whalers	Summer	Neritic, oceanic	0 to 400

Dories (2)	Summer - winter (S)	Neritic, oceanic	5 to 800 (S)
Oreos (4)	Winter - spring (S)	Oceanic	200 to 1600 (S)
Sea mullet	Autumn - winter (L)	Neritic, freshwater, estuarine	Unknown
Skipjack tuna	All year	Neritic, oceanic	0 to 260
Albacore	Summer	Oceanic	50 to 500
Yellowfin tuna	All year (L)	Neritic, oceanic	0 to 250
Southern bluefin tuna	Spring - summer	Oceanic	Unknown
Bigeye tuna	Summer	Oceanic	150 to 250
Black marlin	Spring - summer	Neritic, oceanic	Unknown
Blue marlin	Summer	Oceanic	Unknown
Striped Marlin	Spring - summer	Oceanic	Unknown
Broadbill swordfish	Spring - summer	Oceanic	less than 600
Coral trout (3)	Spring - summer	Neritic, reefs	0 to 100
Rock cod (3)	All year	Estuarine, neritic, reefs	2 to 200
Westralian jewfish	Summer	Neritic, reefs	20 to 200
Mackerel (4)	Variable	Neritic	0 to 100
Sea perch (3)	Spring - autumn	Neritic, reefs	5 to 180

### Oceanic fishes

Common Name (species #)	Spawning Period	Habitat	Depth Range (m)
Tropical snappers (2)	Spring - summer (L)	Neritic	40 to 200
Emperors (4)	Variable (L,S)	Neritic, reefs	2 to 90
Snapper	Winter - summer(L)	Neritic, reefs	1 to 200
Sea mullet	Autumn - winter (L)	Neritic, freshwater, estuarine	Unknown
Tropical Sharks (2)	Summer	Neritic	less than 150

KEY: S = variation between species is known, L = variation between localities is known.

### Whale Sharks

Whale sharks are the largest living fish and can reach a length of 12 m. They feed on a wide variety of planktonic and nektonic prey, including small crustaceans, small schooling fishes, and occasionally on tuna and squid (Last and Stevens, 1994).

Whale sharks occur worldwide in tropical and temperate seas, near the coast and in the open oceans. They prefer waters with sea temperatures in the 21-25 °C range, in the vicinity of cold water upwellings, which provide favourable conditions for the whale sharks' prey. Their movements are thought to be related to local productivity and are often related to schools of pelagic fish (Last and Stevens, 1994).

Whale sharks are highly migratory and small aggregations occur near the coast of central Western Australia each autumn, particularly off Ningaloo Reef in March and April (Last and Stevens, 1994; Clark, 1992). Their occurrence at this time coincides with the coral mass spawning period, when there is an abundance of food (krill, planktonic larvae and schools of small fish) in the waters adjacent to the reef. The survey area is approximately 50 km northwest of Ningaloo Reef.

While a search of the DEWHA EPBC Act Database did not identify this species, individuals may potentially occur within the survey area. Whale sharks are listed as vulnerable under the EPBC Act. Should whale sharks be spotted the vessel will exercise the same avoidance procedures as for whales as per the DEWHA cetacean guidelines (DEWHA, 2008a).

## Environmental Hazard and Controls

### Risk assessment and proposed management measures

Source of Risk	Description of Potential Impacts on the Environment	Proposed Management Measures (see Table 8.1 reference for responsibility)	Consequence Severity Rating	Likelihood/Frequency	Risk Level
R1. Physical presence of vessel – interference with other users activities	Potential social impact on other users e.g. trailing gear collision, damage to fishing gear, etc.	<ul style="list-style-type: none"> <li>Advise Commonwealth Fisheries Industry of expected timing, and location of survey operations. Commonwealth Fisheries Association will inturn notify relevant commercial fishers, as will Wavefield Inseis (8.4.1.7).</li> <li>Advise AMSA of expected timing and location of survey operations. AMSA will inturn notify all mariners that a 5 km safety zone around the survey vessel exists (8.4.1.7).</li> <li>Recover any lost streamer sections if practicable (8.4.1.8). The recovery of streamers will not be practicable under the following circumstances: <ul style="list-style-type: none"> <li>- During periods of inclement weather and/or poor visibility.</li> <li>- If handling systems fail or if vessel power is lost.</li> </ul> </li> <li>Pressure-initiated buoyancy devices fitted to the streamers will facilitate the recovery of lost streamers.</li> <li>Wavefield Iseis will communicate with operators of petroleum facilities surrounding the survey area throughout survey operations notifying them of survey activities and giving them the opportunity to alert Wavefield Inseis of any activities they may be undertaking in the area.</li> </ul>	3	D	Moderate
R2. Physical presence of vessel- collision or grounding leading to large oil spill	Potential oiling of sea birds, fish tainting, shoreline pollution, disruption of fishing activities.	<ul style="list-style-type: none"> <li>Ship Collision Avoidance/ Grounding Procedures in Place (8.4.1.10).</li> <li>Oil spill contingency and Emergency Response Plans in place (8.4.4.6).</li> <li>Crew awareness and exercises in oil spill/emergency response (8.4.4.3; 8.4.4.7).</li> <li>Reporting of spills greater than80L (8.4.4.8).</li> <li>Incident investigation &amp; monitoring requirements (8.4.4.1; 8.4.4.4).</li> </ul>	3	E	Moderate
R3. Quarantine failure - ballast water and hull bio-fouling	Potential to Introduce exotic marine pests and/or diseases.	<ul style="list-style-type: none"> <li>Prior to departure from Singapore check AQIS requirements have been met including and anti-fouling certification (8.4.1.12).</li> <li>Check and maintain ballast water records on vessel.</li> <li>Ensure new equipment has cleared AQIS quarantine inspections.</li> </ul>	3	D	Moderate

### Risk assessment and proposed management measures (cont'd)

Source of Risk	Description of Potential Impacts on the Environment	Proposed Management Measures (see Table 8.1 reference for responsibility)	Consequence Severity Rating	Likelihood/Frequency	Risk Level
R4. Chemical storage failure	Toxic effects on marine life including fish, plankton, benthos, marine mammals and turtles.	<ul style="list-style-type: none"> <li>• Secure containment areas for oils and chemicals (8.4.2.6 and 8.4.2.13).</li> <li>• Focus on chemical storage as part of Wavefield Inseis marine audit.</li> <li>• Use of appropriate materials, e.g., absorbents, for cleanup (8.4.4.5).</li> <li>• Use of drip trays whilst decanting (8.4.4.2).</li> <li>• Cleanup of spills as soon as practicable(8.4.4.10). All attempts will be made to clean up spills immediately, however this may not be practicable under the following circumstances:               <ul style="list-style-type: none"> <li>- During periods of inclement weather and /or poor visibility.</li> <li>- If handling systems fail or if vessel power is lost.</li> <li>- During periods of poor /restricted vessel manoeuvrability.</li> </ul> </li> </ul>	3	E	Moderate
R5. Waste Streams – poor disposal of waste (including sewage and food scraps discharge)	Increased nutrient availability, increased BOD, potential toxic effects on marine life.	<ul style="list-style-type: none"> <li>• Compliance with MARPOL and all laws and regulations. (8.4.1.1; 8.4.2.1).</li> <li>• Wastes that cannot be disposed of at sea (as per MARPOL requirements) will` be segregated labelled and stored in secure areas prior to removal to the shore for appropriate disposal (8.4.2.6; 8.4.2.3; 8.4.2.2; 8.4.2.4).</li> <li>• Personnel will be trained to ensure compliance with the waste management requirements (8.4.2.10).</li> <li>• Treated effluent and food scraps to be disposed in accordance with MARPOL (8.4.1.1).</li> <li>• Dry waste will be managed to prevent contamination of the sea, e.g. skips covered. (8.4.2.5).</li> <li>• Wastes disposed to approved sites onshore (8.4.2.7).</li> <li>• Minimize quantities of waste generated (8.4.2.8).</li> <li>• Bilge water discharged via oily-water separator (8.4.2.11).</li> <li>• Oily water separator will be inspected on Wavefield Inseis audit (8.4.2.11).</li> </ul>	2	D	Low



**Risk assessment and proposed management measures (cont'd)**

Source of Risk	Description of Potential Impacts on the Environment	Proposed Management Measures	Consequence Severity Rating	Likelihood/Frequency	Risk Level
R6. Seismic acquisition – acoustic disturbance	Acoustic disturbance to marine fauna.	<ul style="list-style-type: none"> <li>• Comply with EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales standard management procedures (8.4.1.3) and Appendix 1.</li> <li>• Crew members trained and experienced in whale observation, distance estimation and reporting will be on deck at all times while the seismic recording is being carried out. All whale sightings will be recorded within the DEWHA 'Cetacean Sightings Application' software, and reported, on completion of the survey, to DEWHA (8.4.1.3) and Appendix 1.</li> <li>• The survey is mostly outside main humpback whale migration season, and known breeding areas (see Section 4).</li> <li>• During known humpback migration periods (June to October) survey activity will be concentrated in the western portion of the survey area away from the known migration routes.</li> <li>• Consultation with fishing industry (8.4.1.7).</li> <li>• Distance of permit from sensitive habitat (see Section 4).</li> </ul>	1	C	Low

### Risk assessment and proposed management measures (cont'd)

Source of Risk	Description of Potential Impacts on the Environment	Proposed Management Measures	Consequence Severity Rating	Likelihood/Frequency	Risk Level
R7. Operational handling failure of hazardous materials	Toxic effects on marine life including fish, plankton, benthos, marine mammals and turtles if inadvertently released to sea.	<ul style="list-style-type: none"> <li>• Areas for storage and use of chemicals and dangerous liquids to be contained (8.4.2.3).</li> <li>• MSDS's available for all hazardous materials` (8.4.2.9).</li> <li>• Appropriate materials to be used in the event of a spill eg absorbents (8.4.4.9).</li> <li>• Training of personnel in safe handling procedures (8.4.2.10).</li> <li>• Wavefield Inseis will adopt the following procedures to minimise the potential for spillage during vessel-to-vessel fuel transfer:               <ul style="list-style-type: none"> <li>- A stand-by observer will be present for the entire fuel transfer procedure.</li> <li>- Refuelling will only be conducted in daylight hours and in an acceptable sea state.</li> <li>- Hoses used for fuel transfer will have 'dry-break' coupling fittings.</li> <li>- Prior to fuel transfer, the skipper of the vessel to be refuelled (the survey vessel) and the skipper of the refuelling vessel must both agree that refuelling can go ahead.</li> </ul> </li> <li>• Cleanup of oil or fuel spills as soon as practicable. All attempts will be made to clean up spills immediately.</li> <li>• Chemical storage and handling to be a focus area of the Wavefield Inseis marine audit.</li> </ul>	3	E	Moderate
R8. Damage to vessel due to cyclone resulting in spill of hydrocarbons or other hazardous substances.	Toxic effects on marine life including fish, plankton, benthos, marine mammals and turtles if inadvertently released to sea.	<ul style="list-style-type: none"> <li>• Party Chief and the master of the vessel will obtain at least daily weather reports, more frequently if a cyclone warning has been issued.</li> <li>• Seismic vessel will undertake all required cyclone avoidance procedures, maintaining a distance of at least 400 km from the cyclone.</li> <li>• In the prior to the onset of heavy weather, all chemical and hazardous goods storage areas will be inspected to ensure that all containers are properly stowed.</li> </ul>	3	E	Moderate

## Management Approach

The primary goals of the implementation strategy are to direct, review and manage the operations so that environmental effects and risks are continually reduced to as low as reasonably practical, performance objectives and standards are met for the duration of the activity, and no reportable incidents occur.

The key responsibilities for Environmental Management are as follows:

- The Wavefield Inseis Managing Director is responsible and accountable to the Wavefield Inseis Board for ensuring that appropriate resources are allocated to meet Wavefield Inseis Health, Safety, Security and Environmental Protection Policy requirements; and establishing and regularly reviewing the policy (see Section 2).
- The Party Chief is responsible and accountable for implementing the Health, Safety, Security and Environmental Protection Policy within the operational area, through application of the Environment Plan.
- The MV Geowaver Voyager Master and Party Chief are responsible for implementing this plan.
- The MV Geowaver Voyager Master, Party Chief and Marine Mammal Observer are responsible for implementing the Cetacean Guidelines.
- All project personnel including Wavefield Inseis personnel and third party contractors are responsible and accountable to adhering to the Environmental Policy and this Environment Plan in all tasks that they undertake.

Responsibilities and accountabilities for each position within the Company are documented to avoid confusion over responsibilities and accountabilities.

This EP is a controlled document and may be revised from time to time prior to the start of, or even during, data acquisition. A distribution list ensures that all personnel who have responsibilities do have access to the necessary information to ensure compliance with the EP.

## Consultation

Wavefield Inseis has initiated an ongoing stakeholder consultation program as part of its planning for the proposed survey. The program commenced in October 2008 and is planned to continue for the duration of the proposed survey.

### Wavefield Inseis' stakeholder consultation program

Date	Stakeholder Group	Contact	Issue	Action	Ongoing Consultation
21/11/2008	Australian Fisheries Management Authority (AFMA).	Melissa Brown and Peter Neave	Informing relevant commercial fisheries of proposed survey area and timing of survey	Overview of planned survey activity sent to AFMA	Yes. AFMA will be informed of any changes to the planned survey activity.
21/11/2008	Australian Custom Service – Border Patrol.	Not specified.	Informing border patrol of proposed survey area and timing of survey.	Overview of planned survey activity sent to Australian Custom Service (Border Patrol).	Yes. Australian Custom Service (Border Patrol) will be informed of any changes to the planned survey activity.
21/11/2008	Commonwealth Fisheries Association.	Peter Franklin.	Informing relevant commercial fisheries of proposed survey area and timing of survey.	Overview of planned survey activity sent to Commonwealth Fisheries Association.	Yes. Commonwealth Fisheries Association will be informed of any changes to the planned survey activity.
21/11/2008	Australian Custom Service.	Mark Bailey.	Informing Australian Customs of proposed survey area and timing of survey.	Overview of planned survey activity sent to Australian Custom Service.	Yes. Australian Custom Service will be informed of any changes to the planned survey activity.
21/11/2008	Newfish.	S. Valentine.	Informing Austral Fisheries Pty Ltd of proposed survey area and timing of survey.	Overview of planned survey activity sent to Austral Fisheries Pty Ltd.	Yes. Austral Fisheries Pty Ltd will be informed of any changes to the planned survey activity.
21/11/2008	Royal Australian Air Force (RAAF).	Not Specified.	Informing RAAF of proposed survey area and timing of	Email sent to RAAF to inform RAAF of proposed survey	Yes. RAAF will be informed of any changes to the planned survey

			survey.	operations.	activity.
21/11/2008	Western Australian Seafoods.	Not Specified.	Informing local commercial fishers of proposed survey area and timing of survey.	Overview of planned survey activity sent to WA seafoods.	No.
21/11/2008	Western Australian Fisheries industry Council (WAFIC).	Not Specified	Informing local commercial fishers of proposed survey area and timing of survey.	Overview of planned survey activity sent to WAFIC.	Yes. WAFIC will be informed of any changes to the planned survey activity.

One of the primary aims of this consultation program is to mitigate any potential impacts associated with the presence of the survey operation – interference with other users activities and collision or grounding leading to large oil spill.

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