timor leste

GEOSTREAMER® TRIAL 2D SEISMIC SURVEY ENVIRONMENTAL MANAGEMENT PLAN

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Document Title

Eni Timor Leste

GeoStreamer® Trial 2D Seismic Survey Environmental Management Plan

Abstract:

Eni Timor Leste S.p.A (Eni) plans to undertake a two-dimensional (2D) Seismic Survey in Production Sharing Contract (PSC) Blocks S06-01 (A), S06-02 (B) and S06-03 (C) in the Timor Sea off the south coast of Timor-Leste. This Draft Environmental Management Plan (EMP) is submitted to the Government of Timor-Leste, through the National Directorate of Environment (DNMA), in accordance with the terms of the PSCs between the Government of Timor-Leste and Eni. The EMP describes the seismic survey and the marine environment of the survey area, and determines environmental risks and mitigation measures allowing the setting of environmental performance objectives, standards and criteria.

Rev	Description of Revisions	Date	Prepared by:	Checked by:	Approved by:
0	Issued for use	11/5/10	C Doncon	D Hearty	A Trombetti
A	Internal review	10/5/10	C Doncon	R Phillips	

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ACRONYMS

2D	Two-dimensional
3D	Three-dimensional
ALARP	As Low As Reasonably Practicable
APPEA	Australian Petroleum Production and Exploration Association
DEWHA	Department of the Environment, Water, Heritage and the Arts, Australia
DNPG	Direcção Nacional de Petróleo e Gas (National Directorate of Oil and Gas), Timor-Leste
DNMA	Direcção Nacional do Meio Ambiente (National Directorate of Environment), Timor-Leste
DNPA	Direcção Nacional de Pescas e Aquicultura (National Directorate of Fisheries and Aquaculture), Timor-Leste
EEZ	Exclusive Economic Zone
Eni	Eni Timor Leste S.p.A.
EMP	Environmental Management Plan
ERA	Environmental Risk Assessment
ESD	Environmental Screening Document
FPSO	Floating Production, Storage and Offloading (vessel)
GeoStreamer® Survey	GeoStreamer® Trial 2D Seismic Survey
IUCN	International Union for Conservation of Nature
JPDA	Joint Petroleum Development Area
MARPOL 73/78	*International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto*
MMO	Marine Mammal Observer
MOU74	*Memorandum of Understanding between the Governments of Australia and the Government of the Republic of Indonesia regarding the Operations of Indonesian Traditional Fishermen in Areas of the Australian Exclusive Fishing Zone and Continental Shelf*, *1974*
MSDS	Material Safety Data Sheet
MZA	*Maritime Zones Act 2002*, Government of Timor-Leste

PGS	Petroleum Geoservices
PSC	Production Sharing Contract
Ramsar Convention	*The Convention on Wetlands of International Importance especially as Waterfowl Habitat*, Ramsar, Iran, 1971
SERN	Secretaria de Estado dos Recursos Naturais, (State Secretariat of Natural Resources), Timor-Leste
SOPEP	Shipboard Oil Pollution Emergency Plan
UN	United Nations
UNCLOS	*United Nations Convention on the Law Of the Sea 1982*
UNEP	United Nations Environment Programme
WCMC	World Conservation Monitoring Centre, UNEP

Units of measurement

ºC	degree Celsius	L/d	litres per day
d	day	m	metre
dB	decibel	m^3	cubic metre
km	kilometre	m/s	metres per second
km^2	square kilometres	Nm	nautical mile
km/h	kilometres per hour	y	year
L	litre		

EXECUTIVE SUMMARY

Eni Timor Leste S.p.A. (Eni) has a number of Production Sharing Contracts with the Government of Timor-Leste, which allow Eni to conduct a range of scheduled petroleum exploration activities. Eni is planning an offshore two-dimensional (2D) seismic survey using GeoStreamer® technology in PSC Blocks S06-01 (A), S06-02 (B) and S06-03 (C) in early July 2010, for a duration of 2 days. The survey will be conducted by Petroleum Geoservices (the seismic survey contractor) using the *Beaufort Explorer*.

An Environmental Screening Document (ESD) was submitted to the National Directorate of Environment (DNMA) on 5 July 2007 regarding the "Bicuda Survey". In the ESD, Eni proposed that the 2D Survey should be assessed as a Category B activity, thus requiring the submission and approval of an Environmental Management Plan (EMP). DNMA accepted this proposed level of assessment on 6 August 2007.

This EMP is submitted to the DNMA as the designated authority for environmental assessment. It is based on best practice standards and is compliant with Timor-Leste laws, regulations and guidelines. All aspects of the GeoStreamer® Trial 2D Seismic Survey (GeoStreamer® Survey) will be managed to comply with Eni's Health, Safety and Environment (HSE) Policy.

The scope of the EMP is all operational activities relating to the GeoStreamer® Survey in the PSC Blocks. The EMP describes:

- the activities of the seismic survey and the environment in the vicinity of the survey area;
- the potential environmental effects, risks and measures designed to minimise and/or mitigate actual and potential risks of the survey;
- Eni's Environmental Performance Objectives, Standards and Criteria for the survey; and
- the management measures and strategies to be used in implementing the best practice requirements and commitments made in the EMP.

The coastline adjacent to the survey area is mostly sandy with some isolated communities of coral reefs, with the seabed profile deepening a short distance from shore. Marine fauna includes whale, dolphin, turtle, bird, fish and other species with several of these protected by international treaties or legislation. Traditional fishing communities are on the coast adjacent to the survey area.

From the environmental risk assessment, 20 potential environmental risks were identified, with no High risks, 1 Moderate and 19 Low risks. The potential risks are related to mobilisation, survey operations and the potential for accidental discharges.

Eni's performance objectives, relevant standards, and criteria to measure its performance are outlined in this EMP.

Eni's environmental management strategies and procedures to be used for the GeoStreamer® Survey include responsibilities, training, reporting frameworks, mitigation and response activities and monitoring procedures. Commitments associated with these are listed in the table below, and will be used to reduce environmental risk to as low as reasonably possible (ALARP) and to ensure that environmental performance criteria are met. Responsibility for implementation of the strategies and procedures is clearly defined in the EMP with Eni and PGS individual responsibilities listed.

Key commitments checklist

Item	Topic	Commitment	Responsibility	Target Date
1	Waste segregation and disposal	Wastes segregated on the seismic and chase vessels into clearly marked bins for incineration or appropriate disposal/recycling. Domestic (sewage) waste treated in an extended macerator-aeration system prior to discharge to marine environment. Biodegradable food waste macerated to <25 mm prior to discharge. Discharge to occur when vessel is greater that 12 nm from any chartered reef or coastline. Environmentally acceptable materials chosen where possible. No waste disposal or recycling in Timor-Leste.	Eni and PGS	Throughout survey
2	Refuelling	Dry-break couplings used as standard.	Eni and PGS	Throughout survey
3	Spills and incidents	Wastes not to be discharged via deck drains. Seismic contractor and vessel have accepted reporting and recording procedures. Shipboard Oil Pollution Emergency Plan (SOPEP) in place. Ensure that shipboard oil spill equipment is well maintained. Record all incidents and report to DNMA all spills >80 L.	Eni and PGS	Throughout survey
4	Environmental awareness of crew	Environmental inductions undertaken prior to mobilisation to maximise awareness.	Eni	Prior to and during survey
5	Introduced pests	Fresh water used as ballast water. Recent hull inspection conducted.	Eni and PGS	Prior to mobilisation

Item	Topic	Commitment	Responsibility	Target Date
6	Coral reefs/ intertidal habitats	Bathymetric data (obtained during original Bicuda Survey, 2008) consulted during the survey. Minimum water depth of 10 m for seismic operations in areas where bathymetric surveys have been undertaken and confirmed there are no reefs or intertidal shoals (otherwise the minimum water depth is 15 m). 500 m exclusion zone observed between any part of the *Beaufort Explorer* or its streamer and any reef or intertidal shoal.	Eni and PGS	Prior to mobilisation and throughout survey
7	Fishing community interaction	During the seismic survey the vessels will stay more than 2 km from the coast. Produce Information Notices for distribution to communities adjacent to the survey areas, including coastal *sucos,* explaining the survey and its timing. Regular communication with the DNMA and DNPA staff in Dili, Suai and Same. Indonesian speaker on chase vessel to liaise with fishing vessels ahead of the *Beaufort Explorer*'s course.	Eni and PGS	Prior to and during survey

Item	Topic	Commitment	Responsibility	Target Date
8	Marine mammal interactions	Follow *EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales*: Implement protection zones around survey vessel as follows: • *Observation zone* 3+ km radius from acoustic source: whales monitored to determine if they are approaching the low power zone. • *Low power zone* 2 km to 500 m radius from acoustic source: if whales enter this zone, the acoustic source should immediately power down to low setting. • *Shutdown zone* <500 m radius from acoustic source: if whales enter this zone, the acoustic source shuts down. Conduct pre-start visual observations for 30 min period, to identify any whales in the *Observation zone*. Conduct soft start procedures over 30 min period, involving a sequential build-up of warning pulses at the start of each acquisition line to deter marine mammals from the area. In the event of three or more power-downs per day due to large baleen whales entering the *Low power zone*, demonstrate a low risk of encountering whales during night time operations through enhanced chase vessel observations 5 km ahead of the seismic vessel's course.	Eni and PGS	Throughout survey

1. INTRODUCTION

1.1 BACKGROUND INFORMATION

Eni Timor Leste S.p.A. (Eni) has been awarded Production Sharing Contracts (PSC) by the Government of Timor-Leste to conduct petroleum exploration in designated Contract Areas.

In July 2008, Eni carried out an offshore two-dimensional (2D) seismic survey known as the "Bicuda Survey", in PSC Blocks S06-01 (A), S06-02 (B) and S06-05 (H) off the south coast of Timor-Leste in the Timor Sea. Eni proposes to expand on these activities by undertaking additional 2D seismic activities using GeoStreamer® technology in S06-01 (A), S06-02 (B) and S06-03 (C), to improve the resolution of survey data obtained in those areas.

1.2 THE PROPONENT

Eni is one of the world's major integrated energy companies. In the Timor Sea, Eni has activities in the Joint Petroleum Development Area (JPDA) as well as five PSCs in Timor-Leste's sovereign area.

Eni is committed to achieving the highest practicable standard of environmental protection and this commitment is documented in the Eni Health, Safety and Environment (HSE) Policy (Appendix A). All aspects of the GeoStreamer® Trial 2D Seismic Survey (the GeoStreamer® Survey) will be managed to comply with this Policy. Key features of Eni's HSE Policy are:

- the commitment of senior management to meeting or exceeding industry standards and legislative requirements;
- assigning high priority to environmental issues;
- committing to the continuous improvement of environmental performance; and
- integrating environmental protection into all aspects of operations and ensuring involvement of employees and contractors.

In January 2008, Eni's HSE Integrated Management System achieved certification with ISO 14001:2004 Environmental Management Systems for its seismic survey activities. This certification provides audited assurance of a best-practice environmental management system based on continual improvement.

1.3 SCOPE AND OBJECTIVES OF THIS EMP

The scope of this EMP is all operational activities relating to the GeoStreamer® Survey. The overall aim of this EMP is to demonstrate to the Government of Timor-Leste, through its designated authority, the National Directorate of Environment (DNMA), that Eni have implemented safeguards to reduce potential environmental risks to as low as reasonably practicable (ALARP).

This EMP has been prepared for submission to DNMA, in accordance with the terms of the PSC between the Government of Timor-Leste and Eni.

An Environmental Screening Document (ESD) for the Bicuda Survey was submitted to DNMA on 5 July 2007. In the ESD, Eni proposed that the 2D seismic survey should be assessed as a Category B activity, thus requiring the submission and approval of an EMP. DNMA accepted this proposed level of assessment on 6 August 2007.

The objectives of this EMP are to:

- provide a description of the proposed activity (Section 2);
- describe the environment in the area of the proposed activity (Section 3);
- indicate the potential environmental risks associated with the proposed activity and measures designed to minimise and/or mitigate actual and potential risks (Section 4);
- outline Eni's Environmental Performance Objectives, Standards and Criteria for the proposed activity (Section 5); and
- describe the management measures and strategies to be used in implementing the best practice requirements and commitments made in this EMP (Section 6).

1.4 RELEVANT ENVIRONMENTAL LEGISLATION

DNMA is the designated authority to assess and approve this EMP under Timor-Leste law and has developed guidelines relating to EMP development which were applied in the preparation of this document. Under the Timor-Leste Constitution, Indonesian laws in effect on 25 October 1999 are applicable in the absence of Timor-Leste laws, and thus a number of Indonesian environmental laws are applicable to the GeoStreamer® Survey. Industry best practice guidelines and international agreements, such as the International Convention for the Prevention of Pollution from Ships, 1973, were also used to develop this document.

Table 1.1 highlights the most significant legislation, agreements and codes of practice relevant to this project. Eni will review the environmental legislation database when significant environmental legislation changes occur.

Table 1.1: Legislation, agreements and codes of practice relevant to the GeoStreamer® Survey

Democratic Republic of Timor-Leste Legislation and Regulations
Maritime Zones Act 2002 (MZA). This Act claims for Timor-Leste its Exclusive Economic Zone (EEZ) and seabed (continental shelf) entitlement extending 200 nautical miles (nm) from Timor-Leste's coast, pending an agreement on boundaries with Australia and Indonesia. The MZA is based on international law, notably the 1982 United Nations Convention on the Law of the Sea (UNCLOS).
Timor-Leste Petroleum Act 2005.
DNMA Guideline #5 on Public Engagement.
DNMA Guideline #6 on Environmental Screening.
DNMA Guideline #7 on Preparation of an Environmental Management Plan.
Indonesian Legislation and Regulations in effect on 25 October 1999
Law 23/1997 on Environmental Management.
Reg. 20/1990 on Control of Water Pollution.
Reg. 51/1993 on Environmental Impact Assessment.
International Agreements
United Nations Convention on the Law of the Sea 1982 (UNCLOS).
Convention on the Conservation of Migratory Species of Wild Animals 1979 (commonly known as the Bonn Convention).
International Convention on Civil Liability for Oil Pollution Damage 1969.
International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 1971.
International Convention on Oil Pollution Preparedness, Response and Co-operation 1990.
Convention on Biological Diversity 1992.
International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (commonly known as MARPOL 73/78).
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
Protocol to International Convention for the Prevention of Marine Pollution by Dumping of Waste and Other Matter 1972 (commonly known as the 1996 Protocol).

The Convention on Wetlands of International Importance especially as Waterfowl Habitat, Ramsar, Iran, 1971 (commonly referred to as the Ramsar Convention).
Other Best-Practice Documents
APPEA Code of Environmental Practice 1996: This provides guidance on recommended minimum standards for Australian petroleum industry activities offshore. These standards are aimed at minimising adverse impacts on the environment and ensuring public health and safety by using best practical technologies available.
EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales Produced by the Australian Government's Department of the Environment, Water, Heritage and the Arts (DEWHA). These guidelines detail procedures that should be followed by all seismic vessels operating in Australian waters so as to avoid interference with marine mammals.

1.5 PUBLIC ENGAGEMENT AND CONSULTATION

The public engagement and consultation processes undertaken from May to July 2008 for the original Bicuda Survey are applicable to the GeoStreamer® Survey. The engagement process followed DNMA Guideline #5 on Public Engagement, and was discussed with and endorsed by DNMA. The process was consistent with Eni's HSE Policy, Eni S.p.A.'s Code of Ethics and Eni's overall approach to sustainability.

The engagement program included public invitations to stakeholder participation, followed by notification letters sent to identified key stakeholders with an interest in the seismic survey. A detailed description of the public engagement activities that were completed for the Bicuda Survey is included in the "Bicuda 2D Seismic Survey Environmental Management Plan" (Eni 2008).

Two formal submissions were made to DNMA regarding the Bicuda Survey: one from DNPG/SERN, summarising views from DNPA, DNMA and DNPG; and one from La'o Hamutuk. The submissions focussed on:

- marine mammal interactions and mitigation measures;
- fishing impacts and community interaction;
- waste;
- refuelling; and
- logistics.

Eni incorporated these concerns into the management strategies presented in the EMP for the original Bicuda Survey (Eni 2008), and these are carried over to this EMP for the GeoStreamer® Survey.

2. DESCRIPTION OF ACTIVITIES

2.1 OVERVIEW OF SEISMIC SURVEYS

The proposed 2D seismic survey is similar to the Bicuda Survey undertaken by Eni in Timor-Leste in July 2008, although smaller in scale.

In marine seismic surveying, energy waves are directed at the sea floor and underlying geological strata to various depths – from several hundred to several thousand metres underground. The energy waves are reflected and refracted off the different substrata and recorded for processing and interpretation. The data collected from seismic surveys is interpreted to identify structures likely to contain petroleum hydrocarbons.

Energy waves generated by an air gun are discharged every few seconds, with reflected signals recorded by hydrophones embedded in a streamer that is towed behind the vessel, typically 5 to 15 m below the sea surface (Figure 2.1). Streamers maintain buoyancy through either solid buoyancy devices or kerosene.

2D surveys are designed to capture and process data of single slices of substrate to produce a cross section of its inferred composition, and therefore only tow one streamer of hydrophones. 3D surveys typically involve a vessel towing 6 to 10 streamers, so as to capture multiple data to produce a 3D model. Eni also carried out 3D seismic surveys in Timor-Leste between June 2007 and May 2008.

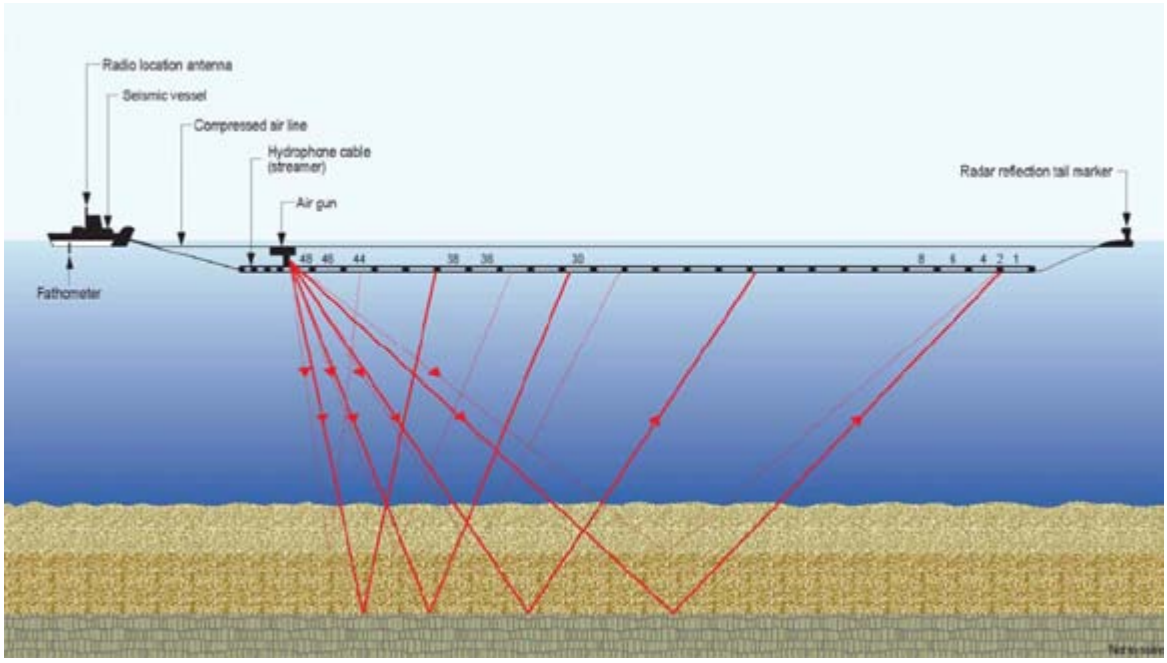


Figure 2.1 Typical 2D marine seismic survey configuration

2.2 THE PROPOSED GEOSTREAMER® SURVEY

The GeoStreamer® Survey is proposed to be conducted in the PSC Blocks S06-01 (A), S06-02 (B) and S06-03 (C), which are located in Timor-Leste territorial waters in depths ranging from approximately 100 m to 1,000 m. The survey includes two acquisition lines, one of approximately 64 km travelling parallel to shore at around 500 m water depth, and one of approximately 30 km in a northwest–southeast direction (perpendicular to shore). The proposed survey lines, and the lines completed during the original Bicuda Survey, are shown in Figure 2.2.

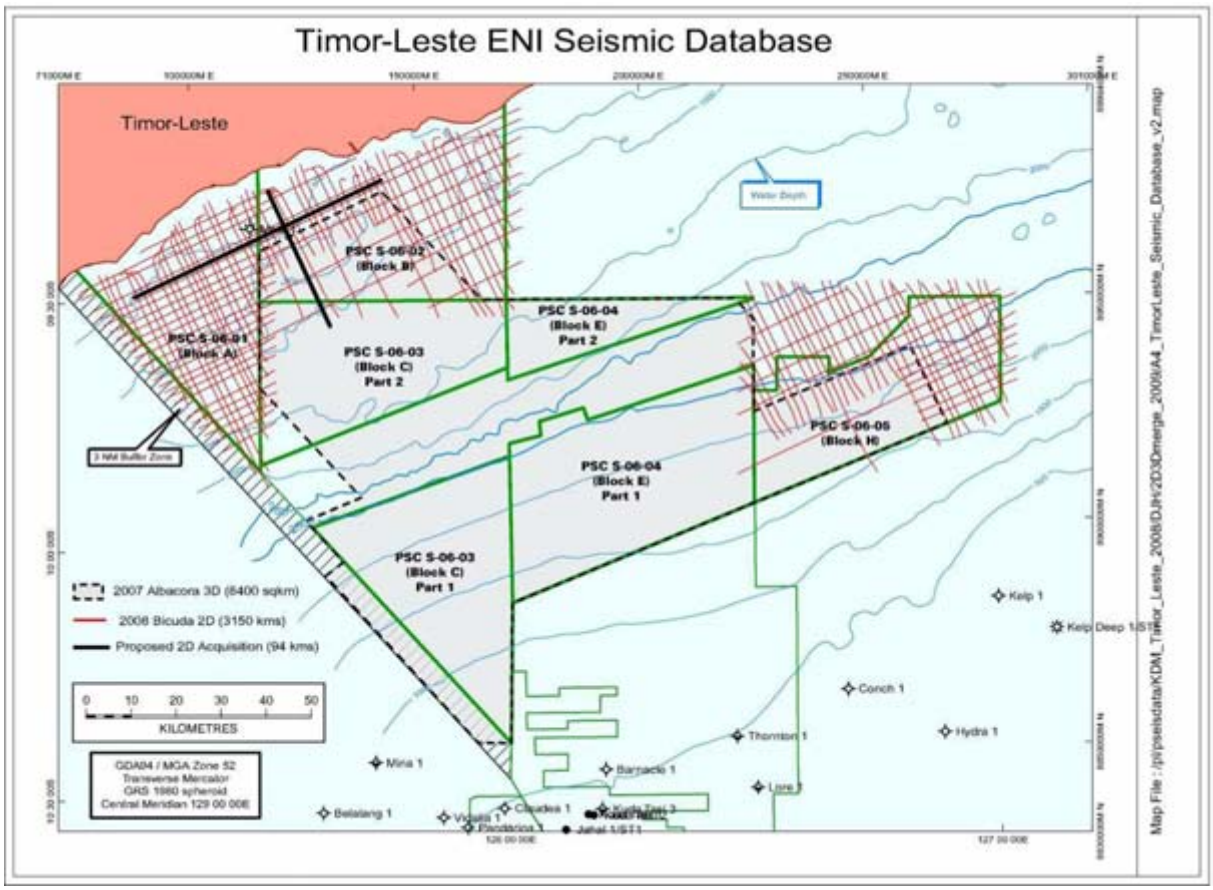


Figure 2.2: Location of the proposed GeoStreamer® Survey (solid black lines)

The proposed GeoStreamer® Survey will be conducted by the seismic survey contractor Petroleum Geoservices (PGS) using the vessel *Beaufort Explorer*. The *Beaufort Explorer* is 84 m in length and is equipped with a helideck for emergency helicopter support (see Appendix B for vessel specifications).

The GeoStreamer® Survey will utilise a 4130 cubic inch airgun (seismic source) with a maximum operating pressure of 2000 psi, which generates a maximum sonic emission of approximately 215 db re 1 µPa. The airgun will be towed 145 m behind the *Beaufort Explorer* at a water depth of 5 m.

The survey will use one 8000 m streamer cable with 480 hydrophone groups spaced 12.5 m apart. The cable will be positioned ~200 m behind the vessel at a water depth of 15 m. At the end of the cable is a yellow tail buoy with a flashing light for night-time observation. The *Beaufort Explorer* will be travelling at a constant speed of 4.5 knots during seismic acquisition.

The *Beaufort Explorer* will be supported by a chase vessel, most likely the *MV Freedom Waves* during the GeoStreamer® Survey. The chase vessel will travel ahead of the survey vessel and will liaise with any fishing vessels encountered during the survey.

The north-western end of the survey line in Block S06-02 (B) is in the shallowest waters, closest to the coast. While the seismic survey is underway, the vessels are not expected to come within 2 km of the coast. The *Beaufort Explorer* is typically able to operate in minimum water depths of 15 m. However, where bathymetric surveys have been undertaken to confirm that no reefs or intertidal shoals occur in the area, the vessel can operate in waters of as low as 10 m depth. Regardless of water depth however, Eni and PGS will apply an exclusion zone of 500 m between the survey activities (including the chase vessel, seismic vessel and its streamer) and the coast, including reefs and intertidal shoals (Figure 2.4).

Figure 2.3: The 500 m exclusion zone between the survey and the coast

Crew change and resupply of fresh provisions for both vessels will occur when the vessels are in port in Dili, before and after the GeoStreamer® Survey. Logistics for these operations are managed by SDV Logistics in Dili.

Eni staff will mobilise via the company's Timor-Leste office in Dili. Emergency support for the survey will be provided by helicopters based at Dili International Airport.

Eni proposes to commence the GeoStreamer® Survey in July 2010; the conceptual schedule for the survey activities is shown in Table 2.1. Exact dates will be confirmed closer to the commencement time.

Table 2.1: Conceptual schedule for the GeoStreamer® Survey

Activity	Approximate duration	Approximate dates
Arrive Dili Port for inward clearance	1 day	1 July 2010
Deploy in-sea equipment	1 day	2 July 2010
Seismic survey	2 day	3–4 July 2010
Retrieve in-sea equipment	1 day	5 July 2010
Leave Timor-Leste waters, outward clearance offshore if possible	1 day	6 July 2010

Eni will produce an Information Notice in Tetun regarding the exact timing of the survey activities, for distribution to communities adjacent to the survey area, including Suai (Cova Lima), Betano (Manufahi) and coastal *sucos*. The English version of the Information Notice is shown in Appendix C.

The *Beaufort Explorer* operates on Marine Distillate Fuel. If required, the vessel will bunker (refuel) in Dili immediately prior to commencing the GeoStreamer® Survey and no at-sea bunkering will be needed during the survey. SDV Logistics will manage the logistics of any bunkering operations in Dili Port. Potential spills will be managed under the vessel's Shipboard Oil Pollution Emergency Plan (SOPEP).

3. DESCRIPTION OF THE ENVIRONMENT

3.1 CLIMATE

Timor-Leste has two annual seasons and three climatic zones which are the result of monsoon activity. On the south coast, the two distinct seasons are the Northwest Monsoon (wet season) from December to June and the Southeast Monsoon (dry season) from August to October, with transitional periods in between (Timor-Leste 2006).

High rainfall is associated with the Northwest Monsoon and low rainfall with the Southeast Monsoon. Heavy rainfalls are also associated with tropical cyclones and thunderstorm activity. Mean annual rainfall for the Timor Sea region is 1,770 mm (Heyward et al. 1997).

Mean air temperatures recorded at the Jabiru Floating Production, Storage and Offloading (FPSO) vessel, approximately 180 nm south of Timor-Leste in the Timor Sea, are 24.9ºC in July and 29.6ºC in December (URS 2002).

3.2 WINDS

The Northwest Monsoon period is characterised by a steady moist west-south-west to north-west wind reaching speeds of 5 m/s for periods of 5 to 10 days. The Southeast Monsoon period is characterised by steady easterly and south-easterly winds of 5 m/s to 12 m/s (the south-east trade winds) (SKM 2001).

The majority of cyclones occur in the region between January and March, with the most severe cyclones most often occurring in the months December to April (SKM 2001). Most (75%) of these cyclones are not fully mature, having an estimated wind speed of less than 80 km/h. Severe cyclones, with wind speeds exceeding 100 km/h occur, on average, once every 2.6 years (Heyward et al. 1997).

3.3 OCEANOGRAPHY

3.3.1 Tides

Tides in the Echo Shoals area (approximately 50 km to the south of Eni's PSC areas) are semidiurnal with a typical tidal range of 4.0 m at springs and 1.8 m at neaps (Australian National Tide Tables – Echo Shoals). Tidal transformations for the Laminaria FPSO facility, to the south-east of the GeoStreamer® Survey, indicate a 10% increase in amplitude, and a phase-lead of 40 minutes (Heyward et al. 1997).

3.3.2 Tidal and non-tidal currents

The tidal currents in the Echo Shoals area are expected to flow east-north-east, and ebb west-south-west, in the upper 100 m of the water column, while flooding southeast, and ebbing west-north-west in the lower portion of the water column. Tidal current speeds in the order of 0.6 m/s (springs), and 0.2 m/s (neaps) are anticipated for the region (Heyward et al. 1997). The tidal currents are influenced by wind driven currents.

The Timor Sea region is influenced by the Pacific-Indian Ocean Throughflow. This produces a current moving at a rate of between 0.1 m/s and 0.4 m/s throughout the year in the Timor Sea between Timor-Leste and northern Australia (Molcard et al. 1996).

3.3.3 Water temperatures

Seawater temperatures in the Timor Sea region range from 25 ºC to 31 ºC at the surface and 22 ºC to 25 ºC below 150 m (OMV 2003). Temperatures at the seafloor can be as low as 10 ºC (Heyward et al. 1997).

3.4 BIOLOGICAL ENVIRONMENT

3.4.1 Marine protected areas

The nearest currently declared marine conservation zones or marine protected areas to the GeoStreamer® Survey area are:

- Jaco Island Marine Park, at the eastern end of Timor-Leste (approximately 130 km north-east);
- the Australian Ashmore Reef National Nature Reserve (approximately 370 km south-west); and
- the Indonesian Teluk Kupang/Pulau Kera Marine Recreation Park (approximately 220 km west) (SKM 2001).

All of these are considered to be too far away to be impacted by the survey activities.

3.4.2 Regional overview

Physical, biological and environmental data for the marine and coastal environment in Timor-Leste is very scarce (Sandlund et al. 2001) hence referral has to be made to isolated or more general studies.

The marine fauna of the Timor Sea is part of the Indo-West Pacific biogeographical province, and the majority of species are widely distributed in this region (Wilson & Allen 1987). Timor-Leste has been identified as part of the Wallacea region (relating mainly to the terrestrial environment) in Southeast Asia which has been identified as a biodiversity "hotspot" (Conservation International 2007). The most ecologically important marine habitats in the Timor Sea region, in terms of biodiversity and productivity, can be grouped into:

- the various submerged banks or shoals on the northern Australian continental shelf and shelf slope;
- the coastal intertidal coral reefs and shallow (20–30 m water depth) reefs; and
- the mangrove and seagrass areas located along the Timor and northern Australian coast and islands (Sandlund et al. 2001; SKM 2001).

3.4.3 Mangroves

Mangroves occupy approximately 7,500 acres along the coastline of Timor-Leste. On the south coast, they tend to form small communities at the mouths of streams and in marshy or swampy terrain (timorNET 2007).

The mangroves species that occur along the coast of Timor-Leste include, *Bruguiera parvifolia, Sonneratia alba, Rhizophora conjugata, Excoecaria agallocha, Avicennia marina, Aegiceras corniculatum, Acanthus ilicifolius, Lumnitzera racemosa, Heritiera litoralis, Acanthus ilicifolius, Achrosticum aureum, Xylocarpus granatum, Corypha utan, Pandanus odoratissimus, Cycas circinalis, Dolichandrone spathacea* and *Melaleuca leucadendron* (timorNET 2007).

3.4.4 Coral reefs and intertidal areas

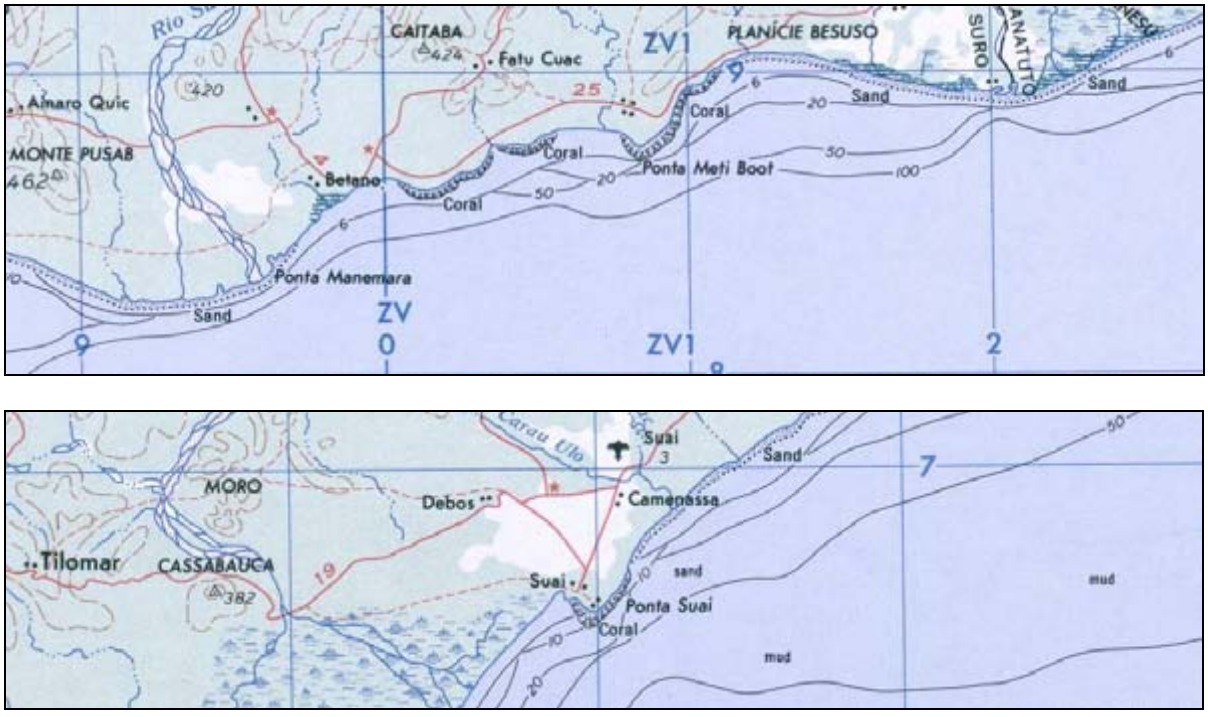
On a global scale, Timor-Leste is near the centre of the region with the highest coral species diversity and there may be in excess of 500 species of coral occurring in Timor-Leste waters (Veron and Stafford-Smith 2000). Intertidal reefs and islands occur along the south coast of Timor-Leste, adjacent to the GeoStreamer® Survey area. Wyatt (2004) surveyed a small area of the nearshore coastal marine environment on the south coast. Brittle stars (ophiuroids) and other mobile organisms as well as a total of 27 taxa of sessile organisms were identified as inhabiting the reef platform. Of the sessile organisms, 18 taxa were algae (a brown alga *Ascidium* sp. and a green alga *Caulerpa* sp.), three sponges (poriferans), two hard corals (scleractinians), two ascidians, one anemone (cnidarian) and one foraminifer.

A series of surveys conducted in Indonesian waters between 1990 and 1998 (Burke et al. 2002) determined that 45% of coral reefs in eastern Indonesia were in good or excellent condition (live coral cover of more than 50%), compared to only 23% in western Indonesia. Burke et al. (2002) also identified a number of coral reefs along the Timor-Leste coast, including five distinct communities along the south coast of Timor-Leste, that were considered to be at Medium to High risk of impact from the combined effects of coastal development, marine-based pollution, sedimentation, overfishing and destructive fishing.

According to mapping of the nearshore area, most of the coastline adjacent to the survey area is identified as “sand”. There are two coral reef communities, one located 10 km east of Betano and the other at the point at Suai (Figure 3.1) (US Army Corps of Engineers 1963).

Aerial observations of the south coast coral reefs conducted previously by Eni during helicopter transfers indicate that the fringing reefs do not extend further than approximately 100 m from shore. An aerial photograph of the reefs west of Betano is shown in Figure 3.2.

The location of Suai and Betano relative to the survey area is shown in Figure 3.3.



Source: US Army Corps of Engineers 1963 Note: depths in fathoms

Figure 3.1: Coral reef zones adjacent to the GeoStreamer® Survey area, around Betano (top) and Suai (bottom).

Figure 3.2: Aerial photograph of fringing coral reefs east of Betano

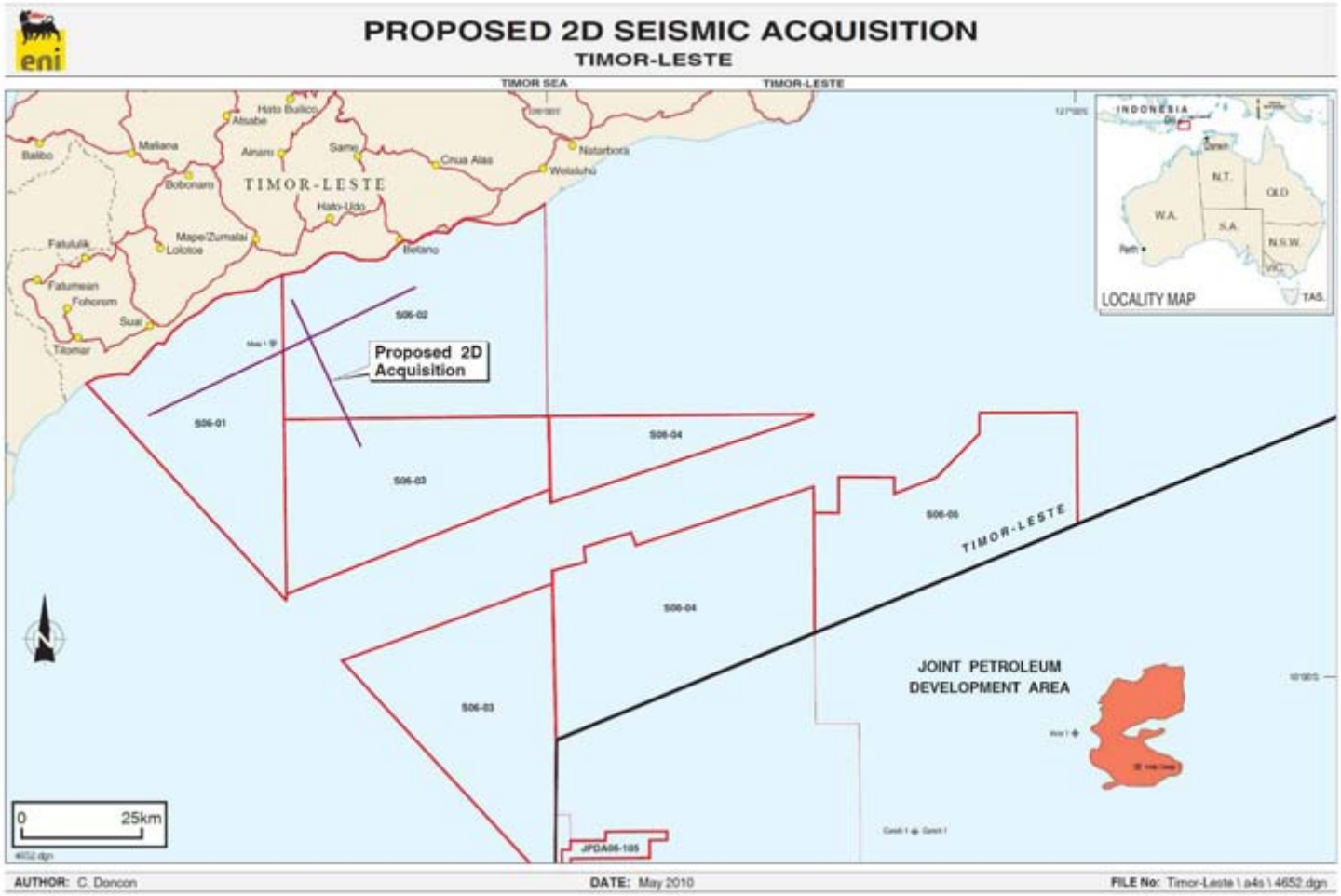


Figure 3.3: Location of the survey area in relation to the south Timor Leste coast

3.4.5 Offshore benthic habitats

Heyward et al. (1997) identified four broad benthic communities for the Big Bank Shoals area, encompassing the shallow banks to the deep water: Halimeda (shallow waters); encrusting sponges (shallow waters); coral filter-feeders (shallow waters); and continental shelf communities (deep water).

With little sea floor topography and hard substrate, such areas offered minimal habitat diversity or niches for animals to occupy. Detritus-feeding crustaceans, holothurians and echinoderms tend to be the dominant epi-benthic organisms of these habitats, however, where an area of hard substrate is available filter-feeding heterotrophs, such as sponges, soft corals and gorgonians may occur (Heyward et al. 1997).

3.4.6 Marine mammals

A number of whale, dolphin and porpoise species could be encountered during the GeoStreamer® Survey, with the Timor Trench providing an important flow-through of species connecting the Pacific and Indian Oceans. Of these, a number of whale species are considered endangered or vulnerable (Table 3.1). A number of dolphins may occur within the GeoStreamer® Survey area, including the Irrawaddy dolphin, the Australian snubfin dolphin, the long snouted spinner dolphin, the spotted bottlenose dolphin, Risso's dolphin, the Indo-Pacific humpback dolphin and the pantropical spotted dolphin. Dugongs occur within Timor-Leste waters, in protected areas coinciding with sizeable seagrass beds.

Table 3.1: Whale species that are endangered, vulnerable and or migratory which may occur in the region

Common Name	Scientific Name	Distribution	Status
Humpback whale	*Megaptera novaeangliae*	Species or species habitat likely to occur within area	Vulnerable, Migratory
Blue whale	*Balaenoptera musculus*	Species or species habitat likely to occur within area	Endangered, Migratory
Bryde's whale	*Balaenoptera edeni*	Species or species habitat likely to occur within area	Migratory
Sperm whale	*Physeter macrocephalus*	Species or species habitat likely to occur within area	Migratory
Antarctic minke whale	*Balaenoptera bonaerensis*	Species or species habitat may occur within area	Migratory
Killer whale	*Orcinus orca*	Species or species habitat may occur within area	Migratory

Marine mammal observations from Eni's Albacora 3D seismic survey in 2007 provide an important insight into the distribution of whales and dolphins in the Timor Sea. In September 2007, observations were made over 22 days, recording a total of 23 sightings of cetaceans comprising approximately 96 individuals (Western Whale Research 2007). These included 13 pods of Pygmy blue whales (*Balaenoptera musculus brevicauda*), and 8 pods of unidentified large whales (most likely also to be Pygmy blue whales). Two pods of unidentified dolphins totalling 70 individuals were also observed. Given the large survey coverage over deep water (up to 2500 m depth) and short observation duration of 22 days (with excellent weather) this number of sightings is considered to be high and indicative of large cetacean populations in the area.

In contrast, observations in December 2007 recorded relatively low numbers of sightings in the Timor Sea (Western Whale Research 2008). Over 13 days, a total of four sightings of cetaceans comprising 16 individuals were recorded. These included one unidentified whale, one sighting of two Fraser's dolphins and two pods of unidentified dolphins. These lower numbers could be a result of the change in season between September (winter/spring) and December (spring/summer), or the shallower water depths of the December survey area (around 500 m).

3.4.7 Marine reptiles

TURTLES

There are no turtle nesting sites or other critical habitat (e.g. breeding or feeding sites) identified within the GeoStreamer® Survey area (UNEP-WCMC 2006). However, Jaco Island and Tutuala Beach have been identified as turtle nesting sites (Nunes 2001) and other breeding sites may exist on the south coast of Timor-Leste where the appropriate conditions occur. There are six turtle species that may be encountered, particularly the Loggerhead turtle and the Green turtle (Table 3.2). During previous seismic surveys by Eni, the seismic vessel encountered Olive Ridley turtles trapped in discarded fishing net, which were subsequently rescued by the seismic crew.

Table 3.2: Marine turtles in the region, their conservation status, habitat and significance

Common Name	Species Name	Status	Habitat and Significance to Area
Olive ridley turtle	*Lepidochelys olivacea*	Endangered, Migratory	Shallow, soft bottomed habitats. Common in region (recorded breeding sites on northern and eastern coasts of Northern Territory, Australia).
Loggerhead turtle	*Caretta caretta*	Endangered, Migratory	Coral reefs, bays and estuaries. Tropical and warm temperate waters. No large rookeries recorded in region.
Flatback turtle	*Natator depressus*	Vulnerable, Migratory	Shallow soft bottomed habitats away from reefs.

Common Name	Species Name	Status	Habitat and Significance to Area
Hawksbill turtle	*Eretmochelys imbricata*	Vulnerable, Migratory	Tidal/sub-tidal coral and rocky reef habitats. Tropical waters. Recorded breeding sites along eastern coast of Northern Territory, Australia.
Green turtle	*Chelonia mydas*	Vulnerable, Migratory	Seaweed rich coral reefs/ inshore seagrass pastures (tropical/ subtropical). May be seasonally common. Recorded breeding site northern coast of Northern Territory, Australia.
Leatherback turtle	*Demochelys coriacea*	Vulnerable, Migratory	Rare within its range. Probably only occasional visitors to tropical waters. No large rookeries recorded in region.

Source: (Environment Australia 2003)

SALTWATER CROCODILES

The distribution of the saltwater crocodile (*Crocodylus porosus*) encompasses Timor-Leste and the islands and coasts surrounding the Timor Sea. The animals usually inhabit territories within tidal river systems and estuaries, sometimes around coastal areas and in freshwater rivers or water bodies (Ross 1998). The saltwater crocodile may be encountered during the GeoStreamer® Survey in areas close to the coast. The saltwater crocodile is listed as Low Risk, Least Concern in the International Union for Conservation of Nature (IUCN) Red List.

SEA SNAKES

Sea snakes are very common in subtropical and tropical waters where they occupy a wide range of habitats and water depths, extending from the coast to the reefs and banks further offshore. Sea snakes are expected in the Timor Sea region, with as many as 15 species known to occur in northern Australian waters (Storr et al 1986). Sea snakes could be encountered during the GeoStreamer® Survey.

3.4.8 Fish

FishBase (2006) lists 144 marine fish species in 38 families for Timor-Leste waters, with 18 pelagic species and 10 deepwater species. One species, the bigeye tuna (*Thunnus obesus*), is listed as Threatened. Many of the species listed for Timor-Leste are found throughout the tropics and are important commercial species, such as the tunas, mackerels and snappers. Table 3.3 lists the families of the finfish species identified in the shoal areas covered by the Memorandum of Understanding between Australia and Indonesia (MOU74) (CSIRO 1999).

Table 3.3: Composition of commercial and non-commercial finfish species identified from video transects in the MOU74 Box shoal areas

Category	Family	No. of species
Commercial	Balistidae	1
Commercial & Non-commercial	Serranidae	6
Commercial	Haemulidae	1
Commercial	Scaridae	1
Commercial	Lethrinidae	1
Commercial	Lutjanidae	1
Non-Commercial	Acanthuridae	1
Non-Commercial	Chaetodontidae	1
Non-Commercial	Pomacanthidae	1

Source: CSIRO 1999

3.4.9 Sharks

The whale shark (*Rhincodon typus*) is listed in FishBase (2006) as occurring within Timor-Leste waters and is considered Threatened. The Great White Shark (*Carcharodon carcharias*) may transit the region (Environment Australia 2002) and is considered to be Vulnerable. There are at least 49 species of sharks identified as occurring within an area which encompasses Australian territorial waters within the Timor Sea (Last & Stevens 1994). The most prolific of the shark species in the Timor Sea region are the whalers, represented by at least twelve species.

3.4.10 Birds

Timor-Leste has approximately 224 species of birds of which 23 are endemic to the Timor island group (World Bank 2005). Of the known species that occur in Timor-Leste, two are listed as Critically Endangered and three are listed as Endangered under the IUCN Red List. Of these birds only the Christmas Island Frigatebird (*Fregata Andrews)* is a seabird. Seabirds that may occur in the GeoStreamer® Survey area includes various tern species, the silver gull (*Larus novaehollandiae*), the lesser frigate bird (*Fregata areii*), the common noddy (*Anous stolidus*) and the migratory seabird, the streaked shearwater (*Calonectris leucomelas*).

CSIRO (1999) recorded over 10,000 seabirds from nine species on Ashmore Reef and at sea within the Timor MOU74 Box during a survey between September and October 1998. The species included the crested tern (*Sterna bergii*), sooty tern (*Sterna fuscata*), roseate tern (*Sterna dougalli*), common noddy (*Anous stolidus*); brown booby (*Sula leucogaster*), masked booby (*Sula dactylatra*), Bulwer's petrel (*Bulweria bulwerii*), Matsudaira's storm-petrel (*Oceanodroma matsudairae*) and Leach's storm-petrel (*Oceanodroma leucorhoa*).

3.5 SOCIO-ECONOMIC ENVIRONMENT

3.5.1 National context

Timor-Leste is 15,400 km^2 in land area, consisting of the Eastern part of the Island of Timor; Oecusse, an enclave in West Timor (Indonesia); and the island of Atauro. The Democratic Republic of Timor-Leste achieved formal independence on 20 May, 2002. Today the population of Timor-Leste is just over one million people and is one of the fastest growing in the world, at around 4% per annum. The predominant religion is Roman Catholic and the official languages of Timor-Leste are Portuguese and Tetun. Indonesian and local languages are also spoken, such as the Malayo-Polynesian language Mambai, spoken in the district of Manufahi. The government system at a regional level is organised into districts, sub-districts and *sucos* (local councils).

Despite significant increases in revenue due to receipts from petroleum and coffee exports, it is still the poorest country in the Asia-Pacific region and was ranked 150 of 177 countries in the 2007 UN Human Development Index. Around 75% of the population lives in rural areas, engaged in agriculture, mostly at the subsistence level. The overall literacy rate in Timor-Leste is around 50%.

Despite this, the country has made significant progress in building an institutional framework to support economic development and promote macroeconomic stability. The National Development Plan identifies governance, poverty reduction and improved food security as development priorities. Timor-Leste has established an internationally-acclaimed Petroleum Fund to manage its petroleum revenues transparently and sustainably.

3.5.2 Communities adjacent to the survey area

The districts of Cova Lima (population 53,000), Ainaro (52,500) and Manufahi (45,000) occur on the coast in the vicinity of the GeoStreamer® Survey area. Within these districts, there are seven sub-districts and around seventeen *sucos*. Small towns and villages are spread throughout these *sucos*, usually located a few kilometres inland from the coast. The two largest population centres on the coast adjacent to the survey area are Suai (population 23,000), capital of Cova Lima district, and Betano, a coastal village in Manufahi.

3.5.3 Traditional fishing

Coastal communities along the 600 km of Timor-Leste's coastline rely on a wide range of fish, including the large tunas, flying fish, coral reef fish and deepwater snappers for their livelihoods. The DNPA estimates that for over half the 20,000 fishermen of Timor-Leste, fishing is the main source of food and income. United Nations (UN) support since 1999 has helped re-establish the nation's fishing capacity, with the fish catch estimated to be 1,600 t in 2002 (Jasarevic 2002).

The main vessel for traditional fishing is the pirogue, a small, flat-bottomed boat often propelled by paddles, although outboard motors are becoming increasingly common. Traditional fishing uses both gill net and handlines, and fishing activities usually do not extend more than 2 nm (<4 km) from the coast, with most activity concentrated 1 nm (<2 km) from the coast.

3.5.4 Commercial fishing

The Government of Timor-Leste issued four commercial fishing licences for the Timor Sea in 2006. These were operated in 2007, but have been inactive since that time. New licences may be issued in 2011. Illegal fishing is also known to occur in the waters south of Timor-Leste.

3.5.5 Shipping

The deeper waters of the Timor Sea are an important shipping route, and are adjacent to a major trade route (US 2000). Examination of 2004 Australian Maritime Safety Authority shipping data shows that, for vessels that reported positions, there were up to 173 ship transits through Eni's Timor-Leste PSC Blocks. Generally, vessels transiting through this area include bauxite and coal carriers and container vessels servicing Australian terminals. This shipping activity is likely to occur in relatively deep waters, and unlikely to coincide with the GeoStreamer® Survey area.

3.5.6 Heritage

There are no known significant marine heritage or archaeological sites in the vicinity of the GeoStreamer® Survey area.

The Australian destroyer HMAS *Voyager* ran aground at Betano in 1942, during World War II. The vessel was abandoned and later destroyed by demolition charges, but fragments of the wreck can be seen close to the beach at Betano.

4. ENVIRONMENTAL RISK ASSESSMENT

4.1 ENVIRONMENTAL RISK ASSESSMENT MATRIX

The potential environmental hazards included in this environmental risk assessment (ERA) are related to activities associated with mobilisation and conducting the seismic survey, as well as with general operations and accidental discharges.

As part of Eni's HSE Integrated Management System, the company's ISO 14001-certified risk management procedure (Eni 2007a) was used as the basis for the ERA. Environmental risk is defined as the chance of an event impacting the environment. It is measured in terms of likelihood and consequence, where consequence may be defined as the outcome of an event, and likelihood as a description of the probability or frequency of the event occurring. Table 4.1 presents Eni's Risk Matrix, defining the likelihood, (environmental) consequence and resulting risk used to determine the level of risk for each event (Eni 2007a).

In order to carry out an ERA of seismic activities on the Timor Sea it is necessary to employ a methodology that:

- identifies the activity and the source of the risk;
- defines the potential environmental effects of the activity;
- identifies the safeguards or risk management measures in place;
- with such safeguards in place, identifies the residual levels of likelihood and consequence; and
- determines residual environmental risk of the activity, using the risk matrix.

Using this model, the potential environmental hazards of the GeoStreamer® Survey are identified within Table 4.2, and the associated environmental risks are identified. The likelihood and consequence ratings applied were informed by Eni's experience on previous seismic surveys undertaken in the area, as well as more broadly within the Asia-Pacific region. A total of 20 potential environmental hazards were identified, 1 at a Moderate level of risk and 19 at Low risk.

Table 4.1: Eni Risk Matrix

Consequence					Increasing Annual Frequency					
Severity	People	Environment	Assets	Reputation	0	A	B	C	D	E
					Could happen in E&P industry	Heard of in E&P industry	Has occurred at least once in Company	Has occurred several times in Company	Happens several times/y in Company	Happen several times / y in one location
1	Slight health effect / injury (not applicable)	Slight impact No sensitive impact on ground/air/water	Slight damage No disruption to operations/business	Slight impact Minor and short lived impact in the locality	*Continuous Improvement*					
2	Minor health effect / injury (not applicable)	Minor impact Impact on localised ground	Minor damage Possible short disruption of operations/business: repair cost: <200,000	Minor impact Some loss of reputation in the area, which should be recovered						
3	Major health effect / injury 1 or more than 1 Lost Time Accident; up to 30 days off for any single injury.[3]	Local impact Regional stakeholder concern or 1-2 years for natural recovery or 1 week for clean-up. Spill <100m[3]	Local damage The unit has been repaired/replaced to resume operations: repair cost <2,500,000. Loss damage to public domain.	Local impact Significant potentially long lived damage to the regional reputation			*Risk Reduction Measure Required*			
4	PTD or 1 fatality Serious permanent disability or death	Major national impact National stakeholder concern or 2-5 years for natural recovery or up to 5 months for clean-up or threatening to biodiversity or impact on interesting areas for science. Spill < 1000m3	Major damage Long time/Major change to resume operations/business: repair cost <25,000,000. Interruption of public services.	Major national impact Serious / permanent damage to the ability of the Company to sustain business position in the location, some broader implications for the Company				*Intolerable Risk*		
5	Multiple fatalities From an accident or occupational illness (e.g. chemical asphyxiation or cancer or epidemic diseases)	Major international impact International stakeholder concern or >2-5 years for natural recovery or > 5 months for clean-up or reduction of biodiversity or impact on special conservation areas. Spill > 1000m3	Extensive damage Total loss of operations/business: repair cost >25,000,000. Extensive damage to public domain	Major international impact Potential loss of future business position in the location / region and / or lasting significant damage to broader Eni image						

Table 4.2: Summary of environmental risks associated with the GeoStreamer® Survey

Source of Risk	Potential Environmental Effects	Safeguards or Risk Management Measures	Likelihood of Consequences Being Realised	Consequence	Risk
Mobilisation					
Environmental Awareness	Rubbish, interference with wildlife, impacts on sensitive environments	• All crew to undertake environmental inductions	A	2	Low
Ballast Water	Displacement of native species	• Fresh water used as ballast water during the GeoStreamer® Survey, therefore no ballast water risk	B	1	Low
Hull Fouling	Displacement of native species	• Recent hull inspections conducted	B	2	Low
Equipment/ Personnel Transfer	Introduction of vermin, weeds and pests	• Personnel and equipment to be transferred through Dili	B	2	Low
General Operations					
Waste/emissions	Deck drainage – impact on water quality	• Appropriate deck drains and bunds on seismic vessel • Deck drainage flows to oil/water separation device that is regularly checked for functionality • Recovered oil is transferred to Australia for disposal	A	1	Low
	Domestic and biodegradable waste – impact on water quality	• *Beaufort Explorer* waste management procedures • Check functionality of macerator and waste water treatment system regularly • Effluents treated to MARPOL 73/78 standards prior to discharge overboard • Chase vessel complies with MARPOL 73/78 regulations • Record sewage treatment and biodegradable waste discharge in waste logs	E	1	Low

Source of Risk	Potential Environmental Effects	Safeguards or Risk Management Measures	Likelihood of Consequences Being Realised	Consequence	Risk
	Solid waste – impact on water quality	• *Beaufort Explorer* waste management procedures • No solid waste disposed of overboard • Solid waste stored appropriately and transported to disposal facility in Australia (no waste disposal in Timor-Leste) • Food and cardboard waste incinerated • Eni to ensure that onshore disposal of wastes is to approved (i.e. licensed) facilities	A	3	Low
	Hazardous waste – impact on water quality	• Hazardous waste is documented, tracked and segregated from other waste streams • Hazardous materials stored onboard for onshore disposal in Australia (no waste disposal in Timor-Leste) • Transfers of hazardous wastes recorded in seismic vessel waste logs	A	3	Low
	Cooling water – elevation of water temperature	• High dilution rates result in no change in salinity detectable outside a localised area • Cooling water will be discharged at less than 2°C above ambient sea surface temperature • Water discharged above sea level (allows for cooling and oxygenation as it falls to sea level)	E	1	Low
	Atmospheric emissions – localised impact on air quality and greenhouse gas emissions	• Engines and incineration equipment maintained at peak efficiency	B	2	Low
	Artificial Light – attraction of fauna	• Preferential use of fluorescent lights, that meet required safety standards	E	1	Low

Source of Risk	Potential Environmental Effects	Safeguards or Risk Management Measures	Likelihood of Consequences Being Realised	Consequence	Risk
Interference with Other Users	Commercial Fishing/Shipping	• Timor-Leste Government Authorities notified, including DNPA • Use navigation lighting on the seismic vessel to ensure visibility at night • Safety zone gazetted around seismic vessel • Regular communication with the DNPA staff in Dili, Suai and Same. • Indonesian speaker on chase vessel to liaise with fishing vessels ahead of the *Beaufort Explorer's* course	B	2	Low
	Traditional Fishing	• During the bathymetric survey the vessel will stay more than 500 m from the coast. • During the seismic survey the vessels will stay more than 2 km from the coast. • Use navigation lighting on the seismic vessel to ensure visibility at night • Produce Information Notices for distribution to communities adjacent to the survey areas, including coastal *sucos,* explaining the survey and its timing. • Use navigation lighting on the seismic vessel to ensure visibility at night • Regular communication with the DNPA staff in Dili, Suai and Same. • Indonesian speaker on chase vessel to liaise with fishing vessels ahead of the *Beaufort Explorer's* course.	A	3	Low

Source of Risk	Potential Environmental Effects	Safeguards or Risk Management Measures	Likelihood of Consequences Being Realised	Consequence	Risk
Noise	Discharge of acoustic source - disturbance to marine mammals (whales, dolphins etc)	• Follow EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales (DEWHA 2008). • Implement protection zones around survey vessel as follows: – *Observation zone* 3+ km radius from acoustic source: whales monitored to determine if they are approaching the low power zone. – *Low power zone* 2 km to 500 m radius from acoustic source: if whales enter this zone, the acoustic source should immediately power down to low setting. – *Shutdown zone* <500 m radius from acoustic source: if whales enter this zone, the acoustic source shuts down. • Conduct pre-start visual observations for 30 min period, to identify any whales in the Observation zone. • Conduct soft start procedures over 30 min period, involving a sequential build-up of warning pulses at the start of each acquisition line to deter marine mammals from the area. • In the event of three or more power-downs per day due to large baleen whales (humpbacks, blues or southern rights) entering the *Low power zone*, demonstrate a low risk of encountering whales during night time operations through enhanced chase vessel observations 5 km ahead of the seismic vessel's course. • Maintain a dedicated marine mammal observer onboard the seismic vessel or chase vessel to ensure consistent and continual observation and recording.	B	2	Low
	Vessel noise - disturbance to marine fauna (cetaceans, turtles, seabirds, fish, etc)	• Short duration of survey (2 days) • Marine biologist onboard the seismic vessel or chase boat • Observations by crew of *Beaufort Explorer* and chase vessel	E	1	Low

Source of Risk	Potential Environmental Effects	Safeguards or Risk Management Measures	Likelihood of Consequences Being Realised	Consequence	Risk
Disturbance to Marine Fauna & Habitats	Damage to coral reefs/ intertidal habitats	• Detailed bathymetric data already obtained for the area (during original Bicuda Survey, 2008), which will be consulted during the survey. • Minimum water depth of 10 m for seismic operations in areas where bathymetric surveys have been undertaken and confirmed there are no reefs or intertidal shoals (otherwise the minimum water depth for operation is 15 m). • 500 m exclusion zone observed between any part of the *Beaufort Explorer* or its streamer and any reef or intertidal shoal.	A	3	Low
Accidental Discharges					
Leakage from Machinery	Impact on water quality/marine flora/fauna	• Drip trays and sumps placed under all engines • Collected waste oil stored in containment tanks prior to shipping onshore • Seismic vessel maintenance and inspection procedures • Seismic vessel has an approved SOPEP • Record and report all spills >80 L to DNMA	B	2	Low
Streamer Damage or Loss	Streamer buoyancy fluid - impact on water quality/marine flora/fauna	• Seismic vessel uses solid streamer without any buoyancy fluid. • Minimal amounts of buoyancy fluid used in front and rear “stretch” assemblies only (<250 L) • Bathymetric survey (using side scan sonar and echo sounder) conducted by chase vessel two weeks prior to seismic vessel being on location, producing detailed bathymetric maps that will be consulted during the survey. • Minimum water depth of 10 m for seismic operations in areas where bathymetric surveys have been undertaken and confirmed there are no reefs or intertidal shoals (otherwise the minimum water depth for operation is 15 m). • 500 m exclusion zone observed between any part of the *Beaufort Explorer* or its streamer and any reef or intertidal shoal.	B	2	Low

Source of Risk	Potential Environmental Effects	Safeguards or Risk Management Measures	Likelihood of Consequences Being Realised	Consequence	Risk
Bunkering (refuelling)	Impact on water quality/marine flora/fauna	• Refuelling (if required) to be undertaken in port in Dili, commencing in daylight hours, suitable weather and steady sea-state conditions • Refuelling only to occur at the discretion of the vessel masters • Dry-break couplings used as standard • Seismic vessel has an approved SOPEP • Record and report all spills >80 L to DNMA	C	2	Moderate
Vessel Collision	Collision resulting in oil and/or diesel spill - impact on water quality/marine flora/fauna	• Timor-Leste Government Authorities notified • Safety zone gazetted around seismic vessel • Interaction between seismic vessel and chase vessel at discretion of the vessel masters • Record and report all spills >80 L to DNMA	A	3	Low

4.2 DETAILED DISCUSSION ON ENVIRONMENTAL RISKS AND THEIR MITIGATION

4.2.1 Transfer of marine pests at ports

Vessels entering Timor-Leste waters from other seas can pose a risk of introducing exotic marine pests, which could be transported via spores or larvae in ballast water, or via hull fouling. The risk of marine pest introduction during the GeoStreamer® Survey is minimal, as the *Beaufort Explorer* will use vessel-generated fresh water in its ballast water system. The vessel was dry-docked for hull cleaning and inspection in October–November 2009, and was cleared to enter Australian waters in December 2009. The *Beaufort Explorer* has not left Australian waters since that time.

4.2.2 General environmental aspects of survey operations

DECK DRAINAGE

The *Beaufort Explorer* has designated containment and bunding zones where oil products are used or stored. Deck drainage and oily wastes are treated using separators and can be discharged overboard if within water quality standards. Minor deck spills will be washed with bio-degradable detergents and polluted deck drainage water will be collected in a settling tank for later disposal onshore. While no wastes will be routinely discharged via deck drains, washdown of the decks may result in minor quantities of chemical residues (such as oil and grease) entering the marine environment through overboard drains.

Used lubricants will be stored aboard the *Beaufort Explorer* and subsequently transported ashore for recycling or disposal at approved locations. Minor oil/lubricant spills will be mopped up with absorbent materials that will be disposed of onshore as hazardous waste.

No significant environmental impacts from deck drainage during the seismic survey are anticipated because of the low concentration of contaminants, minor quantities of overboard discharges involved and the localised zone of effect of any impact.

DOMESTIC AND BIODEGRADABLE WASTES

Operation of the *Beaufort Explorer* and support vessels will typically result in the generation of approximately 10,000 L/d of sewage and wastes from the kitchen, shower and laundry area. This will be released to the marine environment after treatment in an extended macerator-aeration system. The wastes will be required to pass through a screen of less than 25 mm diameter prior to discharge, in accordance with industry best-practice.

Similarly, biodegradable food waste is macerated to a size of less than 25 mm before being discharged overboard, so long as the ship is greater that 12 nm from any chartered reef or coastline. The ship's macerator is regularly maintained and part of vessel operations supervisor's daily check.

The discharge of biodegradable wastes may result in localised increases in nutrient levels, which may stimulate microbial activity and therefore act as a food source for scavenging birds and/or marine animals.

No significant impacts are likely to occur during the seismic survey from domestic waste discharge, as a result of the low volumes involved, the moving survey vessels, oceanic currents and high biodegradability/low persistence of the wastes.

SOLID AND HAZARDOUS WASTE

The *Beaufort Explorer*'s waste management procedure will be followed for the disposal of solid and hazardous wastes, which is fully compliant with MARPOL 73/78. Solid and hazardous waste will be segregated into several waste streams, as shown in Table 4.3, and either stored for onshore recycling; stored for onshore disposal; or incinerated. Recycling and waste disposal will be undertaken in Australia – there will be no waste disposal or recycling undertaken in Timor-Leste.

Transport, storage, handling and disposal of hazardous materials will be in accordance with the seismic vessel procedures and the Material Safety Data Sheets (MSDSs). In addition, PGS screen all products for their technical and environmental qualities and performance. Where technically practicable, the most environmentally acceptable options will be preferentially selected.

Table 4.3: Fate of solid and hazardous waste

Waste stream	Fate
Flammable waste (paper, cardboard, plastic)	Incinerated using on-board incinerator
Metal, cans, cables, wires	Stored onboard for recycling in Australia by a licensed contractor
Other solid waste	Compacted and held in the garbage skips on board for disposal ashore (Australia) by a licensed contractor
Chemicals, flares, solvents, paints	Stored onboard for disposal in Australia by a licensed contractor
Sludge, waste oil	Drained to vessel's waste oil tank. Pumped ashore (Australia) to a licensed contractor for disposal
Cable/streamer fluid	Drained to vessel's waste oil tank. Pumped ashore (Australia) to a licensed contractor for disposal.
Lithium batteries	Stored in appropriate containers onboard for recycling/disposal in Australia by a licensed contractor

COOLING WATER

Seawater is pumped on board the seismic vessel, where it is deoxygenated and sterilised by electrolysis (by release of chlorine from the salt solution) and then circulated as coolant for various plant, including air conditioning condensers and air compressors. The heated water (up to 20 °C above ambient) contains liberated chlorine at total free ion concentrations <2 ppb. The water becomes reoxygenated and loses a substantial quantity of chlorine by vaporisation during its exit to the sea. The anticipated temperature at the sea surface will be in the vicinity of 3 °C above ambient temperatures.

No significant adverse impact is expected from the discharge of cooling waters during the seismic survey given the rapid dilution of heated water and the relatively small volumes of seawater involved. The survey vessel will be moving which will also aid dilution.

ATMOSPHERIC EMISSIONS

Atmospheric emissions from seismic operations arise from propulsion and power generation, with the *Beaufort Explorer* using Marine Distillate Fuel. Emissions will also be released through the incineration of waste products.

Most of the gaseous emissions will be in the form of carbon dioxide (CO_2), although smaller quantities of other gasses, such as oxides of nitrogen (NO_x) and carbon monoxide (CO) will also be generated. Where possible, emissions from engines and power generators will be minimised by means of optimising fuel efficiency and conducting regular maintenance and checks.

ARTIFICIAL LIGHTS

The survey vessel will be well lit at night and during times of poor visibility, to ensure safe operations of the survey. Use of fluorescent lights that meet required safety standards are aimed to decrease the attraction of the vessel light to fauna.

4.2.3 Interference with other users

DISTURBANCE TO TRADITIONAL FISHING

The survey vessels are likely to cause minimal disturbance to traditional fishing practices. During the seismic survey the vessels will stay more than 2 km from the coast. Any disruption will be of a relatively short duration as the survey vessels are constantly moving, passing through a section of coastline relatively quickly. A chase vessel will be present during the survey, with a specific role of liaising with fishing vessels ahead of the *Beaufort Explorer*'s course, and navigation lighting will be used on the vessels at night.

The *Beaufort Explorer* Vessel Master will maintain regular communications regarding its course with DNMA, who will notify DNPA in Dili, Suai and Same so as to minimise interference with fishers in the area. As part of the public engagement program associated with the GeoStreamer® Survey, Information Notices will be distributed to *sucos* adjacent to the survey areas just prior to commencement of the survey.

DISTURBANCE TO COMMERCIAL FISHING AND SHIPPING

The survey area is not located near any major shipping route, although Australian Maritime Safety Authority data indicate that many vessels report passing through the area. Given the short temporal duration of the seismic survey, modern navigation equipment, radios and position reporting to Timor-Leste authorities, the presence of the survey is not anticipated to have any significant impact on commercial fishing and shipping activity.

4.2.4 Seismic and vessel noise

Seismic surveys use acoustic sources to create sound waves. These waves can lead to mortality of marine organisms, particularly smaller ones such as plankton and fish. Various seismic noise exposure levels have been tested for small organisms such as crustaceans, fish, fish eggs and larvae, with no observed organism damage occurring outside 10 m from the source (Swan et al 1994). Given that the source is moving and marine organisms typically exhibit avoidance behaviour within 100–300 m (McCauley et al. 1998), only animals that cannot swim away will receive damage. These animals are likely to be limited to plankton, fish eggs and larvae, that is, those that are not free-swimming.

Due to the deep water and lack of light at the seafloor, benthic communities are sparse in the survey area. The seismic noise will be of relatively low intensity when it is received at the seafloor and is therefore unlikely to affect benthic organisms.

Cetaceans employ an extremely acute acoustic sense to monitor their environment and communicate. Seismic noise may interfere with the acoustic perception and communication of any cetaceans in the vicinity, and may have the potential to induce stress. The distance at which cetaceans react to seismic noise is variable because different cetaceans have different sensitivities. Baleen whales are sensitive to low and moderate frequency sounds, therefore they would be able to hear and respond to seismic surveys (McCauley 1994).

McCauley et al. (1998) studied the effects of seismic noise on humpback whales in the Exmouth Gulf region of Western Australia. Localised avoidance behaviour was noted during the production of seismic noise and it was concluded that the animals are at low risk of physiological effects unless they are close (perhaps to within a few hundred metres) to the seismic airgun array.

The GeoStreamer® Survey will use soft start-up procedures to induce localised avoidance behaviour before the onset of the full seismic noise. Once the survey is started, the firing of the airgun array is continuous and the seismic vessel will be slow moving, relative to free-swimming organisms. This allows such organisms in the survey path to clear the area. Impacts on cetaceans will be minimised by following protocols based on industry best practice and EPBC Act Policy Statement 2.1 – *Interaction between offshore seismic exploration and whales* (DEWHA 2008). These measures include:

- Implementing protection zones around survey vessel as follows:
  - *Observation zone* 3+ km radius from acoustic source: whales monitored to determine if they are approaching the low power zone.
  - *Low power zone* 2 km to 500 m radius from acoustic source: if whales enter this zone, the acoustic source should immediately power down to low setting.
  - *Shutdown zone* <500 m radius from acoustic source: if whales enter this zone, the acoustic source shuts down.
- Conducting pre-start visual observations for 30 min period, to identify any whales in the Observation zone.
- Conducting soft start procedures over 30 min period, involving a sequential build-up of warning pulses at the start of each acquisition line to deter marine mammals from the area.
- In the event of three or more power-downs per day due to large baleen whales (humpbacks, blues or southern rights) entering the *Low power zone*, demonstrating a low risk of encountering whales during night time operations through enhanced chase vessel observations 5 km ahead of the seismic vessel's course.

It is not possible for the survey's seismic source itself to be used to detect marine mammals – the frequencies used are designed to detect sub-surface conditions, not intermediate objects in the water column. Also, the concept of an additional sonar system to detect marine mammals is not practical because it would create interference with the seismic survey.

Vessel noise is considered to be an insignificant risk because of its common occurrence – other vessels regularly pass through the area.

4.2.5 Disturbance to coral reefs and intertidal habitats

Fringing coral reef communities exist near Suai and Betano, adjacent to the nearshore sections of the survey area (as discussed in Section 3.4.4). The likelihood of the *Beaufort Explorer* or its streamer snagging on intertidal habitats is considered low; a number of mitigation measures will be in place for the nearshore sections of the survey:

- a bathymetric survey has been conducted throughout the survey area, during the Bicuda Survey in 2008. This data will be consulted during the GeoStreamer® Survey;
- minimum operational water depth of 10 m in areas where bathymetric surveys have been undertaken that confirm there are no reefs or intertidal shoals (otherwise the minimum water depth for operation is 15 m);
- 500 m exclusion zone observed between any part of the *Beaufort Explorer* or its streamer and any reef or intertidal shoal.

4.2.6 Accidental discharges

GENERAL HYDROCARBON SPILLS

Should any hydrocarbon spill occur during the GeoStreamer® Survey, the impacts associated with such a spill will be managed by implementation of the *Beaufort Explorer*'s Shipboard Oil Pollution Emergency Plan (SOPEP). The selection of an appropriate response strategy for the control and treatment of a spill will depend on a number of factors, such as prevailing weather, size and type of spill. For small spills, the *Beaufort Explorer*'s oil spill response equipment would be employed to contain and absorb the spill. For larger spills further from the coast, it may be environmentally-preferable to allow the spilled fuel to weather naturally until it disappears. During this weathering period, the location of the slick would be regularly monitored and the need for intervention assessed.

Once Marine Distillate Fuel or other hydrocarbon enters the sea it undergoes spreading and weathering. Weathering and dispersal rates depend on wind and sea state conditions. These factors have been described in a number of reports (Jones 1986; Kagi et al. 1988). Strong winds cause a slick to break up naturally. Small droplets of liquid hydrocarbon become entrained in the near surface part of the water column. This enhances natural biodegradation by increasing the surface area available to bacterial decomposition. Residues from weathered oil are subjected to further physical, chemical and biological degradation, which is enhanced in warm and oxygenated conditions such as the waters in the survey area.

LEAKAGE FROM MACHINERY

Leaks of hydraulic fluids from hoses and machinery lubrication oils could occur sometime during the project but are unlikely due to the safeguards in place, including preventative maintenance, manned operations and the presence of oil collection bunds. Further, there will be no open drains leading to the sea surface while operations are in process. Should such an event occur, spill volumes of hydraulic fluid would be very small.

STREAMER FLUID LEAKAGES

The seismic survey streamers could be damaged by a number of events ranging from shark bites penetrating the streamer to snagging on intertidal habitats. The *Beaufort Explorer* uses a solid streamer without any buoyancy fluid, with only minimal amounts (<250 L) of isoparaffinic hydrocarbon (kerosene) fluid used in the front and rear "stretch" assemblies of the seismic array. Safeguards discussed in Section 4.2.5 are relevant to this environmental aspect and result in a low environmental risk assessment.

BUNKERING (REFUELLING) INCIDENTS

It is possible that the *Beaufort Explorer* and chase vessel will require bunkering in Dili Port prior to the start of the survey. This depends on logistical arrangements for both vessels, as they may be able to leave their home ports with full tanks and adequate endurance to carry out the whole survey program without refuelling.

Spills caused by fuel handling mishaps are rare, but the number of times fuel is handled creates additional risk. A credible volume of fuel spilt as a result of a coupling failure or tank overflow has been estimated at 1 m^3. Quantities are minimised by shutdown of pumps and automatic closure of safety valves. Rupture of a fuel transfer hose typically leads to a spill of no more than 0.2 m^3.

To minimise the risk of a spill, bunkering will be carried out according to PGS procedures with the following safeguards as standard:

- use of wire-reinforced hoses and 'dry break' couplings;
- refuelling only during daylight hours and steady sea-state conditions; and
- the Master or First Officer of the vessel actively overseeing the operation.

The *Beaufort Explorer* has a SOPEP and meets international requirements for oil spill response equipment onboard, including sorbent booms.

VESSEL COLLISION

Given the lack of commercial fishing and shipping in the area, a release of Marine Distillate Fuel from a vessel collision is considered highly unlikely. The *Beaufort Explorer*'s fuel capacity is 1273 m^3, but a worst case scenario would be up to 275 m^3 of distillate fuel lost, which would have a generic leak frequency assessment estimated at approximately 1.1 x 10^{-6} (Apache 2001).

The risk of vessel collisions is minimised by adhering to IMO regulations and specifically by:

- keeping watch at all times;
- having fuel tanks protected by ballast tanks;
- maintaining radio contact between seismic and chase vessels at all times;
- regular updates on weather forecasts from local weather bureaus; and
- offloading of chase vessels only in suitable weather.

As previously stated, the *Beaufort Explorer* has a SOPEP and meets international requirements for oil spill response equipment onboard. However, if a spill of 275 m^3 enters the ocean, the most effective response strategy is to monitor the spill. Due to the light nature of the marine fuel and the high water temperature, a very high proportion of the spill will evaporate, but continual monitoring and spill modelling is required.

5. PERFORMANCE OBJECTIVES, STANDARDS AND CRITERIA

Section 4 identified the environmental risks associated with the survey; this section presents the environmental performance objectives that Eni has set, the standards that Eni has adopted to meet objectives, and the criteria by which Eni will measure its performance against their stated objectives. The following definitions are used:

- Performance Objectives are defined as: 'overall goals for environmental performance as they relate to individual aspects'.
- Standards are defined as: 'detailed performance requirements necessary to achieve the performance objectives'.
- Criteria are defined as: 'factors that provide a measure, either direct or indirect, relating to the performance standards'.

The performance objectives, standards and criteria for key environmental risks associated with the seismic survey are detailed in Table 5.1.

Table 5.1: Performance Objectives, Standards and Measurement Criteria

Performance Objectives	Standards	Criteria
MOBILISATION PHASE		
Environmental sensitivities and requirements of the area	Eni HSE Policy	Evidence of environmental inductions given to all crew. Key personnel familiar with environmental requirements, guidelines and procedures outlined in EMP and evidence that they are being followed.
Ballast water discharge	Indonesian *Law 23/1997* on Environmental Management APPEA Code of Environmental Practice 1996	Evidence of fresh water used in ballast system, or recent deballasting if seismic vessel uses sea water ballast
Introduction of exotic species from personnel/equipment	Best practice	Vessel hulls have been inspected prior to entering region
GENERAL OPERATIONS PHASE		
Minimise poor water quality (i.e. hydrocarbons or chemicals) from deck drainage	MARPOL 73/78 Annex I: Prevention of Pollution by Oil APPEA Code of Environmental Practice 1996	Deck drainage flows to oil/water separation device that is regularly checked for functionality Recovered oil is being transferred to mainland for disposal

Performance Objectives	Standards	Criteria
Avoid/minimise impact on water quality from discharge of domestic wastes	MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships Indonesian *Law 23/1997* on Environmental Management (Article 20)	Waste logs show compliance with MARPOL 73/78 and *Beaufort Explorer*'s Waste Management Procedures Waste logs show sewage is treated onboard seismic vessel prior to discharge Waste water treatment system is checked for functionality prior to commencement of activity
Minimise waste volumes of industrial and hazardous wastes released to the marine environment	MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships APPEA Code of Environmental Practice, 1996 Indonesian *Law 23/1997* on Environmental Management (Article 20 & 21) Basel Convention	Solid and/or hazardous wastes stored appropriately and transported onshore Waste logs show compliance with MARPOL 73/78 and *Beaufort Explorer*'s Waste Management Procedures. Solid and hazardous waste disposal records available showing disposal fate of all waste (no waste disposal in Timor Leste) Combustible waste incinerated
Elevation of water temperature from cooling water discharge	ANZECC (2000) water quality guidelines, <2°C above ambient	Water being discharged above sea level (allows for cooling and oxygenation as it falls to sea level)
Minimise atmospheric emissions of exhaust gases and CO_2	Greenhouse Challenge Plus reporting requirements APPEA Code of Environmental Practice 1996	Fuel consumption recorded and greenhouse gas emissions calculated Engines and equipment maintained regularly
Minimise acoustic disturbance to marine fauna	EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales (DEWHA 2008) APPEA Code of Environmental Practice 1996	Soft starts always undertaken Power downs when marine mammals in "low power" or "shutdown zone" Marine mammal observation log kept, and supplied to DNMA
Minimise disturbance to marine habitats such as reefs and intertidal shoals No leakage of kerosene from streamer array	Indonesian *Law 23/1997* on Environmental Management APPEA Code of Environmental Practice 1996	Evidence of bathymetric survey undertaken, such as bathymetric maps on board. Evidence that vessel has not operated in water depth less than 10 m, or 15 m in areas where no bathymetric data is available.
Minimise attraction of fauna to seismic survey lighting	APPEA Code of Environmental Practice 1996	Fluorescent lights observed on board.

Performance Objectives	Standards	Criteria
Minimise disturbance to traditional fishing and communities	DNMA Guideline #5 on Public Engagement Indonesian *Law 23/1997* on Environmental Management Eni HSE Policy	Evidence of public engagement program – meeting minutes, attendance lists etc. Evidence of email communication with DNMA Evidence of Information Notices distributed to adjacent coastal communities.
ACCIDENTAL DISCHARGES		
Avoid and minimise mortality of sensitive fauna from leakage from machinery	MARPOL 73/78 Annex I: Prevention of Pollution by Oil Indonesian *Law 23/1997* on Environmental Management APPEA Code of Environmental Practice 1996 *Beaufort Explorer* SOPEP	Compliance with seismic vessel procedures Operational oil/water separator, maintained regularly All releases of hydrocarbon >80 L reported to DNMA Compliance with SOPEP Amount of waste oil removed from seismic vessel recorded
Prevent spills of diesel, either from refuelling operations or vessel collision	MARPOL 73/78 Annex I: Prevention of Pollution by Oil Indonesian *Law 23/1997* on Environmental Management *Beaufort Explorer* SOPEP APPEA Code of Environmental Practice 1996 Vessel refuelling standards	*Beaufort Explorer* refuelling procedures followed Refuelling at Dili Port (if required) to be undertaken by vessel masters in daylight hours, suitable weather and steady sea-state conditions Safety zone gazetted around seismic survey SOPEP followed and oil spill equipment in place Spills of oil >80 L reported to DNMA Seismic vessel has navigation lighting and is visible at night Watch has been kept at all times
REPORTING		
Record of all incidents and non-conformances	Indonesian *Law 23/1997* on Environmental Management Eni *Procedure: Hazard & Incident Reporting & Investigation* (Eni 2007b)	Eni incident reporting procedure followed. All reporting has been undertaken according to implementation strategy and DNMA notified

6. IMPLEMENTATION STRATEGY

6.1 INTRODUCTION

This section details the environmental management systems and implementation strategies that will be in place for the GeoStreamer® Survey. These include responsibilities; training; reporting frameworks; mitigation and response activities; and monitoring procedures, which are intended to minimise environmental risk and to ensure that environmental performance criteria are met.

6.2 SYSTEMS, PRACTICES AND PROCEDURES

The project will be implemented under the umbrella of Eni's HSE Policy (Appendix A), which the seismic survey contractor, PGS must abide by. Eni will ensure that its personnel and contractors comply with all regulatory controls under relevant legislation and guidelines, as listed in Table 1.1, and with the commitments within this EMP. Key aspects of Eni's environmental management strategies include:

- HSE Integrated Management System and supporting documentation, certified to ISO 14001:2004 Environmental Management Systems;
- Emergency Response Plan covering Eni's activities in Timor-Leste;
- use of personnel with area experience; and
- compliance with APPEA Codes of Environmental Practice (1996).

An Eni representative will be onboard the seismic vessel for the duration of the survey. All crew of the *Beaufort Explorer* will receive an environmental induction at the commencement of the seismic survey. This induction will address the issues and actions identified within this EMP.

PGS as the seismic contractor has day-to-day control of the survey, and has formal, written management systems, practices and procedures for HSE management of its activities. This system and its components have been reviewed by Eni and determined to be acceptable and consistent with Eni's HSE Integrated Management System and the commitments detailed in this EMP. PGS HSE documentation includes:

- Project HSE Plan for Eni's GeoStreamer® Survey;
- *Beaufort Explorer* Medical Evacuation (Medevac) Plan for Eni's GeoStreamer® Survey;
- *Beaufort Explorer* Crew HSE Plan, detailing specific procedures of the seismic vessel including waste management and refuelling; and

- *Beaufort Explorer* SOPEP.

6.3 COMMUNICATION CHANNELS AND ROLES AND RESPONSIBILITIES

Generally, the principal communication channel regarding environmental aspects of the GeoStreamer® Survey will be between DNMA, through the EIA Coordinator, and Eni, through the company's Environmental Adviser. This includes incidents, non-conformances and auditing requirements. DNMA will have direct contact with PGS in a number of situations, including communication on trajectories of the survey and marine mammal logsheets. All email communications with the DNMA EIA Coordinator should be copied to the DNMA Director. Table 6.1 details preliminary contact information for key personnel involved in the survey, including representatives of the Government of Timor-Leste. An up-to-date contact list will be distributed to all parties at the beginning of the survey.

Table 6.1: Contact Details – GeoStreamer® Survey

Title	Name	Telephone	Email
Eni Timor Leste SpA			
Eni Environmental Adviser	Carrie Doncon	+61 9320 1132 (office)	Carrie.Doncon@eniaustralia.com.au
Eni Exploration Manager	Alessandro Trombetti	+61 9320 1137 (office)	Alessandra.Trombetti@eniaustralia.com.au
Eni Chief Geophysicist	David Hearty	+61 9320 1174 (office)	David.Hearty@eniaustralia.com.au
Eni Company Representative – Navigation/Quality	(To be advised)		
Petroleum Geoservices			
Beaufort Explorer Operations Manager	Kate Stonebridge	+65 6735 6411 (office) +65 9233 2808 (mobile)	kate.stonebridge@pgs.com
Beaufort Explorer Vessel Master		+47 6751 5897 Call sign: C6DQ3	beapc@pgs.com
Beaufort Explorer Party Chief Master		+47 6751 5892	beapc@pgs.com
Government of Timor-Leste			
DNMA Director	Augusto Pinto	+670 730 5826 (office)	Ano_pinto@yahoo.com
Chief of EIA Department	Cristovão da. C.P. Martins	+670 333 9119 (office) +670 733 5458 (mobile)	Ercio_0303@yahoo.com
Acting Director/ Chief of Fisheries	Lourenço dos Reis Amaral	+670 723 8304 (office)	Amarallourenco@yahoo.com
DNPG Acting Director/ Director of Planning	Elga Anita T. Pereira	+670 331 7143 (office) +670 740 5249 (mobile)	Pereira_elga@yahoo.com

The commitments that Eni and PGS will comply with to ensure protection of the environment are summarised in the Executive Summary of this document. Table 6.2 details the key roles and responsibilities for Eni and PGS personnel involved in the survey.

Table 6.2: Key EMP roles and responsibilities

Eni Crisis Management Team Leader (Managing Director)
Responsible for resourcing and compliance with HSE policy
Facilitates an emergency response strategy in the event of an incident
Facilitates communication with company personnel, government and the media in the event of an incident
Ensures overall compliance with the Eni EMP with advice from the Eni HSE Manager
Eni Exploration Manager
Supervises the Eni Offshore Seismic Supervisor
Assists the Crisis Management Team Leader in the event of an emergency
Liaises with the Eni Operations Manager
Eni Chief Geophysicist
Verifies that seismic contractor's management commitments are enacted
Assists the Crisis Management Team Leader in the event of an emergency
Reports incidents to the Eni Exploration Manager
Eni Environmental Adviser
Prepares the EMP and coordinates the environmental approvals process and public engagement program
Immediately notifies DNMA of any spill of hydrocarbons of greater than 80 L
Reviews the seismic contractor HSE documentation for acceptability and ensures compliance with the Eni EMP
Reviews seismic contractor environmental audits and conducts Eni independent audits to ensure compliance with the agreed environmental performance conditions
Provides advice in the event of an oil spill or other environmental incident
***Beaufort Explorer* Operations Manager**
Develops a HSE Interface Plan detailing the interface between PGS and Eni HSE management systems, particularly in emergency response scenarios
Ensures the PGS Project HSE Plan is consistent with this EMP
Develops systems, practices and procedures that meet Eni HSE Integrated Management System requirements
Identifies HSE requirements and communicates these to personnel
Manages and, where appropriate, executes vessel HSE activities
Ensures that the HSE effort and resourcing is consistent with vessel needs

Manages the HSE incident tracking system such that all identified actions are properly assigned and tracked to satisfactory closure
***Beaufort Explorer* Vessel Master and Party Chief**
Ensures that the Eni HSE Policy and the PGS Environmental Policy are followed
Responsible for implementation of the PGS HSE Management System and associated documentation on the seismic vessel
Ensures understanding of the Eni and seismic contractor systems through a review of the relevant documentation
Develops operation-specific procedures where required
Communicates the operating policies and procedures to all personnel, ensuring their compliance
Communicates the operational hazards and risks to the workforce and the importance of following good work practices
Monitors the performance against relevant environmental procedures, legislative requirements, commitments and conditions applicable to the GeoStreamer® Survey EMP
Maintains weekly email communication with DNMA (EIA Coordinator) regarding trajectories of the seismic vessel and marine mammal observation records
Reports incidents to Eni Environmental Adviser and Eni Chief Geophysicist
Assists with the conduct of an environmental audit of the seismic vessel and provides the results of this audit to the Eni Environmental Adviser
Eni Company Representative – Navigation/Quality (onboard *Beaufort Explorer*)
Ensures that Eni requirements are being fulfilled onboard during the survey, including commitments detailed in the EMP
Provides supervision and technical direction to personnel involved in the execution of HSE studies

6.4 TRAINING, AWARENESS AND COMPETENCE

Contractors and staff receive appropriate training on their environmental responsibilities in connection with the GeoStreamer® Survey. All Eni and PGS personnel receive an environmental induction, which addresses the issues and actions identified within this EMP.

6.5 MONITORING, AUDITING AND REPORTING

6.5.1 Monitoring

The discharge of domestic wastes will be periodically monitored to ensure that the performance standards in place for the activity are met. All solid and hazardous wastes stored onboard and sent onshore for disposal will be recorded in a waste manifest. Volumes of fuel used during operations will also be recorded on daily logs.

6.5.2 Auditing

Due to the limited nature of this survey, no audits are planned.

6.5.3 Incident reporting

All environmental incidents or deviations from this EMP will be reported in accordance with Eni's Procedure: Hazard & Incident Reporting & Investigation (Eni 2007b).

A reportable incident is defined as

- an incident mentioned in the EMP that has caused, or has the potential to result in, moderate to catastrophic environmental consequences, as categorised in the environmental risk assessment.
- the escape or discharge into the sea of more than 80 L of petroleum liquid.

DNMA will be notified of all reportable incidents within two hours, or as soon as practicable. Further, a written report will be emailed to DNMA within three days.

Additional regulatory reporting includes any non-conformance with the Performance Objectives detailed in this EMP.

6.6 MANAGEMENT AND REVIEW OF THE EMP

This EMP will be reviewed:

- if any significant new environmental risk arises; and/or
- before the commencement of any new activity or significant modification to processes described in this EMP.

Any significant incident occurring during operations would also trigger a review of the EMP.

7. REFERENCES

Apache Energy (2001). *Simpson Development: Public Environmental Report*, Report Number: EA-60-R1-110. Apache Energy Limited, Perth, Australia.

APPEA (1996). *Code of Environmental Practice*. Australian Petroleum Production & Exploration Association Limited, Canberra, Australia.

Burke, L, Selig, L and Spalding, M (2002). *Reefs at Risk in Southeast Asia*. World Resources Institute.

Conservation International (2007). *Biodiversity Hotspots*. Center for Applied Biodiversity Science, Conservation International.

CSIRO (1999). Survey and Stock Size Estimates of the Shallow Reef (0-15 m deep) and Shoal Area (15-50 m deep). *Marine Resources and Habitat Mapping within the Timor Sea MOU74 Box Volume 3: Seabirds and Shorebirds of Ashmore Reef.* Canberra, Australia.

DEWHA (2008). *EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales.* Department of Environment, Water, Heritage and the Arts, Australian Government.

Eni (2007a). *Procedure: Risk Management & Hazard Identification*, HSE Integrated Management System (Reference No.: HSE-PR-01), Eni Australia, Perth.

Eni (2007b). *Procedure: Hazard & Incident Reporting & Investigation*, HSE Integrated Management System (Reference No.: HSE-PR-03), Eni Australia, Perth.

Eni (2007c). *Procedure: HSE Auditing*, HSE Integrated Management System (Reference No.: HSE-PR-05), Eni Australia, Perth.

Eni (2008), *Bicuda 2D seismic survey, Environmental management plan*. HSE Integrated Management System (Reference No.: TL-HSE-PL-001), Eni Timor Leste S.p.A., Dili.

Environment Australia (2002). *White Shark (Carcharodon carcharias) Recovery Plan*. Environment Australia (now DEWHA), Commonwealth of Australia.

Environment Australia (2003). *Recovery Plan for Marine Turtles in Australia*. Prepared by the Marine Species Section Approvals and Wildlife Division, Environment Australia in consultation with the Marine Turtle Recovery Team. Commonwealth of Australia, Canberra.

FishBase (2006). *FishBase*. World Wide Web electronic publication. Froese, R. and D. Pauly. Eds., http://www.fishbase.org, version (10/2006).

Heyward, A Pinceratto, E and Smith, L (eds). (1997). *Big Bank Shoals of the Timor Sea. An environmental resource atlas.* eBook, Australian Institute of Marine Science, Townsville.

Jasarevic, T (2002). *Reviving fisheries in East Timor – Casting nets for development.* UN Volunteers, UNV News, #93, August 2002.

Jones, HE (1986). *Marine Resources Map of Western Australia.* Part I, The Resources; and Part 2, The Influence of Oil on the Marine Resources and Associated Activities with an Emphasis on Those Found in Western Australia. Western Australian Department of Fisheries Report No. 74, Fisheries Department, Perth, Australia.

Kagi, RI, Fisher, SJ & Alexander, R (1988). *Behaviour of Petroleum in Northern Australian Waters.* In: Purcell, RG & Purcell, RR (eds), The North West Shelf Australia Proceeding, North West Shelf Symposium. Petroleum Exploration Society of Australia Limited, Perth, Australia.

Last, PR & Stevens, JD (1994). *Sharks and rays of Australia*. CSIRO, Canberra, Australia.

McCauley RD (1994). *The environmental implications of offshore oil and gas development in Australia – seismic surveys.* In Swan, JM, Neff, JM and Young, PC (eds.), "Environmental Implications of Offshore Oil and Gas Development in Australia - The Findings of an Independent Scientific Review", pp. 19-122. Australian Petroleum Exploration Association, Sydney, Australia.

McCauley RD, Jenner MN, Jenner, C, McCabe KA and Murdoch, J (1998). The response of humpback whales (Megaptera novaeangliae) to offshore seismic survey noise: preliminary results of observations about a working vessel and experimental exposures. *APPEA Journal*, 38 (1): 692-707.

Molcard, R, M Fieux, and AG Ilahude (1996) The Indo-Pacific throughflow in the Timor Passage. *J. Geophys. Res*., 101, 12,411-12,420.

Nunes, MN (2001) *The Natural Resources of East Timor. A physical, geographical and ecological review*. Sustainable Development and the Environment in East Timor: Proceedings of the Conference on Sustainable Development in East Timor, 2001, Anderson, R & Deutsch, C Eds. Timor Aid, Dili, Timor-Leste.

OMV (2003) *Timor Sea Regional Environment Plan for Drilling Operations*. OMV Australia Pty Ltd, Perth, Australia.

Ross, JP (ed.). (1998). *Crocodiles. Status Survey and Conservation Action Plan* [Online]. 2nd Edition. IUCN/SSC Crocodile Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. (http://www.flmnh.ufl.edu/natsci/herpetology/act-plan/plan1998a.htm).

Sandlund, OT, Bryceson, I, de Carvalho, D, Rio, N, da Silva, J, Silva, MI (2001). *Assessing Environmental Needs and Priorities in East Timor*. Final Report. UNDP Dili and Norwegian Institute for Nature Research, Trondheim, Norway.

SKM (2001) *Sunrise Gas Project Draft Environmental Impact Statement for Woodside Energy Ltd*, Sinclair Knight Merz, Perth, Australia.

Storr, GM, Smith, LA & Johnstone, RE (1986). *Snakes of Western Australia.* WA Museum, Perth, Australia.

Swan, JM, Neff, JM and Young, PC (1994). *Environmental Implications of Offshore Oil and Gas Development in Australia – the findings of an independent scientific review,* Australian Petroleum Exploration Association, Sydney, Australia.

Timor-Leste (2006), *Travel Guide Timor-Leste: the Climate*. Web portal of the Government of the Democratic Republic of Timor-Leste, IT Division, Ministry of Transport, Communication & Public Works (http://www.timor-leste.gov.tl/AboutTimorleste/climate.htm).

timorNET (2007). *East Timor, an Information Service on East Timor*. University of Coimbra, Portugal.

UNEP-WCMC (2006), *Marine Turtle Interactive Mapping system (IMAPS), – Interactive Map Service*, (http://bure.unep-wcmc.org/imaps/indturtles/viewer.htm), Marine Programme, UNEP World Conservation Monitoring Centre, Cambridge, UK.

URS (2002) *Environment Plan for Jabiru Field*. Prepared for Newfield Australia (Ashmore Cartier) Pty Ltd, Perth, Australia.

US (2000). *Asia-Pacific Economic Update, January 2000. U.S. Pacific Command's Strategic Planning and Policy Directorate.* Regional Strategy and Policy Division, USCINCPAC J537, HI 96861-4015.

US Army Corps of Engineers (1963). Map SC 51-8: Bobonaro, Series T503, US Army, Washington, DC, USA. (http://www.lib.utexas.edu/maps/ams/indonesia/txu-oclc-21752461-sc51-8.jpg)

Veron, JEN And Stafford-Smith, M (2000). *Corals of the World*. AIMS, Cape Ferguson.

Western Whale Research (2007). *Marine Mammal Observer Field Report (Final) for Eni Timor Leste's Albacora 3D Seismic Survey* (MMO: A Jones), 1-23 September 2007. Western Whale Research, Busselton, Australia.

Western Whale Research (2008). *Marine Mammal Observer Field Report (Final) for Eni Timor Leste's Albacora 3D Seismic Survey* (MMO: S Peet), 29 November – 15 December 2007. Western Whale Research, Busselton, Australia.

Wilson, BR & Allen, GR (1987). *Major components and distribution of marine fauna.* In: Fauna of Australia, Vol 1A - General articles. Australian Government Publishing Service, Canberra Australia.

World Bank (2005). *World Bank Country assistance Strategy for Timor-Leste FY06-08.* Report No. 32700-TP, 18-Aug-05. Timor-Leste Country Management Unit, World Bank.

Wyatt, ASJ (2004). *Preliminary survey of the nearshore coastal marine environment of the south coast of East Timor: a baseline for assessing the impacts of a developing nation.* Bachelor of Engineering thesis, University of Western Australia (Nov 2004).

APPENDIX A

ENI HEALTH, SAFETY AND ENVIRONMENT POLICY

eni australia

HEALTH, SAFETY & ENVIRONMENT POLICY

In our hydrocarbon, exploration and production activities, Eni Australia and its associated companies are committed to maintaining a fair and effective culture in Health, Safety and Environment (HSE) for everyone involved in our activities.

This policy applies to all operational and project activities under Eni Australia's control, including activities carried out by contractors.

Eni Australia will:

- ✓ **Set Health, Safety and Environment as a core value for all business activities;**
- ✓ **Play a leading role in promoting best HSE practice throughout our activities;**
- ✓ **Set objectives and targets, implemented through appropriate programmes, thus ensuring the continual improvement in overall HSE performance;**
- ✓ **Implement safe working and fitness to work programmes to pursue the goals of zero harm to the health of, or injury to, people and protect the environment and business assets;**
- ✓ **Comply with relevant legislation and other requirements to which Eni Australia subscribes or apply company standards where laws and regulations do not exist;**
- ✓ **Assess and manage HSE risks across each life cycle for all business activities;**
- ✓ **Maintain a documented HSE Integrated Management System certified to ISO14001 which enables comprehensive reporting and review of performance;**
- ✓ **Include HSE performance in appraisal of staff and contractors;**
- ✓ **Prevent pollution and minimise greenhouse gas emissions, effluents, discharges and other impacts on the environment while safeguarding our resources; and**
- ✓ **Remain committed to sustainable development and the welfare of our host communities.**

Eni Australia expects that everyone recognises their personal responsibility for HSE and their right to report openly any HSE issue or concern. In addition everyone is obliged to intervene in the case of unsafe acts or conditions.

To ensure we meet these objectives and respect the interests of those who may be affected by our operations, Eni Australia will consult with, listen to and respond openly to all staff, contractors, regulators, customers, local communities and public interest groups.

Managing Director _____

Antonio Baldassarre

Date 15/10/2009

APPENDIX B

BEAUFORT EXPLORER – VESSEL SPECIFICATIONS

M/V BEAUFORT EXPLORER MARITIME AND SEISMIC SPECIFICATION

Maritime Specification

Name	: Beaufort Explorer
Owner	: Arrow Seismic Invest IV Limited
Maritime operator	: GC Rieber Shipping Limited
Flag	: Nassau
Port of registry	: Bahamas
Builder and date built	: Brattvaag, Norway 1983
Vessel classification society and notations to class Vessel, Helideck	: Det Norske Veritas + IAI(MV), EO,SF Supply
Call sign	: C6DQ3
IMO number	: 8112500

Vessel Dimensions

Length	: 84,70 m
Breadth	: 16.80 m
Draft	: 5.50 m

Vessel Tonnage

Gross (IMO-69)	: 3375 Tonnes
Net	: 1013 Tonnes

Vessel Capacities

Fuel (HFO & MGO) Day	: Storage tk:s 1273m3 @100%, 1171m3 @90%.
Fresh water	: 190m3
Lube oil	: 10m3
Cable oil	: 4.5m3
Fresh water maker type and capacity	: R/O plant 20m3/24hrs
Fuel consumption (shooting/ in transit)	: 15/11m3/24hrs at max speed
Maximum endurance	: 57 days
Maximum range at cruising speed	: 15400 nm
Vessel speed (cruising/maximum)	: 8 kn
Main propulsion systems	: 1 x diesel electric Liaanen TCN92/68A 1492KW
Propulsion type	: Azimuth thrusters – controllable pitch
Emergency propulsion type	: Aquamaster azimuth thrusters 1 x UL 2001/6100
Accomodation (single berths)	: 58 (14 single cabins, 22 double cabins)
Helideck	: 8.6 T
Cranes and other lifting plant	: 3 x 40TM, 1 x 80TM
Gate valve (number, size)	:

Electrical Installations and Power Supplies

Power plant	: 4 x Wartsila Vasa 8R 22 engines with 4 x AVK Generators
	: Emergency generator: 24 kW

Communication Systems

VHF Radio	: 2 x Sailor VHF DSC RT2048
	: 1 x Sailor VHF RT 143
SSB radio	: Furuno 1570 MF/HF
Email	: Master_beaufort@gcrieber.co.uk, beapc@pgs.com

Navigational Aids

Radar	: Furuno FR-2115, 3cm
	: Furnuo FR-2110, 3cm
Auto pilot	: Robertson AP9 MK3
Track Pilot	: MaxSea
Heading sensor	: Robertson Model SKR 82
Water speed log	: JRC NWW - 16
Echosounder	: Furuno –FE -700

Vessel Fire Fighting Equipment

Fire detection system	: Autronica Automatic Fire Detection type BX II
Fire Pumps	: 2x 100m3/h
Emergency fire pump	: 25m3/h
Helideck fire pop-up	: foam monitor
Hydrants and hoses	: 30
Inert gas and other fixed systems incinerator.	: FM200 – Engine room, compressor room,
Foam deluge system	: 3% AFFF, Foam concentrate to streamer deck
Portable fire extinguishers	: 86

Vessel Safety and Survival

Fireman's outfits	: 5
Breathing apparatus spares	: 6 cylinders
Life rafts	: 4 x 25 persons
	: 2 x 20 person
	: 2 x 16 person
MOB raft	: 4 x12 persons
Life jackets	: 110
Survival suits	: 65
Life buoys	: 19

HSE

Full compliance with SOLAS, Marpol 73/78 and other relevant maritime and industrial standards, E&P Forum and IAGC requirements

Hospital and medical facilities	: Yes
Environmental management	: Yes
Waste segregation onboard	: Yes
Refueling at sea procedures	: Yes

Acquisition Configuration

High capacity multi-streamer operations	: No
Source	: Single

Seismic Specifications

Streamer System

Manufacturer and type	: PGS GeoStreamer® (solid)
Skin material	: Polyurethane
Outside diameter	: 62 mm
Length of each group	: 12.5 m
Streamer set-up	: Typical 1 x 8100 m
Manufacture and type of hydrophones	: Teledyne T-2BX or equivalent and Velocity
Sensors Mark III	
Type of array (e.g. linear, binomial)	: Linear
Number of hydrophones per group/ distance apart	: 12 per 12.5m
Coupling between phones and pre-amp	: Capacitive
Sensitivity at 9 m depth (V/bar)	: 20 V/Bar
Depth	: project specific – 4m to 35m
Manufacturer and type of depth controller	: Digicourse 5011
Manufacturer and type of compass	: Digicourse 5011
Manufacturer and type of Velocimeters	: N/A

Recording System

Manufacturer and type	: GeoStreamer Data Acquisition System + gAS
Number of seismic and auxiliary channels	: Typical 1 x 648 + 48
Format(s) available	: SEG-D
Tape drives	: IBM 3592
Sample rates	: 0.5ms, 1 ms, 2 ms, 4ms
High cut filters available	: 428, 214, 107 Hz, 341dB/Oct
Low cut filters available	: 4.4Hz, 12dB/Oct
Auxiliary channels allocation	: Typically appended to streamer seismic data
Telemetry systems pre-amp gain	: 0 dB Hydrophones/18 dB Velocity sensors

Energy Source

Manufacturer and type	: Sodera G-Gun
Max Effective volume of standard array(s)	: (1 x 4130 cu in) at 2000 psi
Maximum number of sub-arrays	: 6
Standard array depth(s)	: 5 - 10 m (multilevel source not tested yet)
Position of depth transducers	: Front and tail of subarray
Working pressure	: 2000 psi or 2500 psi depending on volume
Type of firing sensors	: Moving coil
Position of firing sensors	: Each gun
Type of firing synchroniser unit	: RTS BigShot
Timing resolution	: 0.1 ms
Timing accuracy	: +/- 1.0 ms
Position of near/far field phones	: At each gun or cluster
Air compressors capacity	: 1100 cfm
Number of air compressors	: 3
Minimum time between shots for each array	: 6 - 7 s

Navigation and Positioning Systems

Differential GPS

Standard system	: Skyfix.XP and Starfix.HP
Subcontractor	: Fugro Survey AS
Processing software	: Multifix and SPM2000

Relative GPS (Source and Tailbuoy Positioning)

Standard system	: Seatrack 220 and 320
Processing software	: Starfix Suite

Vessel Heading Sensors

GPS heading reference	: N/A
Survey gyrocompasses, manufacturer/model	: 2 x SG Brown Survey Meridian

Echosounder

Manufacturer/model	: Simrad EA 600
Frequencies	: 12 + 38 kHz
Maximum sounding depth	: 2200 m

Integrated Navigation Computer System

Type	: ORCA-2D
Supplier	: Concept Systems Ltd
Hardware description	: Linux Based PC's
2 x IBM x3650 with RAID 5	
1 x HP XW 8600 with RAID 5	
1 x Dell Precition 390 with software RAID	
2 x Lenovo Think Centre M57 Display server	
Tape drives	: 3592 available

Onboard Seismic QC Processing

Standard hardware configuration	: 5 IBM Xseries 335 nodes
	: 1 Holoseis Hi-End Visualisation PC
Standard software configuration	: LINUX based PGS VIPER v4.0.1-3
	Parallel 3D Seismic processing and QC system

Onboard Seismic Data Processing : N/A

APPENDIX C

INFORMATION NOTICE

Eni Timor Leste

Eni Timor Leste S.p.A.

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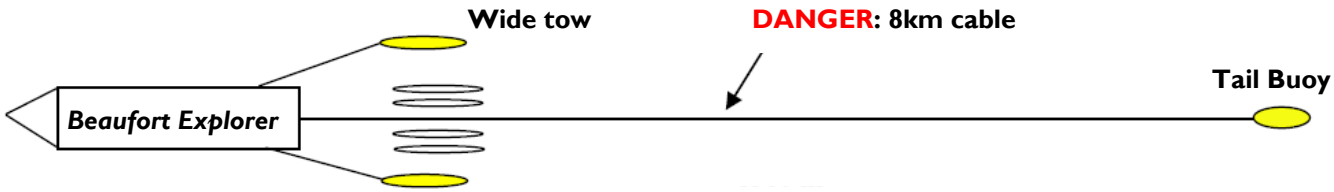
INFORMATION NOTICE
GeoStreamer® Trial 2D Seismic Survey

Eni Timor Leste is planning a 2D seismic survey using GeoStreamer® technology in the sea off the south coast of Timor-Leste. This survey is similar to work completed by Eni in 2008, in the same area. This Information Notice is part of Eni's Environmental Management Plan which has been approved by *Direcção Nacional do Meio Ambiente (DNMA)*.

Eni is using the company Petroleum GeoServices to do the survey. The survey will be around 2 days in duration, in early July 2010. It will be undertaken using the vessel ***Beaufort Explorer*** and the chase vessel ***Ocean Dynasty*** as support. The *Beaufort Explorer* sails at a constant speed of around 5 knots, towing one **8km-long cable**. At the end of the cable is a yellow Tail Buoy, with a flashing light for night time illumination. The *Beaufort Explorer* sails in different directions and her **manoeuvrability is limited**.



The *Beaufort Explorer* will be accompanied at all times by the chase vessel. The chase vessel will look out for fishing vessels ahead of the seismic vessel, and the crew speak Bahasa Indonesia. **For the safety of you and your boat, please keep clear of the *Beaufort Explorer* and her cable**.

During the survey both vessels will stay more than 2 km from the coast.

Further information can be found in the Environmental Management Plan available at www.sern-tl.org or from the contacts below. Please contact Eni and/or DNMA if you have any questions:

- Florencio Fernandes (Eni, Dili) ☎ 731 2099
- Augusto Pinto (DNMA, Dili) ☎ 730 5826
- Domingos (Bulldozer) (DNMA, Suai): ☎ 736 5693
- Davíd Sarmento (DNMA, Same): ☎ 734 0155