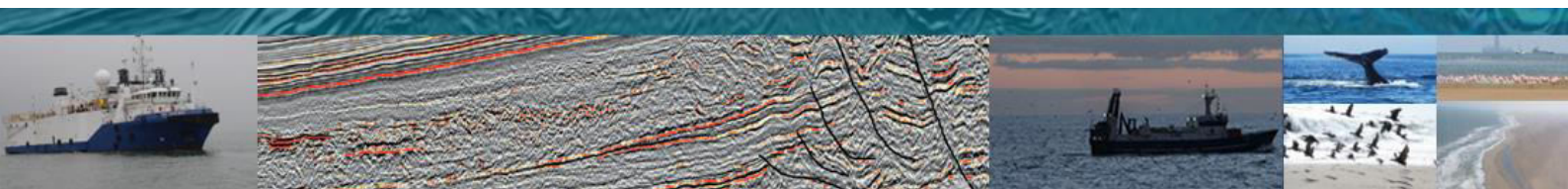


TGS Geophysical Company (UK) Limited

Final Environmental Management Plan (EMP) Report to Support the Application for Environmental Clearance Certificate (ECC) for the Proposed Multiclient or Proprietary 3D Seismic Survey covering Blocks 2513, 2613, 2614B, 2713, 2714A, 2714B, Kudu Gas Field 2814A, and 2814B and Portions of Blocks 2813A, 2814B, 2914A, 2915 and 2815, **Orange and Lüderitz Basins, Offshore Southern Namibia**



December 2022

Dukes Court, Duke Street,
Woking, GU21 5BH,
UNITED KINGDOM

SUMMARY INFORMATION

Proponent

TGS Geophysical Company (UK) Limited

MEFT ECC Reference Application No.

APP-00687

Project Title / Subject on the ECC

Environmental Clearance Certificate for the Proposed Multiclient or Proprietary 3D Seismic Survey covering Blocks 2513, 2613, 2614B, 2713, 2714A, 2714B, Kudu Gas Field 2814A, and 2814B and Portions of Blocks 2813A, 2814B, 2914A, 2915 and 2815, Orange and Lüderitz Basins, Offshore Southern Namibia

Petroleum Exploration Activities

3D Offshore Seismic Survey Operations

Location Survey Area of Interest

Blocks 2513, 2613, 2614B, 2713, 2714A, 2714B, Kudu Gas Field 2814A, and 2814B and Portions of Blocks 2813A, 2814B, 2914A, 2915 and 2815, Orange and Lüderitz Basins, Offshore Southern Namibia

National Regulatory Framework

Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007) and Environmental Impact Assessment (EIA) Regulations No. 30 of 2012

Proponent Address

TGS, Dukes Court,
Duke Street, Woking,
GU21 5BH, UNITED KINGDOM

Permitting / De-Risking Advisors / Environmental Consultants

Risk-Based Solutions (RBS) CC
10 Schützen Street, Erf No. 7382, Sivieda House
Windhoek Central Business District (CBD)
P. O. Box 1839, **WINDHOEK, NAMIBIA**
Tel: +264-61-306058 / 224780 / 236598
Fax: +264-61-245001, **Mobile:** 811413229
Email: smwiya@rbs.com.na
Global Office / URL: www.rbs.com.na

Environmental Assessment Practitioner (EAP)

Dr Sindila Mwiya
(PhD, PG Cert, MPhil, BEng (Hons), Pr Eng)

CITATION: Risk-Based Solutions (RBS), 2022. Final Environmental Management Plan (EMP) Report to Support the Application for Environmental Clearance Certificate (ECC) covering Blocks 2513, 2613, 2614B, 2713, 2714A, 2714B, Kudu Gas Field 2814A, and 2814B and Portions of Blocks 2813A, 2814B, 2914A, 2915 and 2815, Orange and Lüderitz Basins, Offshore Southern Namibia.

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NONTECHNICAL SUMMARY

TGS Geophysical Company (UK) Limited here in referred as (“**TGS**”) (the “**Proponent**”) is proposing to conduct multiclient or proprietary (exclusive) 3D seismic survey operations over a 63780 km² Area of Interest (AOI) situated in the Lüderitz and Walvis Basins Namibia. The proposed survey area falls in water depths ranging from ca-200 m to ca-2500 m from east to west, respectively. The proposed 3D seismic survey activities are planned to be implemented from February 2023.

The proposed survey will be undertaken over multiple survey events and seasons using one (1) or two (2) third-party chartered survey surveys compliant to the International Convention for the Prevention of Pollution from Ships (MARPOL) and Namibian Maritimes legal requirements.

The proposed survey area falls in water depths ranging from ca-200 m to ca-2500 m from east to west, respectively. The proposed 3D seismic survey activities are planned to start from January / February 2023, if the Environmental Clearance Certificate (ECC) is granted by the Environmental Commissioner in the Ministry of Environment, Forestry and Tourism (MEFT). The proposed survey will be undertaken over multiple survey events and annual seasons using one (1) or two (2) third-party chartered survey surveys compliant to the International Convention for the Prevention of Pollution from Ships (MARPOL) and Namibian Maritimes legal requirements.

This Environmental Management Plan (“**EMP**”) Report is prepared based on the findings and recommendations of the impact assessment results presented in the Environmental Impact Assessment (“**EIA**”) Report. This EMP Report provides key mitigations measures with respect to the significant impacts that the proposed multiclient 3D seismic survey activities are likely to have on the receiving marine environments (physical, biological, socioeconomic and ecosystem). The mitigation measures cover the entire outlined project area in the southern offshore Namibia and the immediate surrounding areas with respect to routine and non-routine or accidental events / activities during the mobilisation and pre-survey preparation, actual survey, and post survey / demobilisation operations project stages.

The proposed 3D seismic survey activities will be undertaken using chartered survey and will be undertaken over multiple survey events, over multiple seasons and using one (1) or two (2) survey vessels as may be required.

The environmental assessment process inclusive of the preparation of EIA and this EMP Reports has been undertaken in accordance with the provisions of Petroleum (Exploration and Production) Act 1991 (Act 2 of 1991) and associated amendments, the Environmental Impact Assessment (EIA) Regulations No. 30 of 2012 and the Environmental Management Act, 2007 as well as international best practices. Key project alternatives as described in the EIA Report have been considered and include: Project location and the no-action alternative, other marine users and potential user conflicts, influence on the ecosystem function, services, use values and non-use or passive.

Detailed mitigation measures and monitoring plan have been developed and are presented in this EMP Report for implementation and monitoring by the Proponent (TGS Geophysical Company (UK) Limited). TGS Geophysical Company (UK) Limited takes the environmental sensitivities of the offshore marine habitats seriously and integrates both environmental and social issues into the corporate governance of the company during the appraising and undertaking of marine seismic surveys operations globally. The mitigation measures presented in this report are modelled around two main concepts and these are: The industry and TGS Geophysical Company (UK) Limited best practices and local phenomena unique to the area of exploration (Orange and Lüderitz Basins, southern offshore Namibia).

In addition to the company’s strict compliance with all the relevant national regulations and standards of the country where the company operates, TGS Geophysical Company (UK) Limited always considers international standards of protection developed through the Joint Nature Conservation Committee (JNCC) “guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys”, and the International Association of Geophysical Contractors (IAGC)’s “recommended mitigation measures for cetaceans during geophysical operations”. These international best industry practices have proved to be effective in several different countries like Canada, Australia, Norway, and the United States. These guidelines have been developed based on noise attenuation modelling,

international experiences during seismic acquisition and a cautious approach to the disturbance of marine mammals from seismic surveys.

TGS Geophysical Company (UK) Limited has also tailored mitigation measures by merging the company's standard measures with local species events like turtle nesting windows, whale migration corridors, key fish spawning areas, key fishing seasons, breeding and feeding areas as well as several unique marine ecosystems of local area and in this case, the Orange and Lüderitz Basins, southern offshore Namibia. The overall EMP Framework and mitigation measures as presented in this report are tailored-made to Namibia's southern offshore environment.

The following is the summary of basis for the key mitigation measures that are presented in this EMP report and to be implemented by TGS Geophysical Company (UK) Limited with respect to the proposed 3D seismic survey activities over the Orange and Lüderitz Basins in the southern offshore Namibia:

1. Seasonality and timing.
2. Establishment of buffer zones.
3. Use of Marine Mammal Observer (MMO).
4. Use of Fisheries Liaison Officers (FLOs).
5. Use of Passive Acoustic Monitoring (PAM) Technology.
6. Soft starts' and 'pre-firing' observations.
7. Termination of firing in the 500m exclusion zone with respect to marine mammals.
8. Marine Animal Monitoring and Mitigation Plan aboard the Survey Vessel.
9. The use of Turtle friendly tail buoys.
10. The use of support vessel and fisheries liaison officer.
11. Pollution management.
12. Spill management.
13. Compliance to all MARPOL (marine pollution) regulations and waste disposal procedures, and.
14. Adoption of the precautionary principles in the absence of any specific mitigation measures being provide in this EMP, the Proponent shall always adopt the precautionary approach.

The EIA which is the specialist report on marine mammals, birds, fish and fisheries. It is hereby recommended that the Proponent (TGS Geophysical Company (UK) Limited be issued with an Environmental Clearance Certificate (ECC) for the proposed multi-client 3D seismic survey activities operations in the Orange and Lüderitz Basins, offshore southern Namibia. Good communication and pre-notification practices will limit unnecessary disruption and delays to other marine users. Due consideration should be given to the presence of all fishing vessels while running survey lines and communication channels should kept open to avoid close encounters. Additionally, support vessels moving to/from Lüderitz Bay may encounter commercial fishing vessels of other fishing sectors and potentially cause disruption, but on a very short-term. Adherence to prescribed maritime communication procedures will limit any likely encounters. In the interests of amicable co-use of the BCLME resources, and also for marine safety, the following procedures should mitigate any negative interactions with fisheries:

- (i) The surveyor must formally notify the Petroleum Commissioner (MME) of the survey, stating the proposed location of the survey lines, the commencement date and the anticipated duration.

- (ii) This information should also be relayed to all affected parties (Directorate of Maritime Affairs, Namibian Ports Authority, South African HydroSAN and the MFMR Monitoring, Control and Surveillance Unit - Walvis Bay).
- (iii) In the interest of good relations, direct communication and facilitation with any vessels in the area at the time of the survey is important. Openness to the possibilities of adjusting survey lines and trawling location to cause minimum disruption of operations to both parties.
- (iv) Good communications through MFMR to the fisheries (i.e., Association of Namibian Fishing Industries and the Namibian Large Pelagic and Hake Longlining Association) with pre-notification of survey activities and vessel paths (navigational co-ordinates of the survey area, timing and duration of proposed activities).
- (v) Notices to Mariners should be distributed timeously to fishing companies and directly to fishing vessels, stating the following:
 - a) The co-ordinates of the proposed survey lines.
 - b) The proposed survey timeframes and day-to-day location of the seismic vessel.
 - c) The proposed safe operational limits of the survey vessel, and.
 - d) Movements of support vessels.
- (vi) Radio Navigation Warnings and Notices to Mariners should be distributed via Navigational Telex (Navtext) and Lüderitz radio for the duration of the survey.
- (vii) It is recommended that updates of the scheduled weekly survey plan be circulated to the operators of affected fishing vessels on a daily basis and notify trawlers when the survey may move into trawling areas.
- (viii) Establish communications with the known long-line fishers if drifting buoys (with radar responders) are sighted.
- (ix) Award compensation for damage to fishing gear and other proven direct impacts should it be shown the damage is as a direct result of negligence on the part of the contractor, and.
- (x) An experienced Fisheries Liaison Officer (FLO) should be deployed on board the survey vessel to initiate and facilitate radio communications with maritime vessels in the vicinity of the survey area. The FLO should report daily on vessel activity, ramp up procedures, environmental matters, fauna sightings, and respond and advise on action to be taken in the event of encountering fishing gear.

October to April is the most favourable weather window to undertake the proposed 3D seismic survey activities operation especially in the deeper waters where there are less likely negative influences / overlaps of the proposed survey activities / area on the receiving sensitivity marine environments such as the fish, fisheries, and marine mammals. Within the deep-water portion of survey area, operations may be undertaken without major influences from the other marine users except the for the poor winter weather between June-October.

All environmental liabilities rest with TGS Geophysical Company (UK) Limited (the Proponent) and thus the company is ultimately responsible for the EMP implementation, environmental performance monitoring and reporting thereof to the Environmental Commissioner in the Ministry of Environment, Forestry, and Tourism as may be stipulated in the ECC to be issued. A “close up” report shall be prepared and submitted to the Government (Ministry of Mines and Energy, (MME), Ministry of Environment, Forestry, and Tourism (MEFT), Ministry of Fisheries and Marine Recourse (MFMR) and the Ministry of Work and Transport (MWT), Department of Maritimes Affairs) after completing each event of the proposed 3D seismic survey activities operations.

1. INTRODUCTION

1.1 General Overview

TGS Geophysical Company (UK) Limited here in referred as (“**TGS**”) (the “**Proponent**”) is proposed to conduct multiclient or proprietary (exclusive) 3D seismic survey covering Blocks 2513, 2613, 2614B, 2713, 2714A, 2714B, Kudu Gas Field 2814A, and 2814B and Portions of Blocks 2813A, 2814B, 2914A, 2915 and 2815 falling in the Orange and Lüderitz Basins Offshore Namibia (Figs. 11.1-1.4). The water depth of the 63780 km² of the proposed 3D seismic survey area of interest ranges from ca-200m to -2500m m from east to west, respectively.

The proposed 3D seismic survey is planned to be implemented from January / February 2023 subject to granting of the Environmental Clearance Certificate (ECC) by the Environmental Commissioner in the Ministry of Environment, Forestry and Tourism (MEFT). The proposed survey will be undertaken over multiple survey events and seasons / years with each survey event lasting for about seventy (70) days or more at sea. The survey vessel/s to be used will be in full compliant to all the provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL) and Namibian Maritimes legal requirements. The activities associated with proposed project have been grouped as follows:

- (i) Routine and physical presence of the survey and support vessels in the area including the Port of Walvis Bay, physical presence of survey and support vessels, Physical disturbance of the survey operations., sound generation from proposed 3D seismic survey airguns including sound of the survey and support vessels engines, increased light levels from routine vessels operations, atmospheric emissions from routine operations of the survey and support vessels, and planned marine discharges, and.
- (ii) Accidental events covering: Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils, loss of vessel, equipment or material, collision with marine wildlife during vessel operations, and, loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or another major event.

The following is the summary of the proposed project implementation stages as assessed in this Environmental Impact Assessment (EIA) Report with mitigation measures provided in the Environmental Management Plan (EMP) Report:

- (i) Mobilisation and pre-survey preparations.
- (ii) Actual survey operations.
- (iii) Post survey operations, and.
- (iv) Non-routine or accidental events.

Both the survey and support vessels will use existing facilities in the Port of Walvis Bay for supplies, fuelling and crew changeover as may be required and if required. No helicopter crew transfer support is anticipated except in event of an emergency.

1.2 Spatial and Survey Coverage and the EMP Applicability

The spatial coverage of the proposed 3D seismic survey and impact assessment and management thereof covers the current outlined initial survey area as shown in Figs. 1.1-1.3 and covering the current and future seismic survey extension falling within the Lüderitz and Walvis Basins, offshore southcentral Namibia. The outlined area shown in Figs. 1.1-1.3 is defined as the immediate impact zone.

The receiving environment in this area likely to be directly influenced by the survey activities will includes a radius of 500 m safety exclusion zone around the survey vessel and surrounding areas where discharges to sea and sound may propagate and affect marine wildlife and immediate environment. Survey area broader impact zone include all the surrounding socioeconomic zones likely to be affected by the proposed survey operations and logistics including support vessels.

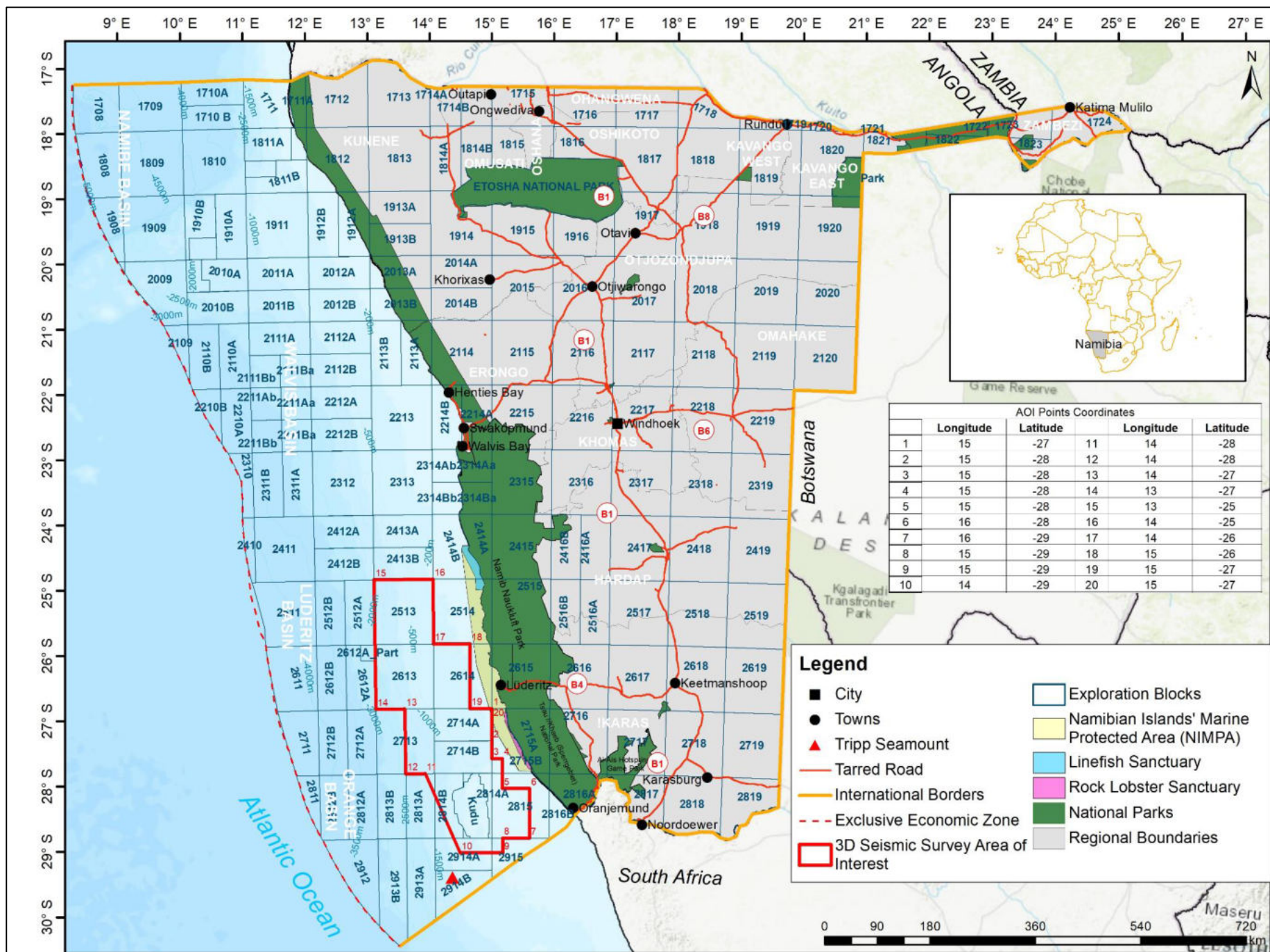


Figure 1.1: Regional location of the proposed 3D seismic survey coverage in the Orange and Lüderitz Basins, southern Namibia.

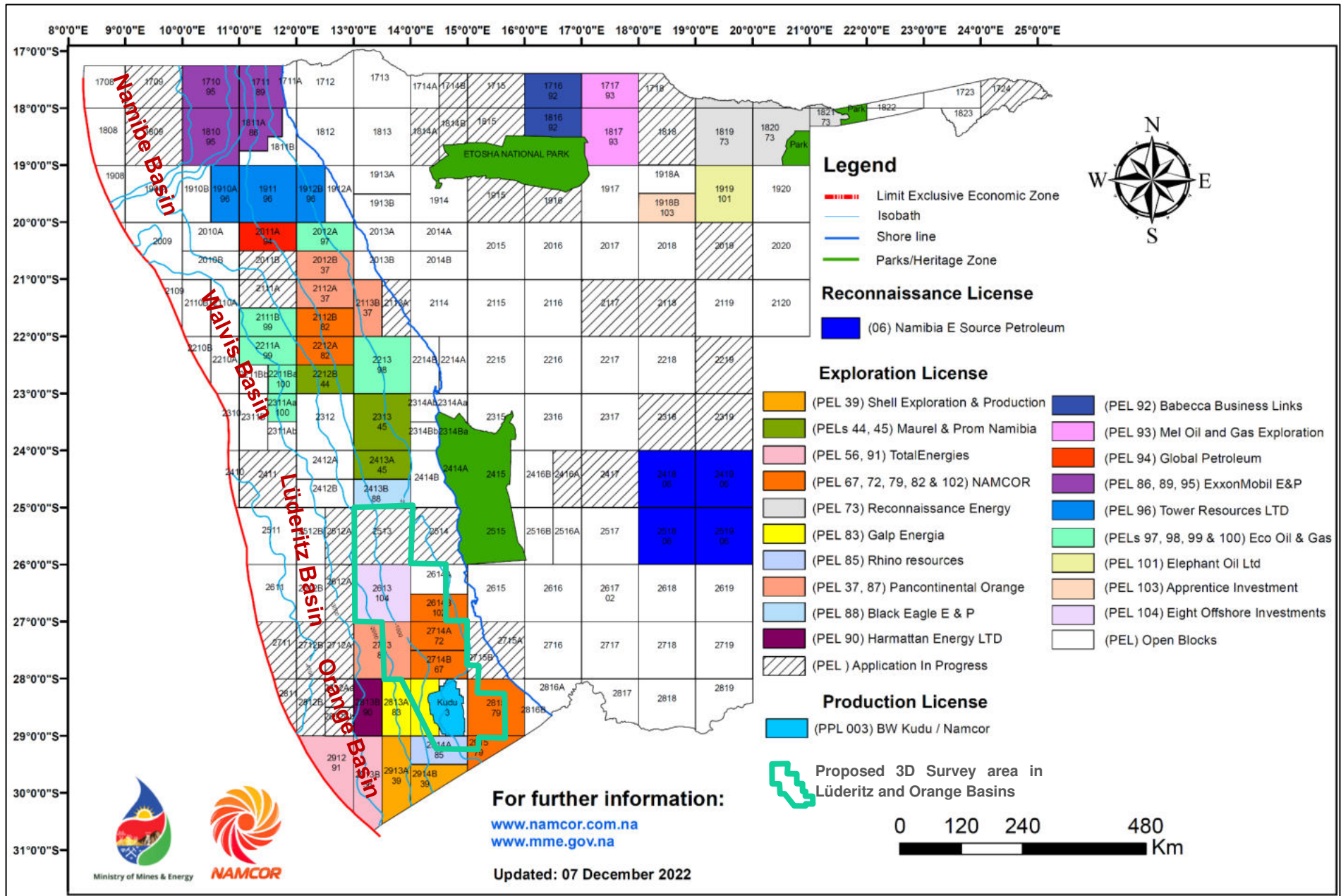


Figure 1.2: Hydrocarbon map of Namibia showing the proposed 3D seismic survey activities area covering Blocks 2513, 2613, 2614B, 2713, 2714A, 2714B, Kudu Gas Field 2814A, and 2814B and Portions of Blocks 2813A, 2814B, 2914A, 2915 and 2815 falling in the Orange and Lüderitz Basins Offshore Namibia (Modified Source: www.mme.gov.na).

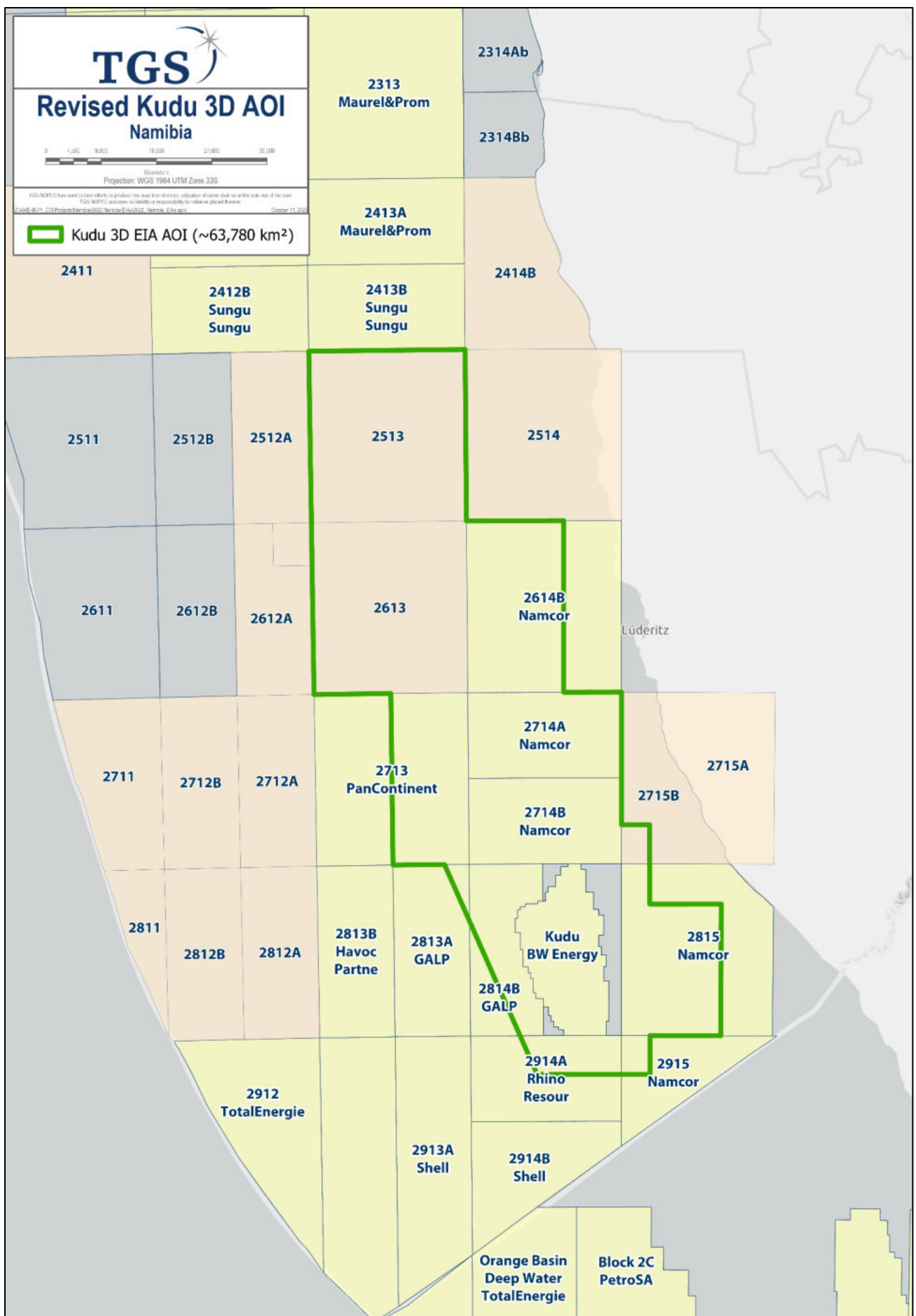


Figure 1.3: TGS proposed 3D seismic survey activities area covering Blocks 2513, 2613, 2614B, 2713, 2714A, 2714B, Kudu Gas Field 2814A, and 2814B and Portions of Blocks 2813A, 2814B, 2914A, 2915 and 2815 falling in the Orange and Lüderitz Basins Offshore Namibia with water depth ranging from ca-200 to-2500m.

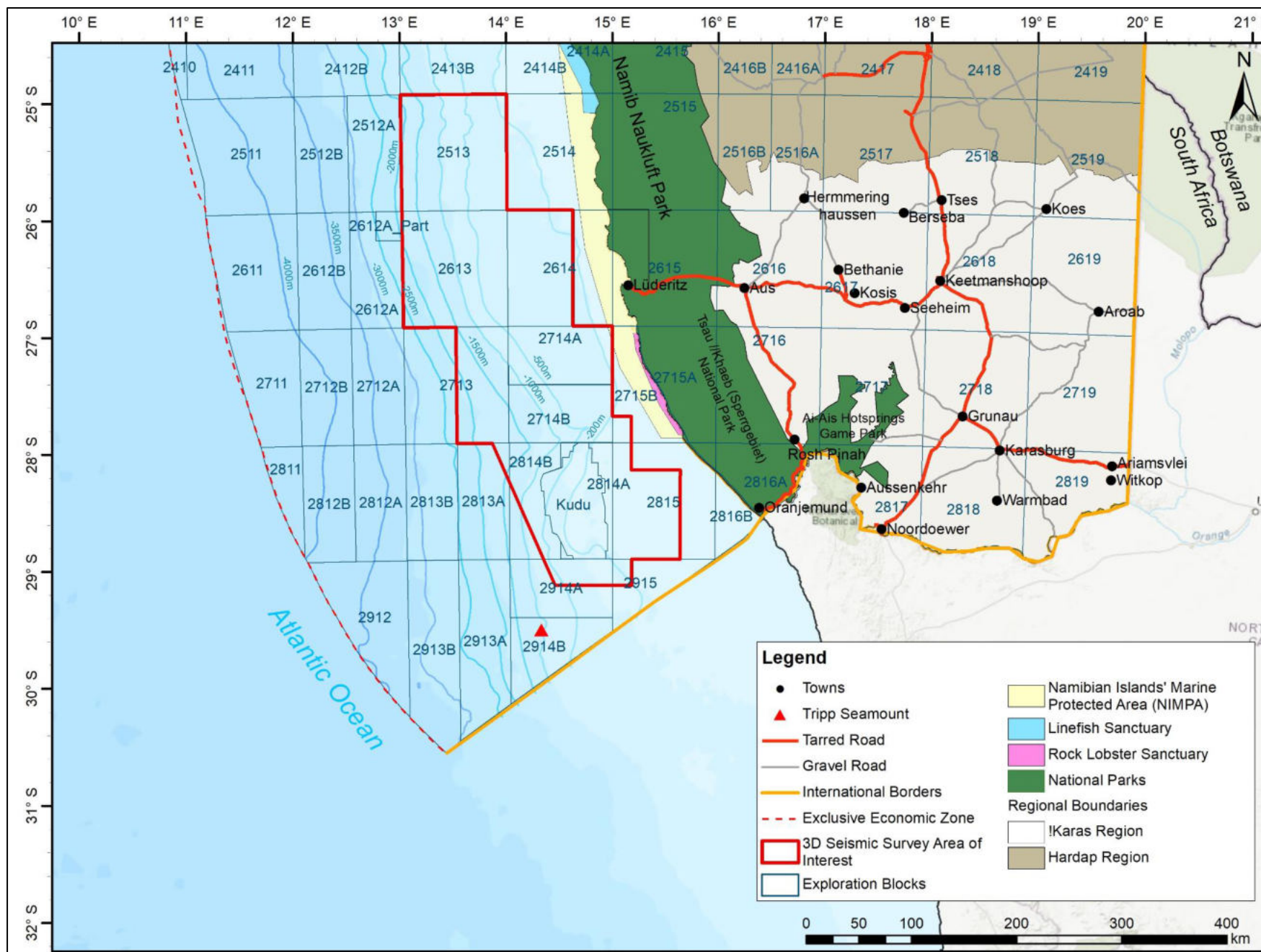


Figure 1.4: TGS proposed 3D seismic survey activities area covering Blocks 2513, 2613, 2614B, 2713, 2714A, 2714B, Kudu Gas Field 2814A, and 2814B and Portions of Blocks 2813A, 2814B, 2914A, 2915 and 2815 falling in the Orange and Lüderitz Basins Offshore Namibia with water depth ranging from ca-200 to-2500m.

1.3 Multiclient, Proprietary Surveys and Environmental Clearance Certificate

1.3.1 Overview

Geophysical and geological related surveys and data sets are acquired, processed, owned, stored and sold on either a Multiclient (MC) or proprietary (Exclusive) contractual business arrangements. TGS is a leading energy data and intelligence company, known for its asset-light, multi-client business model and global data collection (www.tgs.com/about-us/this-is-tgs). TGS employs approximately 480 employees with its corporate headquarters in Oslo, Norway and its operational headquarters in Houston, Texas, U.S.A. The company's other main offices are located in the UK, Brazil and Perth, with further employees located in other cities around the globe. The company's stock is traded on the Oslo Stock Exchange, is part of the OBX Index (25 most liquid shares at the OSE). TGS offers extensive global data libraries that include seismic data, magnetic and gravity data, multi-beam and coring data, digital well logs and production data, and new energy solutions data. TGS also offers specialised services such as advanced processing and analytics and cloud-based data applications and solutions.

1.3.2 Multiclient (MC) Surveys

Under a MC system, seismic survey is conducted by a seismic contractor company over an area that might be covering either a single or multiple Petroleum Exploration Licences (PELs) and unlicensed areas. The collected MC datasets are sold / licensed to a number of clients on a non-exclusive basis. The data acquired is held under a MC seismic data library owned by the contractor and later may be transferred to a partner/s / Government depending on the contractual and confidentiality arrangements.

The cost and findings from MC seismic survey data sets are shared among the different parties involved which may include: Seismic contractor, Government and Licence (PEL) holder/s. Contractually, the partnership decides how they split the cost and decide upon how the data will be managed and proceeds shared.

1.3.3 Proprietary / Exclusive Surveys

Proprietary also called Exclusive seismic survey is undertaken for a single client or partnership, and the area of coverage is often limited to specific licensed (PEL) area. The cost of the survey and ownership of the data under a proprietary seismic survey business arrangement falls under the responsibilities of the individual license (PEL) holder. On relinquishment of the petroleum exploration rights, the seismic data sets collected is handed over to the Government.

1.3.4 Environmental Clearance Certificate for Multiclient or Proprietary Surveys

An Environmental Clearance Certificate (ECC) granted to a Proponent who is a seismic contractor may be used to acquire both MC and Proprietary (Exclusive) seismic survey, on conditions that all the contractual arrangements and data ownership requirements among the various parties involved in the partnership including the Government have been agreed.

However, an ECC granted to a Proponent who is a license (PEL) holder may be used to acquire only Proprietary or Exclusive seismic survey data in line with provisions of the Petroleum Agreement with respect to the data ownership and other contractual requirements as agreed. The ECC applied for this project covers both MC and Proprietary (Exclusive) seismic survey business arrangements.

1.4 Project Motivation, Permitting and Regulatory Requirements

1.4.1 Project Motivation

Although offshore seismic survey operations in Namibia began as far back as 1968, a lot more still need to be done to have a full understanding of the petroleum systems of the deep-water offshore Namibia (Fig. 1.5). The datasets from the proposed 3D seismic survey by the Proponent will provide critical insight into the subsurface geological evolution, offshore basin architecture, depositional, structural history and delineate potential drill-ready subsurface geological structures.

The data sets to be acquired will:

- (i) Expand the overall offshore 3D seismic survey data coverage for Namibia (Fig. 1.5), and.
- (ii) Enhance the interpretation contrast, confidence, and overall quality of the results over the anticipated subsurface structures within the AOI.

The results and data from the proposed survey are likely to increase the interest by multinational oil and gas companies in conducting oil and gas exploration activities in Namibia. The increase in exploration activities could lead to additional commercial discovery of economic petroleum reserves. Recent discovery of light oil by TotalEnergies Venus prospect in Petroleum Exploration License (PEL) 56 and Shell Upstream Namibia BV Graff-1 in PEL 39 are likely to propel Namibia into an oil and gas producing country in the next six (6) to ten (10) years (Fig. 1.6).

The proposed 3D seismic survey can be classified as a small, short-term, local project aimed at supporting the development of fossil fuel opportunities offshore Namibia while at the same time will provide datasets that could support the development of other resources such as offshore wind energy, suitable industrial hydrogen sites, minerals resources and large-scale CCS facilities terrains. Namibia and indeed the global offshore continental shelves broadly represent the largest potential storage for Gigaton-scale Carbon Capture and Storage (CCS).

CCS is a promising and great potential emission reductions strategy towards meeting globally commitments targets, national regulatory compliances, meeting corporate performance targets, participating in potential new CO₂ banking and markets systems and meeting overall Environment, Social and Governance (ESG) national and corporate pillars.

1.4.2 Permitting Regulatory Requirements

Oil and gas exploration and production regulatory framework in Namibia provides for strict contractual obligations by a Proponent with respect to environmental performances. The proposed activities (3D seismic survey) fall under Petroleum (Exploration and Production), 1991, (Act No. 2 of 1991) is administered by the Petroleum Commissioner in the Ministry of Mines and Energy as the Competent Authority. Under Petroleum (Exploration and Production), 1991, (Act No. 2 of 1991) the implementation of 3D seismic survey requires the Proponent to adhere to environmental laws and regulations of the country.

Under the Environmental Impact Assessment (EIA) Regulations, 2012 and the Environmental Management Act, 2007, (Act No. 7 of 2007), the proposed 2D and 3D seismic survey cannot be undertaken without an Environmental Clearance Certificate (ECC). The Proponent is required to have prepared EIA and EMP Reports to support the application for the ECC for the proposed seismic survey operations.

In fulfilment of the environmental requirements, the Proponent appointed Risk-Based Solutions (RBS) CC as the environmental / permitting de-risking Consultant, led by Dr Sindila Mwiya and supported by Ms Emerita Ashipala and Mr Samison Mulonga as the Environmental Assessment Practitioners (EAPs) to prepare this Environmental Management Plan (EMP) Reports to support the application for ECC. This report has been prepared in accordance with the provisions of the EIA Regulations, 2012 and the Environmental Management Act, 2007, (Act No. 7 of 2007) (Fig. 1.7).

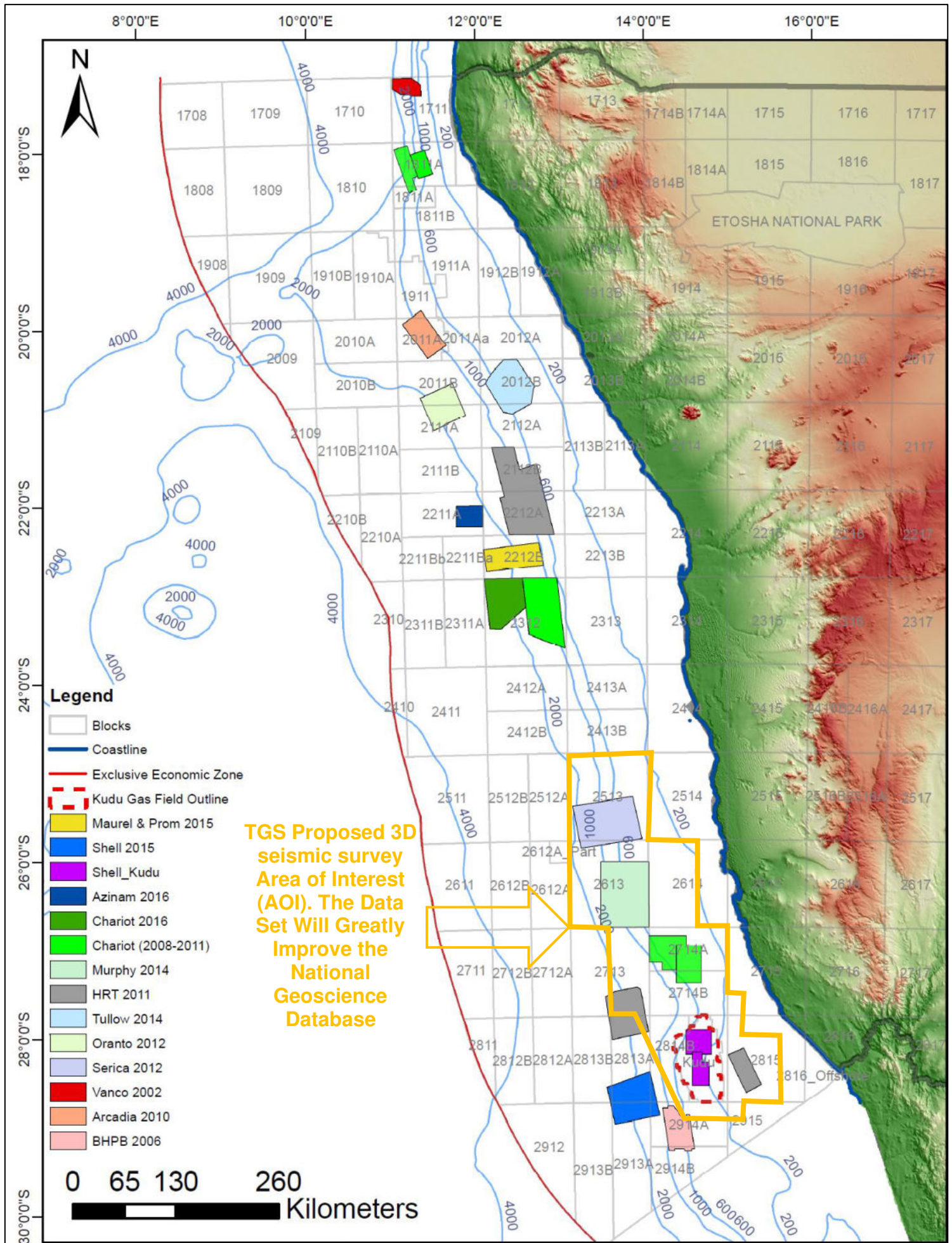


Figure 1.5: Overview of the 3D seismic survey database coverage of Namibia as of 2016 with respect to the proposed survey (Source: www.namcor.com.na).

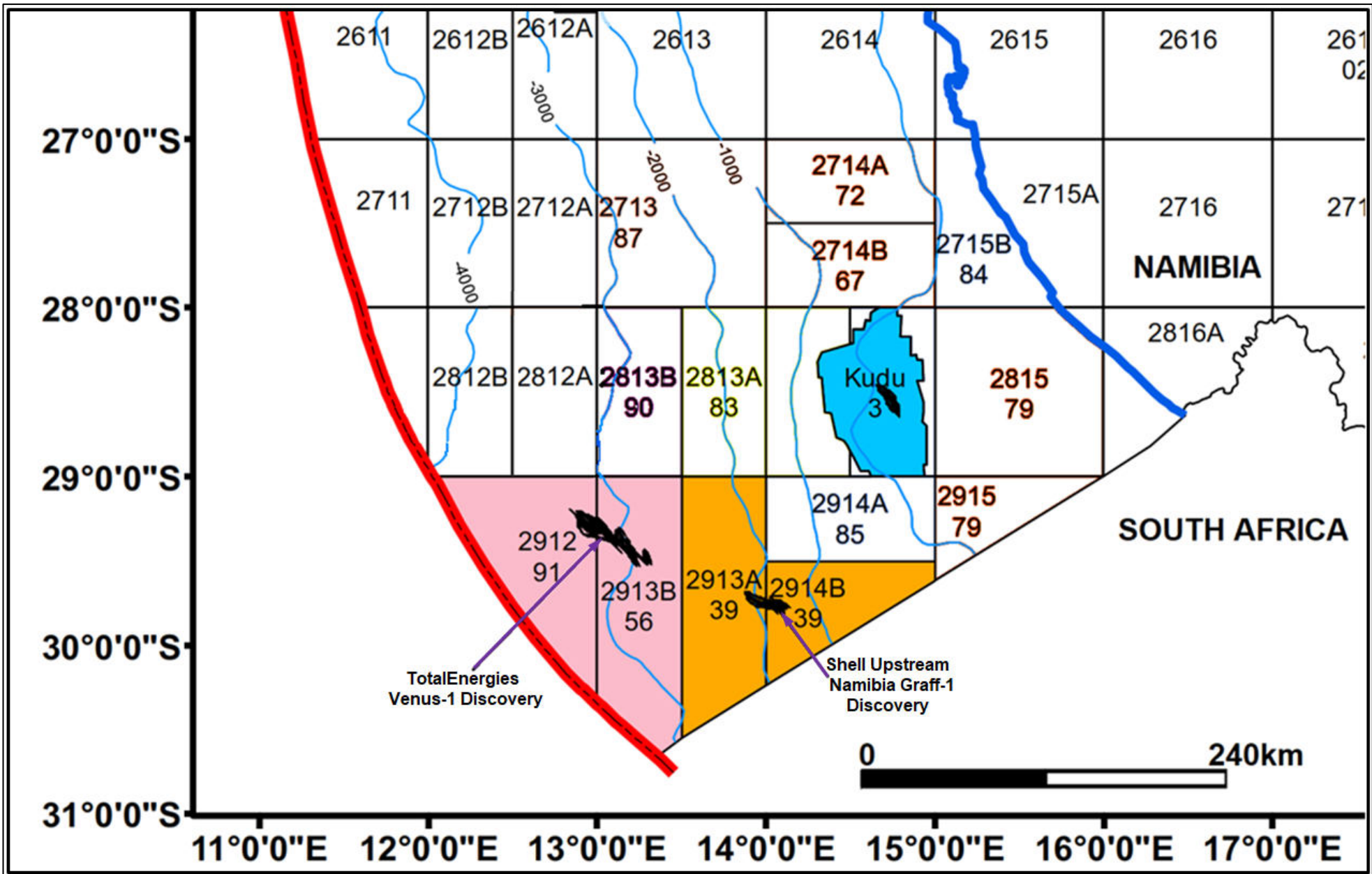


Figure 1.6: Locations of the known oil and gas discoveries offshore Namibia showing the Kudu Gas Field, the TotalEnergies Venus-1 discovery in Petroleum Exploration License (PEL) 56 covering Blocks 2912 and 2913B and the Shell Upstream Namibia BV Graff-1 discovery in PEL 39 covering Blocks 2913A and 2913B situated in the deep-water Orange Basin (Base map Source: www.mme.gov.na).

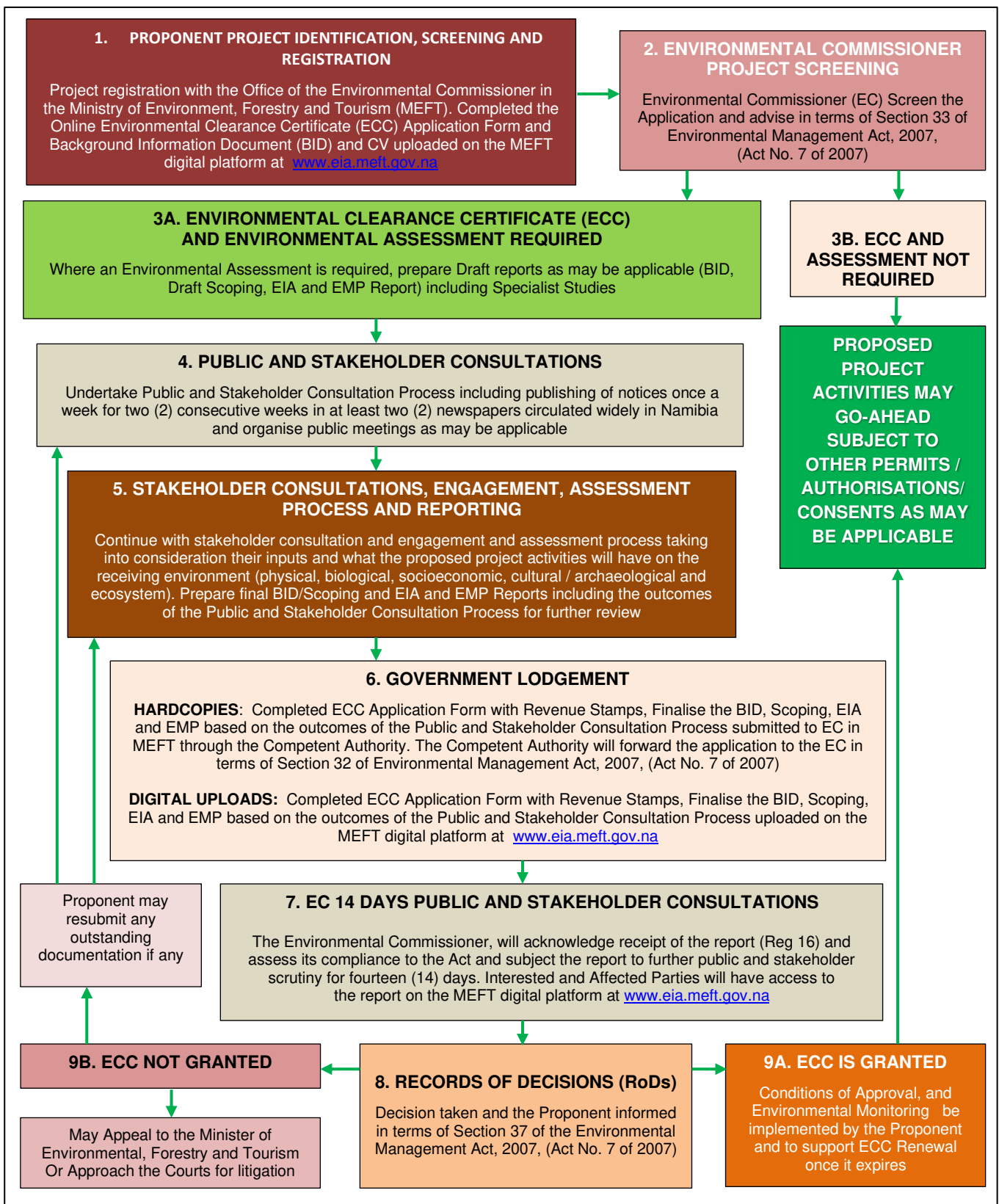


Figure 1.7: RBS schematic presentation of Namibia's Environmental Assessment procedure.

2. PROJECT SUMMARY AND REGULATORY REGISTER

2.1 Proposed Project Summary

The following is the general summary specifications of the proposed 3D seismic survey activities by TGS (Figs. 2.1-1.4):

- ❖ **Proposed activities** – Multiclient or Proprietary (Exclusive) 3D seismic survey.
- ❖ **Location** – Blocks 2513, 2613, 2614B, 2713, 2714A, 2714B, Kudu Gas Field 2814A, and 2814B and Portions of Blocks 2813A, 2814B, 2914A, 2915 and 2815 falling in the Orange and Lüderitz Basins Offshore Namibia (Figs. 1.1-1.4).
- ❖ **Summary of the 3D seismic survey layout (Fig. 2.1):**
 - Streamer Spread: 10 x 150 m x 8100 m
 - Streamer Depth: 15 m flat tow
 - Number of Channels: 648 per streamer
 - Fan Mode: 25% max.
 - Source Volume: ~ 3000 cu.in.
 - Source Depth: 8 m
 - Shot Point Interval: 12.5 m triple source fired sequentially
 - Sail Line Interval: 750 m
 - Record Length: 14 s cont. rec. (extracted and deblended)
 - Fold: 122, and.
 - Bin Size: 6.25 m x 25 m.
- ❖ **3D seismic survey Water Depth of the main key target area** – Ranges from ca-200m to -2500m from east to west respectively.
- ❖ **Nearest Namibian Port** –Port of Lüderitz or Walvis Bay.
- ❖ **Nearest fishing ground** –Tripp Sea Mount tuna fishing grounds (October – April fishing season).
- ❖ **Operating company** – TGS.
- ❖ **Survey vessel(s)** – To be confirmed and multiple vessels (2) may be used.
- ❖ **Type of Survey** – 3D Streamers.
- ❖ **Desired acquisition time** – From January / February if the ECC is granted by the Environmental Commissioner, and.
- ❖ **Estimated survey duration** –Seventy (70) days per survey event and multiple survey events will be undertaken over the next three (3) years.

2.2 General Description of a Typical Seismic Survey

Seismic survey is a key tool that resources companies exploring for hydrocarbons (oil and natural gas) use to map the subsurface and kilometres below the ground either on land (onshore) or in the sea (offshore). The basic principle of seismic survey method is the application of controlled generation of sound / acoustic waves by a seismic source to obtain an image of the subsurface. The generated

acoustic wave that travels deep into the earth, is reflected by the various rock formations of the earth and returns to the surface where it is recorded and measured by receiving devices called hydrophones (Figs. 2.1-2.3).

Airguns are the most common sound source used in modern offshore seismic surveys (Figs. 2.1-2.3). An airgun is an underwater pneumatic device from which high-pressure air is released suddenly into the surrounding water. On release of pressure the resulting bubble pulsates rapidly producing an acoustic signal that is proportional to the rate of change of the volume of the bubble. The frequency of the signal depends on the energy of the compressed air prior to discharge. Arrays of airguns are made up of towed parallel strings (Figs. 2.1-2.3).

A single airgun could typically produce sound levels of the order of 220 - 230 dB re 1 mPa @ 1 m, while arrays produce sounds typically in the region of 250 dB re 1 mPa @ 1 m. Most of the energy produced is in the range of between 0 - 120 Hz bandwidth, although energy at much higher frequencies is also produced and recorded. High-resolution surveys and shallow penetration surveys require relatively high frequencies of between 100 – 1, 000 Hz, while the optimum wavelength for deep seismic work is in the 10 - 80 Hz range.

During the survey operation, the seismic vessel records the data from all the hydrophones, including accurate coordinates of the vessel and its hydrophones. As shown in Figs. 2.1-2.3 and Table 2.1, the proposed 3D seismic survey will employ numerous streamers and many hydrophones, providing enough data to give a detailed subsurface profile of the rock layers as illustrated in Figs. 2.1-2.3. The depths of the reflecting layers are calculated from the time taken for the sound to reach the hydrophones via the reflector. This is known as the two-way travel time.

The pulse of sound from the guns radiates out as a hemispherical wave front, a portion is reflected towards the hydrophones from rock interfaces. The path of the minute portion of the reflected wave-front intercepted by a hydrophone group is called a ray path. Hydrophone groups spaced along the streamer pick out ray paths that can be related to specific points on the reflector surface.

Graphs of the intensity of the recorded sound plotted against the two-way time are displayed as wiggle traces. Seismic recording at sea always uses the Common Depth Point (CDP) method. A sequence of regularly spaced seismic shots is made as the survey vessel accurately navigates its course. Shots are usually timed to occur at distances equal to the separation of the hydrophone groups. In this way up to 120 recordings of the echoes from any one of 240 reflecting points can be collected. Each represents sound, which has followed a slightly different ray path, but has all been reflected from the same common depth point.

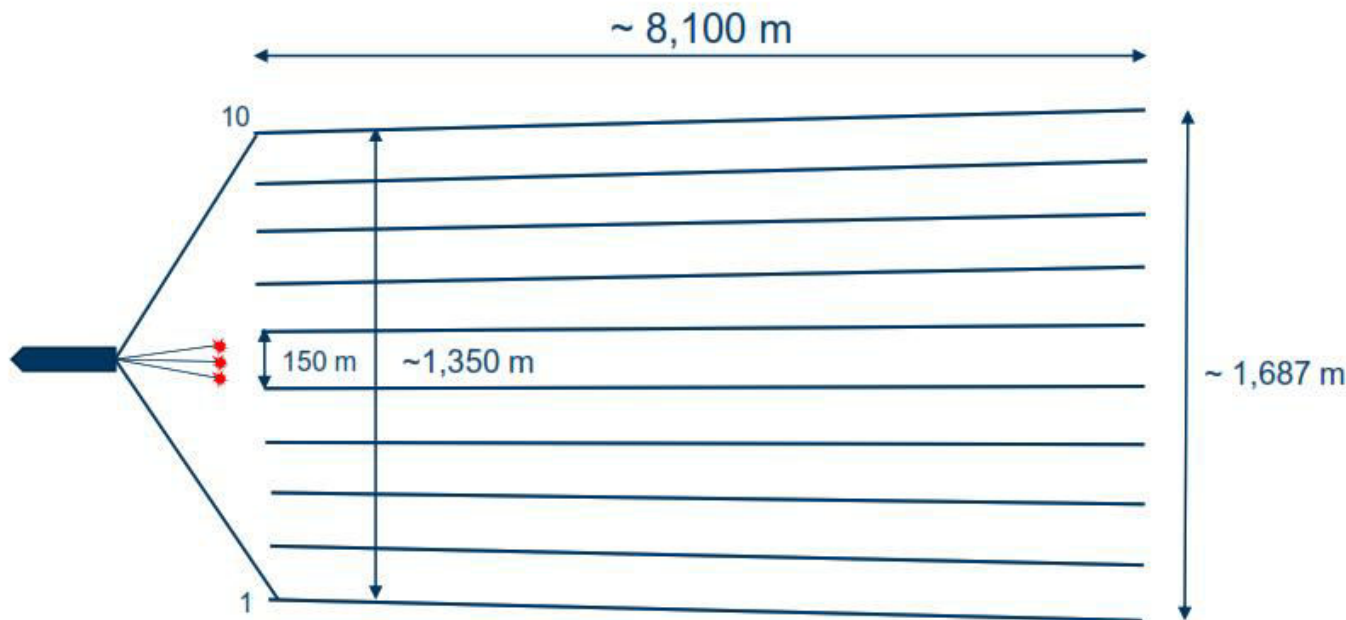
By analysing the time, it takes for the seismic waves to travel between the rock formations and the surface, geophysicists, geologists, and petroleum engineers use sophisticated software to create subsurface images /maps showing potential drill-ready subsurface geological structures called reservoirs that may contain hydrocarbons (Fig. 2.4).

2.3 Envisaged Logistical Arrangements Support

The vessel/s, helicopter and all other supporting equipment will to be used for the proposed 3D seismic survey will be in full compliance with all the requirements of the international convention on the prevention of pollution from ship (MARPOL) policies and practices as well as all the national marine related regulations administered by the Department of Maritime Affairs in the Ministry of Works and Transport (MWT) and Ministry of Fisheries and Marine resources (MFMR). The Ports of Lüderitz and Walvis Bay will serve as the operations base as may be required for the supply of materials, consumables, port requirements and services where needed.

Configuration 10 x 150 m x 8,100 m, Triple Source

TGS recommended configuration that optimizes source energy and desired bin size.
(Quad source compromises source energy for all providers)



Triple Source:
12.5 m shot-point interval

Not to scale

Parameter	Value
Streamer Spread	10 x 150 m x 8100 m
Streamer Depth	15 m flat tow
Number of Channels	648 per streamer
Fan Mode	25% max.
Source Volume	~ 3000 cu.in.
Source Depth	8 m
Shot-Point Interval	12.5 m triple source fired sequentially
Sail Line Interval	750 m
Record Length	14 s cont. rec. (extracted and deblended)
Fold	122
Bin-Size	6.25 m x 25 m

- 8 km offset data for imaging
- Bin-size 6.25 m x 25 m
- Fan mode for reduced infill

See the energy at
TGS.com

- 9 -

TGS

Figure 2.1: Example illustration of marine seismic survey layout and configurations.

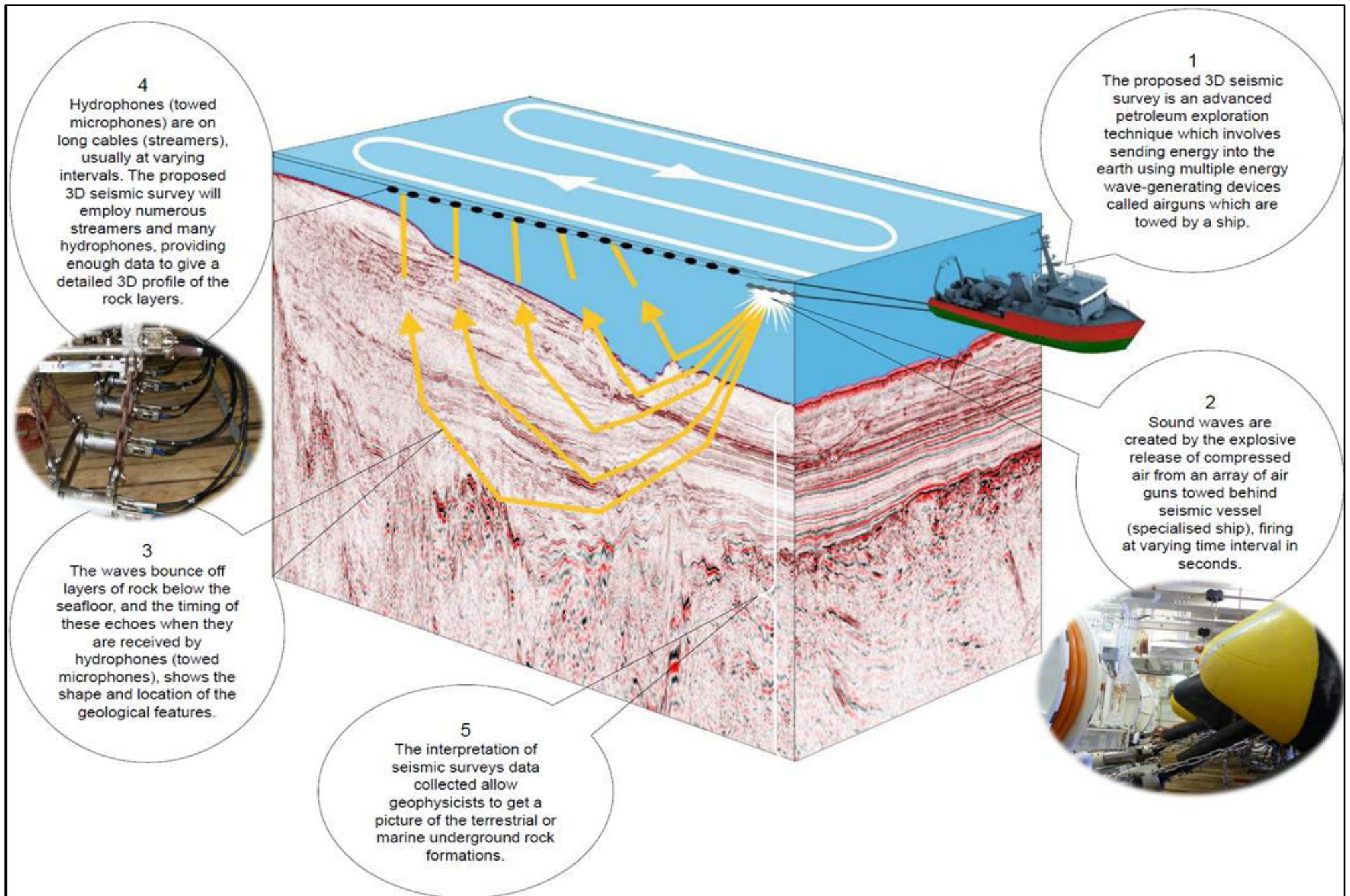


Figure 2.2: Illustration of the of the principles of marine / offshore seismic survey method.

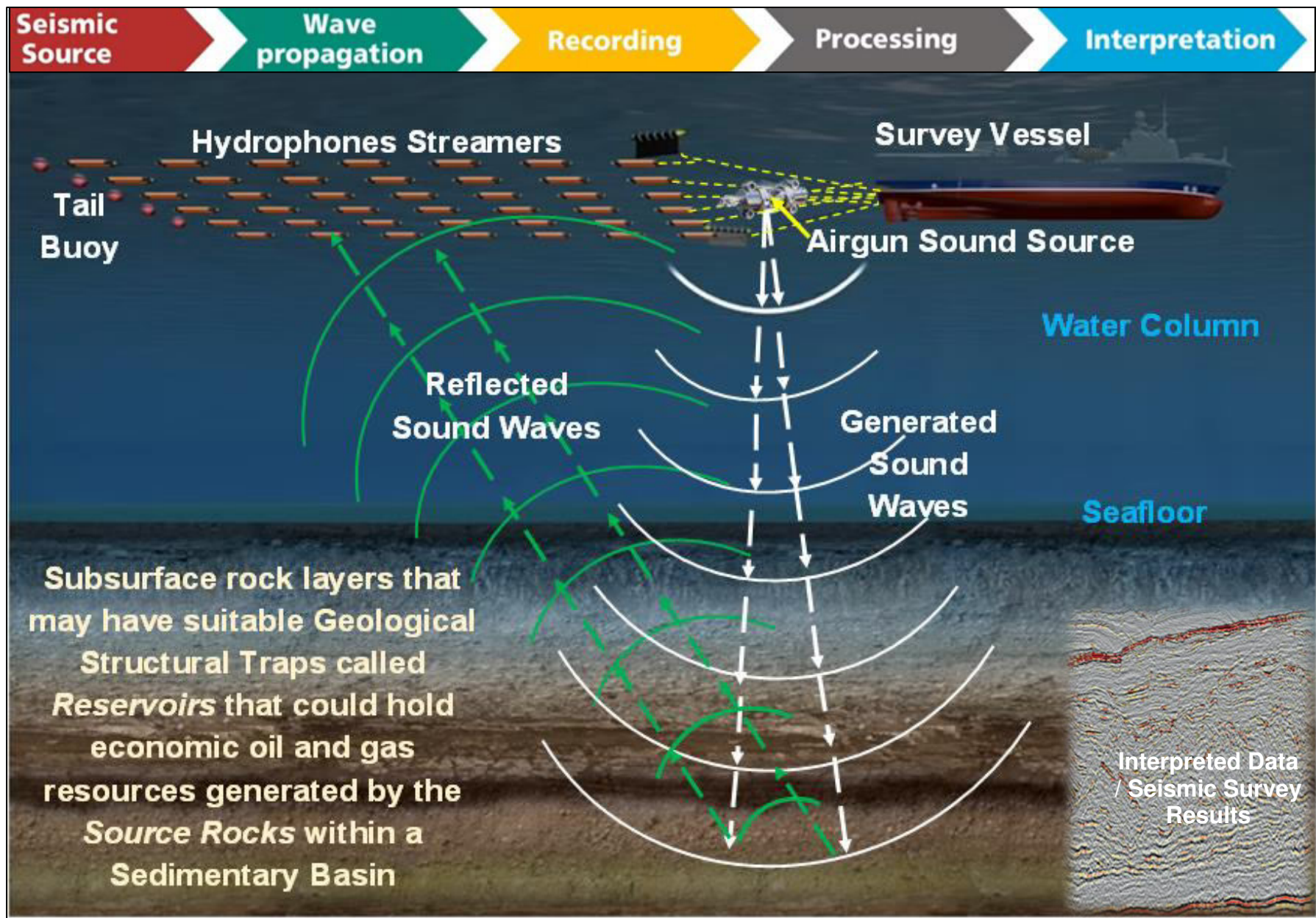


Figure 2.3: Illustration of the application of marine seismic survey method involving data collection and analyses of the times for seismic waves to travel between the various subsurface rock formations. Geophysicists, geologists, and petroleum engineers use sophisticated software to create subsurface images /maps showing potential drill-ready subsurface geological structures called reservoirs that may contain commercial hydrocarbons as shown in Fig. 2.4 (Image Source: www.youtube.com/watch?v=FN8IAb0rG9A).

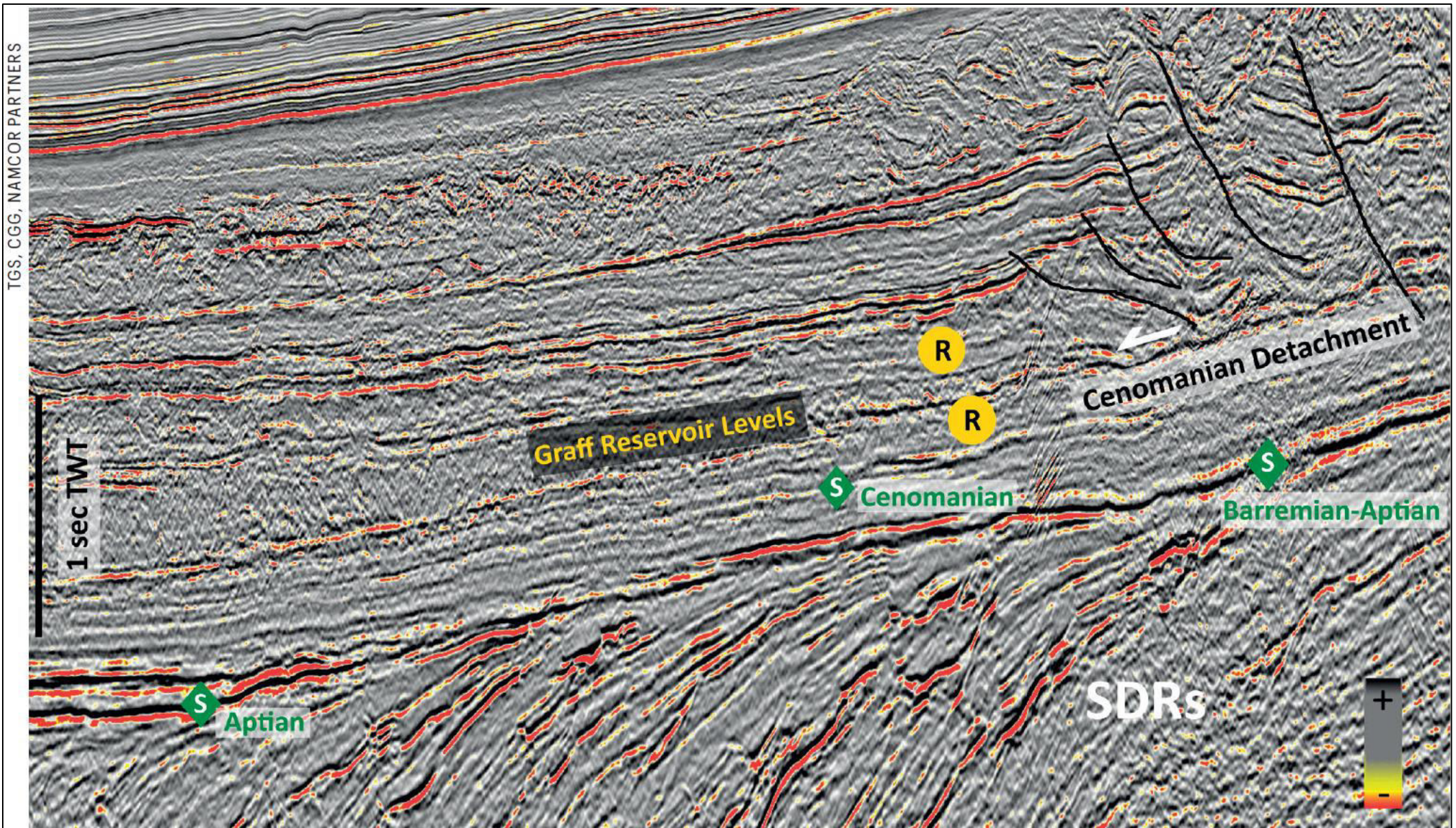


Figure 2.4: An example of the results of seismic survey data interpretation from the Orange Basin, offshore Namibia showing the SW–NE dip line through the Graff light oil discovery trend at the western end of the toe-thrust system and the base of the collapse structures. The Santonian–Campanian turbidites have been trapped above the outer high, which likely acts as a backstop for the reservoir influx from the east. Light oil in two different reservoir levels has been discovered by Shell in 2022 (Source: Winter F., Intawong A. and Robinson J., 2022).

2.4 Summary of Proposed Project Regulatory Register

The following is the summary of the regulatory register for all applicable legislations with respect to the proposed 3D seismic survey:

1. Namibian Constitution Articles 91(c) and 95.
2. Environmental Management Act, (EMA), 2007, (Act No. 7 of 2007) and Environmental Impact Assessment (EIA) Regulations No. 30 of 2012.
3. Petroleum Products and Energy Act 13 of 1990 (as amended by the Petroleum Products and Energy Amendment Act 29 of 2004, Act 3 of 2000 and Act 16 of 2003).
4. Namibian Ports Authority Act 2 of 1994 (as amended in 2000 and the accompanying 2001 Port Regulations).
5. Health Act (No. 21 of 1988) and Public and Environmental Health Act, 2015 (Act No. 1 of 2015).
6. Foreign Investment Act 27 of 1990.
7. Merchant Shipping Act 57 of 1951.
8. Water Act 54 of 1956 (as amended).
9. Sea Shore Ordinance 37 of 1958.
10. Aviation Act 74 of 1962 (as last amended by the Aviation Amendment Act 10 of 1991 and the Aviation Amendment Act 27 of 1998) (and the Namibian Civil Aviation Regulations 2001).
11. National Monuments Act 28 of 1969 (as amended by the National Monuments Amendment Acts 22 of 1970 and 30 of 1971, the Expropriation Act 63 of 1975, and the National Monuments Amendment Act 35 of 1979).
12. Hazardous Substance Ordinance 14 of 1974.
13. Atmospheric Pollution Prevention Ordinance 11 of 1976.
14. Dumping at Sea Control Act 73 of 1980.
15. Marine Traffic Act 2 of 1981 (as amended by the Marine Traffic Amendment Act 5 of 1983, the Marine Traffic Amendment Act 15 of 1991, and the Namibia Ports Authority Act 2 of 1994).
16. Prevention and Combating of Pollution of the Sea by Oil Act 6 of 1981 (as amended by the Prevention and Combating of Pollution of the Sea by Oil Amendment Act 59 of 1985, Act 63 of 1987, and Act 24 of 1991, and the Namibian Ports Authority Act 2 of 1994).
17. Territorial Sea and Exclusive Economic Zone of Namibia Act 3 of 1990 (and the Territorial Sea and Exclusive Economic Zone of Namibia Amendment Act 30 of 1991).
18. Nature Conservation Amendment Act 5 of 1996.
19. The Marine Resources Act 27 of 2000 (and the Regulations relating to the Exploitation of Marine Resources 2001).
20. Wreck and Salvage Act 5 of 2004.
21. National Heritage Act 27 of 2004 (and the Regulations/Appointments/Declarations made under the National Monuments Act 28 of 1969 and the Regulations 2005).

22. Atomic Energy and Radiation Protection Act 5 of 2005 (and the Radiation Protection and Waste Disposal Regulations 2011).
23. Labour Act 11 of 2007 (and the Labour Amendment Act 2 of 2012).
24. Tobacco Products Control Act 1 of 2010 (and the Regulations).
25. Disaster Risk Management Act 10 of 2012.
26. International Conventions and Protocols:
 - a) International Plant Protection Convention (IPPC) 1951 (as last amended in 1997).
 - b) Convention on Wetlands of International Importance, Especially as Waterfowl Habitat (The Ramsar Convention on Wetlands) 1971.
 - c) Declaration of the United Nations Conference on the Human Environment 1972.
 - d) Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) 1972 (as amended).
 - e) Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (and amendments)
 - f) International Convention for the Prevention of Pollution from Ships (MARPOL) 1973 (as modified by the Protocol of 1978.
 - g) International Convention for the Safety of Life at Sea (SOLAS) 1974 (as amended).
 - h) United Nations Convention on the Law of the Sea (UNCLOS) 1982.
 - i) Vienna Convention for the Protection of the Ozone Layer 1985 and Montreal Protocol on Substances that Deplete the Ozone Layer 1987.
 - j) Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal 1989.
 - k) International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC) 1990.
 - l) United Nations (UN) Framework Convention on Climate Change 1992 and Kyoto Protocol to the UN Framework Convention on Climate Change 1997.
 - m) Convention on Biological Diversity (CBD), Rio de Janeiro, 1992.
 - n) Stockholm Convention on Persistent Organic Pollutants (POPs) 2001 (as amended in 2009 and 2011).
 - o) United Nations Educational, Scientific and Cultural Organization (UNESCO) Convention on the Protection of the Underwater Cultural Heritage 2001.
 - p) Convention for the Safeguarding of the Intangible Cultural Heritage 2003.
 - q) Convention on the Protection and Promotion of the Diversity of Cultural Expressions 2005.
 - r) Revision of International Standards for Phytosanitary Measures No. 15 Regulation of Wood Packaging, and.
 - a) Regional Agreements: Southern African Development Community (SADC) Protocol on Mining 1997 and on Energy 1998.

3. EIA RESULTS AND MITIGATIONS MEASURES

3.1 Introduction

The potential positive and negative impacts likely to be associated with the proposed 3D seismic survey have been identified, described, and assessed in the EIA Report. Mitigation measures are described in this EMP report.

3.2 Summary Assessment of Positive Impacts

The following is summary of the key positive impacts that the proposed 3D seismic survey activities will have on socioeconomic landscape of Namibia:

- ❖ Increased earnings by the State through rights' rentals and payment of direct and indirect taxes.
- ❖ Increased understanding and knowledge of the deep-water petroleum systems of Namibia that could finally led to the discovery of economic oil or gas resources that will change the economic landscape of Namibia for benefits of its people.
- ❖ Contributions to the national geosciences' skills development and knowledge transfer through on job training and short-term job attachments of Namibians.
- ❖ Contributions to the short and long-term strategies of attracting investments in the petroleum exploration sector in Namibia through new data acquisition, research, monitoring and management.
- ❖ Contribution to the long-term strategy that will promote the coexistence of petroleum operations with other marine users in Namibia.
- ❖ Direct contributions to the training of young Namibians through increased contributions to the national PetroFund which is currently offering several scholarships to Namibians to be able to study at foreign universities.
- ❖ Contributions to economic growth through ongoing exploration investments and potential future oil and gas discovery.
- ❖ Creation of employment opportunities through short and long-term contracts, and.
- ❖ Contribution to the development of local infrastructures and new businesses to support the ongoing oil and gas exploration opportunities particularly around the Port of Walvis Bay.

3.3 Summary Assessment of Negative Impacts

3.3.1 Overall EIA Negative Impact Assessment Framework

The overall impact assessment framework adopted for this project used the Leopold matrix which is one of the best known internationally matrix methodology available for predicting the impact of a project on the environment.

The Leopold matrix is a two-dimensional matrix cross-referencing the following:

- ❖ The activities linked to the project stages covering mobilisation and pre-survey preparations, actual survey operations, post survey operations, and non-routine or accidental events that are likely to have an impact on the receiving environment, and.
- ❖ The existing environments (physical, biological, and socioeconomic) that could possibly be affected by the project.

The activities linked to the proposed 3D seismic survey activities operations are listed on one axis, while the receiving environments (physical, biological and socioeconomic) are listed on the other axis, and divided in following three (3) major groups:

- ❖ Physical conditions: marine and coastal air quality, change climate, seawater quality, seabed topography and sediment quality.
- ❖ Biological conditions: marine and coastal benthic ecology, fishes, turtles, seabirds, seals and cetaceans, and.
- ❖ Socioeconomic conditions and other users: marine and coastal fishing industry, tourism and recreation, minerals exploration and mining, other petroleum exploration licence.

The proposed 3D seismic survey activities have the potential to affect the receiving environments in many ways. The first step in impact identification has been to identify the various types of activities associated with the mobilisation and pre-survey preparations, actual survey operations, post survey operations stages of the proposed survey, together with their associated emissions and discharges where appropriate.

At a high level, the main sources of impact of the proposed survey operations are:

- ❖ Planned or routine events: where an aspect (i.e. impact producing factor) is a result of routine Project activities. For example, the generation of atmospheric emissions from the survey and support vessels can be considered a planned event, and.
- ❖ Unplanned or non-routine (accidental) events: where an aspect is a result of mishaps or failures, including failure of equipment, procedures not being followed, human error, unforeseen events, or process equipment not performing as per design parameters. Typical examples are spills, leaks, emergency emissions, collisions, and explosions.

Overall, the following is the summary of the project related activities linked to planned/ routine and unplanned / accidental events of the mobilisation and pre-survey preparations, actual survey operations, post survey operations stages of the proposed survey:

1. Port of Walvis Bay or Lüderitz including onshore support operations and waste management.
2. Physical presence of survey and support vessels.
3. Physical disturbance of the survey operations.
4. Sound generation from 3D seismic survey activities airguns including sound of the survey and support vessels.
5. Increased light levels from routine vessels operations.
6. Atmospheric emissions from routine operations of the survey and support vessels.
7. Planned marine discharges.
8. Unplanned marine discharges (e.g. minor spillages of fuel, lubricants / maintenance oils).
9. Accidental event: Loss of vessel, equipment or material.
10. Accidental event: Collision with marine wildlife during vessel operations.
11. Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or another major event.

Accidental events can potentially lead to significant impacts, for example in the event of an oil spill. However, they are clearly not a part of the intended activity and their potential occurrence has a low probability of occurrence associated with it.

The activities / sources of potential impact due to the project and the receiving environment that could potentially be affected has been assessed in the EIA report and presented in form of a two-dimensional cross-referencing Leopold matrix covering the following:

- ❖ Sensitivity of receptors (Table 3.1).
- ❖ Impact magnitude (Table 3.2).
- ❖ Duration of exposure (Table 3.3).
- ❖ Geographical extent (Table 3.4).
- ❖ Probability, likelihood of occurrence (Table 3.5), and.
- ❖ Overall significant impacts (Table 3.6).

Table 3.1: Sensitivity of receptors.

RECEIVING ENVIRONMENT SENSITIVITY			RECEPTORS / TARGETS THAT MAY BE IMPACTED (MARINE AND COASTAL RESOURCES)																	
SENSITIVITY RATING		CRITERIA	PHYSICAL ENVIRONMENT					BIOLOGICAL ENVIRONMENT					SOCIOECONOMIC ENVIRONMENT							
1	Negligible	The receptor or resource is resistant to change or is of little environmental value.	Air Quality	Change Climate	Seawater Quality	Seabed Topography	Sediment Quality	Benthic Ecology	Fishes	Turtles	Seabirds	Seals	Cetaceans	Fishing Industry	Tourism and Recreation	Minerals Exploration and Mining	Other Petroleum Exploration Licence Holders	International Shipping Line	International Communication Lines / Cables	
2	Low	The receptor or resource is tolerant of change without detriment to its character, is of low environmental or social value, or is of local importance.																		
3	Medium	The receptor or resource has low capacity to absorb change without fundamentally altering its present character, is of high environmental or social value, or is of national importance																		
4	High	The receptor or resource has moderate capacity to absorb change without significantly altering its present character, has some environmental or social value, or is of district/regional importance.																		
5	Very High	The receptor or resource has little or no capacity to absorb change without fundamentally altering its present character, is of very high environmental or social value, or is of international importance.																		
SOURCES OF POTENTIAL IMPACT	ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	ONSHORE / COASTAL																		
		1.	Port of Walvis Bay including Onshore support operations and waste management	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		OFFSHORE																		
		2.	Physical presence of survey and support vessels	1	1	2	1	1	1	2	4	2	2	4	4	1	1	1	1	1
		3.	Physical disturbance of the survey operations	1	1	1	1	1	1	2	4	2	2	4	4	1	1	1	1	1
		4.	Sound generation from the proposed 2D or 3D seismic survey activities airguns including sound of the survey and support vessels	1	1	1	1	1	1	4	4	4	2	4	4	1	1	1	1	1
		5.	Increased light levels from routine vessels operations	1	1	1	1	1	1	2	2	4	2	4	2	1	1	1	1	1
	6.	Atmospheric emissions from routine operations of the survey and support vessels	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	7.	Planned marine discharges	1	1	2	1	1	1	2	2	2	2	3	2	1	1	1	1	1	
	ACCIDENTAL	8.	Unplanned marine discharges (e.g. minor spillages of fuel, lubricants / maintenance oils	1	1	2	1	1	1	2	2	2	2	3	2	1	1	1	1	1
		9.	Accidental event: Loss of vessel, equipment or material	1	1	1	1	1	1	2	2	2	2	3	2	1	1	1	1	1
10.		Accidental event: Collision with marine wildlife during vessel operations	1	1	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	
11.		Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or other major event.	1	1	4	1	1	1	4	4	4	4	4	4	1	1	1	1	1	

Table 3.2: Impact magnitude.

MAGNITUDE		RECEPTORS / TARGETS THAT MAY BE IMPACTED (MARINE AND COASTAL RESOURCES)																		
		PHYSICAL ENVIRONMENT					BIOLOGICAL ENVIRONMENT					SOCIOECONOMIC ENVIRONMENT								
		SCALE	DESCRIPTION	Air Quality	Climate Change	Seawater Quality	Seabed Topography	Sediment Quality	Benthic Ecology	Fishes	Turtles	Seabirds	Seals	Cetaceans	Fishing Industry	Tourism and Recreation	Minerals Exploration and Mining	Other Petroleum Exploration Licence Holders	International Shipping Line	International Communication Lines / Cables
0	no observable effect																			
1	low effect																			
2	tolerable effect																			
3	medium high effect																			
4	high effect																			
5	very high effect (devastation)																			
SOURCES OF POTENTIAL IMPACT	ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	ONSHORE / COASTAL																		
		1.	Port of Walvis Bay including Onshore support operations and waste management	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		OFFSHORE																		
		2.	Physical presence of survey and support vessels	0	0	3	0	0	0	3	3	3	3	3	2	1	0	1	1	0
		3.	Physical disturbance of the survey operations	0	0	0	0	0	0	3	3	3	3	3	2	1	0	1	1	0
		4.	Sound generation from the proposed 2D or 3D seismic survey activities airguns including sound of the survey and support vessels	0	0	0	0	0	0	3	1	1	1	3	2	1	0	1	1	0
		5.	Increased light levels from routine vessels operations	0	0	0	0	0	0	1	1	3	1	3	0	1	0	1	1	0
	6.	Atmospheric emissions from routine operations of the survey and support vessels	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	7.	Planned marine discharges	0	0	3	0	0	0	1	3	3	3	3	0	1	0	1	1	0	
	ACCIDENTAL	8.	Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils	0	0	1	0	0	0	3	3	3	3	3	4	1	0	1	1	0
		9.	Accidental event: Loss of vessel, equipment or material	0	0	1	0	0	0	1	1	1	1	3	3	1	0	1	1	0
10.		Accidental event: Collision with marine wildlife during vessel operations.	0	0	0	0	0	0	0	0	0	0	3	0	1	0	1	1	0	
11.		Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or other major event.	0	0	1	0	0	0	4	4	4	4	4	4	1	0	1	1	0	

Table 3.3: Duration of exposure.

DURATION OF IMPACT EXPOSURE		RECEPTORS / TARGETS THAT MAY BE IMPACTED (MARINE AND COASTAL RESOURCES)																	
		PHYSICAL ENVIRONMENT					BIOLOGICAL ENVIRONMENT					SOCIOECONOMIC ENVIRONMENT							
		Air Quality	Climate Change	Seawater Quality	Seabed Topography	Sediment Quality	Benthic Ecology	Fishes	Turtles	Seabirds	Seals	Cetaceans	Fishing Industry	Tourism and Recreation	Minerals Exploration and Mining	Other Petroleum Exploration Licence Holders	International Shipping Line	International Communication Lines / Cables	
SCALE	DESCRIPTION																		
T	Temporary																		
P	Permanent																		
SOURCES OF POTENTIAL IMPACT	ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	ONSHORE / COASTAL																	
		1.	Port of Walvis Bay including Onshore support operations and waste management	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
		OFFSHORE																	
		2.	Physical presence of survey and support vessels	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
		3.	Physical disturbance of the survey operations	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
		4.	Sound generation from the proposed 2D or 3D seismic survey activities airguns including sound of the survey and support vessels	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
		5.	Increased light levels from routine vessels operations	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	6.	Atmospheric emissions from routine operations of the survey and support vessels	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	
	7.	Planned marine discharges	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	
	ACCIDENTAL	8.	Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
		9.	Accidental event: Loss of vessel, equipment or material	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
10.		Accidental event: Collision with marine wildlife during vessel operations.	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	
11.		Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or another major event.	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	

Table 3.4: Geographical coverage / extent.

GEOGRAPHICAL COVERAGE		RECEPTORS / TARGETS THAT MAY BE IMPACTED (MARINE AND COASTAL RESOURCES)																		
		PHYSICAL ENVIRONMENT					BIOLOGICAL ENVIRONMENT					SOCIOECONOMIC ENVIRONMENT								
		Air Quality	Climate Change	Seawater Quality	Seabed Topography	Sediment Quality	Benthic Ecology	Fishes	Turtles	Seabirds	Seals	Cetaceans	Fishing Industry	Tourism and Recreation	Minerals Exploration and Mining	Other Petroleum Exploration Licence Holders	International Shipping Line	International Communication Lines / Cables		
SCALE	DESCRIPTION																			
L	limited impact on location																			
O	impact of importance for municipality;																			
R	impact of regional character																			
N	impact of national character																			
M	impact of cross-border character																			
		ONSHORE / COASTAL																		
SOURCES OF POTENTIAL IMPACT	ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	1.	Port of Walvis Bay including Onshore support operations and waste management	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	
		OFFSHORE																		
		2.	Physical presence of survey and support vessels	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		3.	Physical disturbance of the survey operations	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		4.	Sound generation from the proposed 2D or 3D seismic survey activities airguns including sound of the survey and support vessels	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		5.	Increased light levels from routine vessels operations	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		6.	Atmospheric emissions from routine operations of the survey and support vessels	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
	7.	Planned marine discharges	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	
	ACCIDENTAL	8.	Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		9.	Accidental event: Loss of vessel, equipment or material	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
		10.	Accidental event: Collision with marine wildlife during vessel operations.	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L
11.		Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or another major event.	L	L	O	L	L	L	O	O	O	O	O	O	L	L	L	L	L	

Table 3.5: Probability, likelihood of occurrence.

PROBABILITY, LIKELIHOOD		RECEPTORS / TARGETS THAT MAY BE IMPACTED (MARINE AND COASTAL RESOURCES)																		
		PHYSICAL ENVIRONMENT					BIOLOGICAL ENVIRONMENT					SOCIOECONOMIC ENVIRONMENT								
		Air Quality	Climate Change	Seawater Quality	Seabed Topography	Sediment Quality	Benthic Ecology	Fishes	Turtles	Seabirds	Seals	Cetaceans	Fishing Industry	Tourism and Recreation	Minerals Exploration and Mining	Other Petroleum Exploration Licence Holders	International Shipping Line	International Communication Lines / Cables		
SCALE	DESCRIPTION																			
A	Extremely unlikely (e.g. never heard of in the industry)																			
B	Unlikely (e.g. heard of in the industry but considered unlikely)																			
C	Low likelihood (egg such incidents/impacts have occurred but are uncommon)																			
D	Medium likelihood (e.g. such incidents/impacts occur several times per year within the industry)																			
E	High likelihood (e.g. such incidents/impacts occurs several times per year at each location where such works are undertaken)																			
SOURCES OF POTENTIAL IMPACT	ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	ONSHORE / COASTAL																		
		1.	Port of Walvis Bay including Onshore support operations and waste management	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
		OFFSHORE																		
		2.	Physical presence of survey and support vessels	A	A	C	A	A	A	C	C	C	C	C	C	A	A	A	A	A
		3.	Physical disturbance of the survey operations	A	A	A	A	A	A	C	C	C	C	C	C	A	A	A	A	A
		4.	Sound generation from the proposed 2D or 3D seismic survey activities airguns including sound of the survey and support vessels	A	A	A	A	A	A	E	E	C	C	E	E	A	A	A	A	A
		5.	Increased light levels from routine vessels operations	A	A	A	A	A	A	A	A	C	A	A	A	A	A	A	A	A
	6.	Atmospheric emissions from routine operations of the survey and support vessels	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	
	7.	Planned marine discharges	A	A	B	A	A	A	B	B	B	A	A	A	A	A	A	A	A	
	ACCIDENTAL	8.	Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils)	A	A	B	A	A	A	B	B	B	B	B	B	A	A	A	A	
		9.	Accidental event: Loss of vessel, equipment or material	A	A	A	A	A	A	A	A	A	A	B	A	A	A	A	A	
10.		Accidental event: Collision with marine wildlife during vessel operations.	A	A	B	A	A	A	B	B	B	B	B	B	A	A	A	A	A	
11.		Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or other major event.	A	A	B	A	A	A	B	B	B	B	B	B	A	A	A	A	A	

Table 3.6: Significance of impacts.

SIGNIFICANCE						RECEPTORS / TARGETS THAT MAY BE IMPACTED (MARINE AND COASTAL RESOURCES)																			
						PHYSICAL ENVIRONMENT					BIOLOGICAL ENVIRONMENT					SOCIOECONOMIC ENVIRONMENT									
IMPACT SEVERITY [Magnitude, Duration, Extent, Probability]	RECEPTOR CHARACTERISTICS (SENSITIVITY)					Air Quality	Climate Change	Seawater Quality	Seabed Topography	Sediment Quality	Benthic Ecology	Fishes	Turtles	Seabirds	Seals	Cetaceans	Fishing Industry	Tourism and Recreation	Minerals Exploration and Mining	Other Petroleum Exploration Licence Holders	International Shipping Line	International Communication Lines / Cables			
	Very High (5)	High(4)	Medium (3)	Low (2)	Negligible (1)																				
Very High (5)	Major [5/5]	Major [4/5]	Moderate [3/5]	Moderate [2 /5]	Minor 1/5																				
High (4)	Major [5/4]	Major [4/4]	Moderate [3/4]	Moderate [2/4]	Minor[1/4]																				
Medium (3)	Major [5/3]	Moderate[4/3]	Moderate[3/3]	Minor[2/3]	None[1/3]																				
Low (2)	Moderate [5/2]	Moderate[4/2]	Minor[3/2]	None[2/2]	None[1/2]																				
Negligible (1)	Minor [5/1]	Minor [4/1]	None [3/1]	None [2/1]	None [1/1]																				
SOURCES OF POTENTIAL IMPACT		ROUTINE AND PHYSICAL PRESENCE OPERATIONAL ACTIVITIES	ONSHORE / COASTAL																						
			1.	Port of Walvis Bay including Onshore support operations and waste management	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	
			OFFSHORE																						
			2.	Physical presence of survey and support vessels	2/1	1/1	2/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	2/1	2/1	2/1	4/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
			3.	Physical disturbance of the survey operations	2/1	2/1	2/1	2/1	2/1	2/1	4/1	3/2	3/2	3/2	3/2	4/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
			4.	Sound generation from the proposed 2D or 3D seismic survey activities airguns including sound of the survey and support vessels	1/1	1/1	1/1	1/1	1/1	1/1	4/3	4/3	2/1	2/1	4/3	4/3	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
			5.	Increased light levels from routine vessels operations	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	4/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
		6.	Atmospheric emissions from routine operations of the survey and support vessels	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	
		7.	Planned marine discharges	1/1	1/1	3/2	1/1	1/1	1/1	3/2	3/2	3/2	3/2	3/2	2/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	
		ACCIDENTAL	8.	Unplanned marine discharges (e.g., minor spillages of fuel, lubricants / maintenance oils	1/1	1/1	3/2	1/1	1/1	1/1	3/2	3/2	3/2	3/2	3/2	3/2	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	
			9.	Accidental event: Loss of vessel, equipment or material	1/1	1/1	1/1	1/1	1/1	1/1	1/1	3/2	3/2	3/2	3/2	4/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	
10.	Accidental event: Collision with marine wildlife during vessel operations.		1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	4/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1			
11.	Accidental Event: Loss of Marine Gasoline Oil (MGO) containment on the survey or support vessels due to ship collision or other major event.		1/1	1/1	4/1	1/1	1/1	1/1	3/2	3/2	3/2	3/2	3/2	3/2	3/2	1/1	1/1	1/1	1/1	1/1	1/1	1/1			

3.3.2 Impact Assessment Summary on Marine Mammals, Birds, Fish and Fisheries

3.3.2.1 Summary of the Overall Impacts

Table 3.7 summarises the potential impacts discussed in detail in the specialist report on marine mammals, birds, fish and fisheries (Annex 2 to the EIA Report). The assessment of the impacts in Table 3.7 are given without mitigation measures applicable. The impacts are considered at different levels, (such as physiological, perceptual and behavioural), but the overall impact is presented. The source of impact (noise, seismic vessel, support craft, pollution) and duration of the impact (short/long term) are also considered, as well as whether the impact is to an individual or at population level. In the end, population and long-term impacts are the defining criteria. Table 3.8 summarises the potential impacts if the suggested mitigation measures are applied.

3.3.2.2 Assessment of Potential Impacts on Cape Fur Seals

Noise from the seismic survey is expected to have no impact on seal populations. Noise disturbance from support aircraft, such as helicopters, can cause startle response and panic behaviour. The impact would be high in the immediate short term, however, in the long term, impact on marine mammals from the noise of low-flying aircraft related to the survey operations is considered negligible in comparison to other aircraft noise sources in the region. Individual seals may be impacted by discarded waste and gear lost overboard, but this will be equal to any similar threat posed by fishing or other vessels.

3.3.2.3 Assessment of Potential Impacts on Marine Mammals

Air gun noise is only expected to impact low-frequency cetaceans within close range of the operating airgun. As there are no known resident low-frequency cetaceans, the impact will be on migrating mammals. The number of mammals migrating through the Namibian waters is relatively low and wide-spread. If mitigation measures such as soft-starts, visual observation and exclusion limits are applied, the impacts of seismic noise can be lessened to acceptable levels. Overall, the expected impacts at population level are considered low in the long-term.

Noise from support vessels will have an insignificant impact, because whales and dolphins are likely to display avoidance reactions at a distance of about 1 km. The communication and navigation sounds emitted by whales and dolphins should not be masked by noise emitted by supply vessels and therefore, it is considered to be of insignificant impact.

The impact of prey displacement as a result of seismic activities is considered to be of very low significance overall, as marine mammals have an adaptable diet and prey on more than one fish species. In addition, these creatures are highly mobile and able to follow prey in different directions. The impact of the seismic survey on feeding would be of very low significance.

3.3.2.4 Assessment of Potential Impacts on Sea Turtles

Although the occurrence of sea turtles in the region has increased in recent years, they are, by and large, still only occasional visitors. The likelihood of encountering turtles during the survey operations is moderate to low. None-the-less, should a turtle be in very close range of the seismic array, the potential impact on turtle physiology, behaviour and feeding is considered to be of high intensity in the short-term, but of low probability.

The impact on turtle mortality due to entanglement or garbage consumption can be high, but if turtle exclusion tail buoys are fitted to the hydrophone array and MARPOL 73/78 solid waste disposal procedures are followed this impact will be lessened to low significance. The impact of seismic noise on turtle migration is considered to be insignificant, since turtles make use of magnetic cues rather than acoustics for navigation.

3.3.2.5 Assessment of Potential Impacts on Sea Birds

Only a few sea bird species frequent deep, offshore waters and the likelihood of encountering significant numbers of endangered species is slim. The potential physiological impact of seismic pulses on non-

diving birds is considered to be insignificant as birds would be expected to stay away from the noise source and the buoys of the seismic array. The potential of pathological impact is considered to be of low-moderate significance on diving sea birds without mitigation and of very low significance with mitigation such as warning ramp-up procedures and if marine mammal observers are employed. In comparison to the impact of long-line fishing on pelagic birds, the potential impact of noise from this seismic survey on bird populations in the long term, is considered insignificant.

Avoidance behaviour would be limited to the immediate vicinity of the airgun array and only for the duration of the actual firing and vessel passage. The impact on behaviour is thus considered to be of MEDIUM intensity and of short duration, but overall, of very low significance in the long term. The impact of the seismic noise on non-diving bird behaviour is considered to be insignificant.

The impact of prey displacement as a result of the survey on the foraging of diving and non-diving birds is considered to be of moderate intensity in the medium term in the immediate vicinity of the shooting operations, and of very low significance overall. Research has shown that shoaling fish disturbed by seismic firing return to the area within a relatively short time period. In addition, the extent of prey species and wide ranges over which sea birds feed indicate that the impact of the seismic survey on feeding would be of very low significance.

Birds are generally only drawn to vessels to scavenge on discarded waste, or by lights at night. As long as the vessels comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) regulations, general waste should not pose a threat to and have zero impact on marine bird populations.

There is the possibility of a sea bird becoming entangled in, or colliding with lines and structures, particularly at night when shipboard lighting may cause disorientation and temporarily lowered visual ability. However, if lighting is reduced to minimal onboard safety requirements, then such incidents are likely to be scarce and the significance level and impact is considered low.

Noise disturbance from aircraft can cause startle responses and avoidance behaviour. The impact can be high in the immediate short term, however, if aircraft avoid known breeding colonies the aircraft noise directly related to the survey operations is considered negligible in comparison to other aircraft noise sources.

Sea birds are most likely to be severely impacted by the seismic vessel in the event of an oil spill or other major water-borne pollution. Such an event could be of high intensity in a localised area for a short term. The fact that the survey activities are generally offshore and away from any large or sensitive breeding colonies, and that foraging birds will likely to be able to avoid any such spills, will lessen the impact. The chances of such an incident are equal to any other vessel operating within the Benguela Current Large Marine Ecosystem Programme. Thus, the overall impact of the survey on sea birds is regarded as low.

3.3.2.6 Assessment of Potential Impacts on Fish

The impact on larvae close to the surface in the vicinity of the airgun will be of high intensity in the short term, but in overall comparison with natural mortality, the impact of the seismic survey is considered to be of very low significance to larval stages, particularly if timing and spatial mitigating measures are employed. Seismic noise disturbance may impact the spawning activities of certain fish species. However, most of the commercially important species spawn inshore and north of the proposed survey area, and in view of the relatively short duration of the disruption to species and the wide distribution of fish, the impacts of the survey on fish recruitment at the population level are considered to be of low significance.

The potential impact of physiological damage to pelagic species in close proximity to the noise source would be of high intensity. The potential impact would be limited to the short-term period of surveying activities in the population locale. The overall impact of physiological damage to pelagic fish species is considered to be of low to very low significance dependant on the mitigation measures employed. However, the potential impact on demersal species and on species in shallow and inshore water would be insignificant as they are expected to be well out of the range of damage. Also, certain species of

commercial importance (herring, mackerel, gobi, sharks) have under-developed or no swim bladders and there is little risk of injury from seismic noise. The physiological impact on large pelagic species is considered to be negligible.

The fish of the area are generally highly mobile and exhibit large migration patterns and ranges, so while the potential impact on fish behaviour could be of high intensity, this would be limited to shallow waters and /or close proximity to the airgun, and restricted to the short-term duration of the survey operating in the area, but limited to the survey area. The impact of fish behaviour is, thus, considered to be of low significance both with and without mitigation measures.

3.3.2.7 Assessment of Potential Impacts on Fisheries

Research indicates that catch rates should be resumed within a few days, as Catch per unit effort returns to normal within a week of seismic operations ceasing. Thus, the expected impact on commercial catch and effort is considered to be of moderate to low significance depending on timing and location. Most of the fishing grounds lie inshore and north of the proposed survey area and will as such experience little or no disruption as a result of survey activities.

The most affected sector will be the tuna fishery. While the seismic survey will not impact the fish themselves or the species as a whole, it may interfere with and obstruct the fishing vessels. In addition, seismic noise may cause the fish to alter their migration route and avoid the areas of seismic operations. This can have a direct impact on the fishing industry, which targets tuna species in known locations. The pole-and-line fishery in particular, is a very small and seasonal fishery, operating only a couple of months in the year. The effort is variable dependent on fish availability.

The fishery operates on windows of opportunity. When a shoal is located, many vessels will congregate at one location for a number of days. Albacore tuna congregate at Tripp Seamount. Although boats preferentially frequent this area catches vary from year to year, as the movement of albacore between South Africa and Namibia is poorly understood and there is no clear pattern.

Due consideration must be given to this fishery and negotiations regarding the timing of the seismic survey could lessen any negative associated impacts. Flexibility is paramount in limiting impacts on this fishery, which could be high if no mitigation or consultation is undertaken, but low to moderate depending on the timing of the survey and fish stock availability.

3.3.2.8 Overall Impact Assessment

Fishing areas, marine mammals (Cetacean migratory routes), and sensitive coastal environments with respect to the proposed are all shown in Fig. 3.1. Table 3.7 summarises the potential impacts detailed in the EIA Report, marine mammals, birds, fish and fisheries and underwater acoustic modelling specialist reports.

The assessment of the impacts is given without mitigation measures are shown in Table 3.7. The impacts have been considered at different levels, (such as physiological, perceptual and behavioural), with the overall impact also presented. The source of impact (noise, seismic vessel, support craft, pollution) and duration of the impact (short/long term) are also considered, as well as whether the impact is to an individual or at population level. In the end, population and long-term impacts are the defining criteria.

Table 3.8 summarises the potential impacts with mitigation measures applied. The overall impact of this proposed survey is regarded as being of moderate significance in the short-term and low significance in the long-term, assuming mitigation measures are applied (Table 3.8).

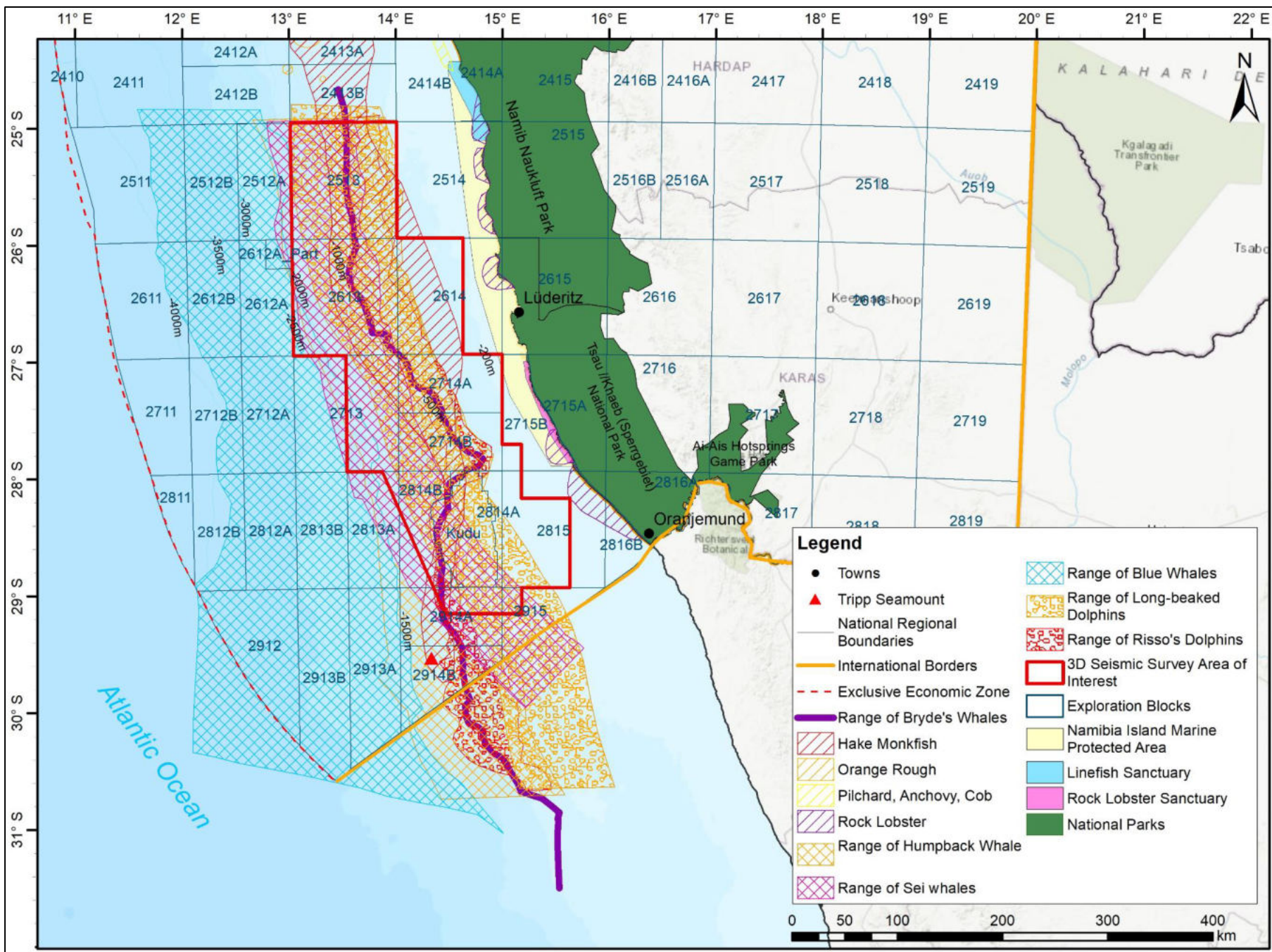


Figure 3.1: Fishing areas, marine mammals (Cetacean migratory routes), and sensitive coastal environments with respect to the proposed 3D survey area, (Data Source: Geological Survey of Namibia and National Marine Information and Research Centre, 2003).

Table 3.7: Summaries of the potential impacts without mitigation measures are applied.

Potential Impacting Factors	Impacted Sectors – WITHOUT mitigation measures applied									
	Air quality	Water quality	Marine Mammals Cape Fur Seals Cetaceans		Marine Turtles	Sea Birds	Shore Birds	Fish	Fisheries	Tuna Fishery
Seismic Noise – short term	No impact	No impact	Low impact	Moderate impact	Low-Moderate impact	Low-Moderate impact	No impact	Low-Moderate impact	Low-Moderate impact	Moderate - High impact
Seismic Noise – long term	No impact	No impact	Insignificant impact	Low impact	Insignificant impact	Insignificant impact	No impact	Low impact	Low impact	Low-Moderate impact
Light disturbance	No impact	No impact	No impact	No impact	No impact	No impact	Low-Moderate impact	No impact	No impact	No impact
Aircraft Noise – short term	No impact	No impact	Moderate - High impact	Low impact	No impact	Low impact	Moderate - High impact	No impact	No impact	No impact
Aircraft Noise – long term	No impact	No impact	Low impact	No impact	No impact	No impact	Low impact	No impact	No impact	No impact
Vessel exclusion zone – short term	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	Moderate - High impact	Moderate - High impact
Vessel exclusion zone – long term	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	Low impact	Low impact
Waste generation	No impact	Moderate impact	Moderate impact	Low impact	Moderate - High impact	Moderate impact	Low-Moderate impact	Low-Moderate impact	Low impact	Low impact
Air Emissions	Moderate impact	No impact	No impact	No impact	No impact	Insignificant impact	Insignificant impact	No impact	No impact	No impact
Major accidental spill of diesel/oil	Insignificant impact	High impact	Moderate impact	Moderate impact	Moderate impact	Low-Moderate impact	High impact	Moderate impact	Moderate - High impact	Moderate - High impact
Small accidental spills	No impact	Moderate impact	Insignificant impact	Insignificant impact	Insignificant impact	No impact	Insignificant impact	Insignificant impact	No impact	No impact
Ballast water	No impact	Moderate - High impact	No impact	No impact	No impact	No impact	No impact	Low-Moderate impact	Low impact	No impact

Table 3.8: Summaries of the potential impacts with mitigation measures are applied.

Potential Impacting Factors	Impacted Sectors – WITH mitigation measures applied									
	Air quality	Water quality	Marine Mammals Cape Fur Seals Cetaceans		Marine Turtles	Sea Birds	Shore Birds	Fish	Fisheries	Tuna Fishery
Seismic Noise – short term	No impact	No impact	Insignificant impact	Low impact	Low impact	Low impact	No impact	Low impact	Low-Moderate impact	Moderate impact
Seismic Noise – long term	No impact	No impact	Insignificant impact	Insignificant impact	No impact	Insignificant impact	No impact	Insignificant impact	Low impact	Low impact
Light disturbance	No impact	No impact	No impact	No impact	No impact	Low impact	No impact	No impact	No impact	No impact
Aircraft Noise – short term	No impact	No impact	Moderate impact	Insignificant impact	No impact	Insignificant impact	Moderate – impact	No impact	No impact	No impact
Aircraft Noise – long term	No impact	No impact	Insignificant impact	No impact	No impact	No impact	Low impact	No impact	No impact	No impact
Vessel exclusion zone – short term	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	Moderate impact	Moderate impact
Vessel exclusion zone – long term	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	Insignificant impact	Low impact
Waste generation MARPOL	No impact	Low impact	Insignificant impact	Insignificant impact	Low impact	Insignificant impact	Insignificant impact	No impact	No impact	No impact
Air Emissions MARPOL	Low-Moderate impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact	No impact
Major accidental spill of diesel/oil	Insignificant impact	Moderate - High impact	Low-Moderate impact	Low-Moderate impact	Low-Moderate impact	Low impact	Moderate - High impact	Low impact	Moderate impact	Moderate impact
Small accidental spills	No impact	Insignificant impact	Insignificant impact	Insignificant impact	Insignificant impact	No impact	Insignificant impact	Insignificant impact	No impact	No impact
Ballast water Control	No impact	Insignificant impact	No impact	No impact	No impact	No impact	No impact	Insignificant impact	No impact	No impact

4. EMP IMPLEMENTATION AND MITIGATION MEASURES

4.1 Aims and Objectives of the EMP

This EMP Report has the following specific objectives:

1. Ensure that the key environmental impacts identified and assessed in the EIA Report are addressed.
2. Ensure compliance with all applicable national regulations and MARPOL (marine pollution) regulations and waste disposal procedure and all legal frameworks and other requirements that must be adhered to.
3. Promote environmental management and communicate the aims and goals of the project EMP to all stakeholders, contractor, subcontractor and all key employees of the Proponent who will be involved in the proposed 3D seismic survey activities operations.
4. Incorporate environmental management principles into project design and operational procedures.
5. Ensure all workers, contractors, sub-contractors and all those who are involved in the project are meeting all requirements with respect to environmental management.
6. Address issues and concerns raised in the EIA process.
7. Serve as an action plan for environmental management.
8. Provide a framework for implementing commitments to address all the key impacts identified in the EIA Report.
9. Provided a framework for preparing and maintaining records of project environmental performance (i.e. monitoring, audits and compliance tracking), and.
10. Prepare an environmental monitoring plan whose aim is to ensure that the mitigation measures during the project mobilisation and pre-survey preparations, actual survey operations, post survey operations, and non-routine or accidental events are effectively implemented, and the positive impacts are enhanced, and.
11. Provide a basis for preparing the “close up” report to be submitted to the Government (Ministry of Mines and Energy, (MME), Ministry of Environment, Forestry, and Tourism (MEFT), Ministry of Fisheries and Marine Recourse (MFMR) and the Ministry of Work and Transport (MWT), Department of Maritimes Affairs) once the proposed 3D seismic survey activities operations have been completed.

4.2 Principles of Environmental Management

The following principles of environmental management, as stated in Part II, Section 3 of the Environmental Management Act, 2007, Act No. 7 of 2007 have been considered in the preparation of this EMP for proposed 3D seismic survey activities in the Walvis Basin:

1. Use renewable resources on a sustainable basis for the benefit of present and future generations.
2. Involve the community in natural resources management and promote and facilitate the sharing of benefits from the use of resources.
3. Promote public participation in decisions affecting the environment and ensure that their interests, needs and values are considered.

4. Promote equitable access to all environmental resources and consider the functional integrity of ecological systems so that the sustainability of systems is ensured and that harmful effects are prevented.
5. Undertake environmental assessments for all projects that may adversely impact on the environment, or the use of natural resources.
6. Promote sustainable development in all aspects relating to the environment.
7. Protect and respect Namibia's cultural and natural heritage, including its biological diversity, for the benefit of present and future generations.
8. Reduce the generation of waste and polluting substances at source by adopting the option that provides the most benefit or causes the least environmental damage, at costs acceptable by society, in the short- and long term.
9. Promote the reduction, re-use and recycling of waste.
10. Adopt the "polluter pays" principle.
11. In cases where there is enough evidence to conclude that there are threats of serious or irreversible damage to the environment, the lack of full scientific certainty may not be used as an excuse for postponing cost-effective measures to prevent environmental degradation, and.
12. Prevent damage to the environment. if this is not possible, reduce, limit, or control activities that may cause damage to the environment.

4.3 The EMP Framework

The following is the summary of the EMP Framework based on the precautionary principles and principles of environmental management as detailed in the Environmental Management Act, 2007, Act No. 7 of 2007 for the proposed offshore 3D seismic survey activities:

- ❖ The proposed 3D seismic survey activities can only be implemented once the MEFT has issued an Environmental Clearance Certificate.
- ❖ All interested and affected parties (I&APs), particularly other users of the marine environment, must be notified prior to the survey start.
- ❖ Attempts must be made to reduce the likelihood of possible cumulative impacts through co-ordination of activities with other operators / users of the marine environment.
- ❖ All communications and public consultation should be channelled through a single interface, usually the Proponent's Representative (PR) / Operations Manager (OM).
- ❖ Conditions and provisions as detailed in this EMP shall be adhered to for conservation and preservation of the natural environment.
- ❖ The Proponent's Representative (PR) / Operations Manager (OM) is responsible for the implementation of the remediation of any environmental damage in accordance with the recommended methodology and/or the best available procedures / practices.
- ❖ Vessel crew should be trained in good environmental practices and onboard supervision shall always be applied.
- ❖ A Marine Mammal Observer (MMO/ Fisheries Liaison Officer (FLO) and /or Independent Marine Observer (IMO) who is familiar with fisheries sectors in the area and experienced in seabird and

marine mammal identification and observation techniques must be appointed to be onboard throughout the survey period, and.

- ❖ In the absence of any specific mitigation measures being provided in this EMP, the Proponent shall always adopt the precautionary approach.

4.4 Hierarchy of Mitigation Measures Implementation

A hierarchy of methods for mitigating significant adverse effects has been adopted in order of preference and as follows:

- (i) Enhancement, e.g., protection of habitats through operational approaches.
- (ii) Avoidance, e.g., flexible implementation timing to avoid effects on ecological receptors.
- (iii) Reduction, e.g., limitation of effects on receptors through design or operational changes, and.
- (iv) Compensation, e.g., community benefits.

4.5 Roles and Responsibilities

4.5.1 Overview

Management and monitoring of the environmental elements that may be affected by the different activities of the 3D seismic survey through the allocation of resources, roles and responsibilities is an important element of the mitigatory process. This EMP provides for the human resources roles and responsibilities necessary for the implementation and monitoring of the key components of the mitigation measures.

4.5.2 Proponent's Representative (PR) / Operations Manager (OM)

The proponent shall appoint a **Proponent's Representative (PR) / Operations Manager (OM)** with responsibilities not limited to the following with respect to the EMP implementation:

- ❖ Act as the PR and implementing agent on behalf of the proponent.
- ❖ Ensure that the proponent's responsibilities are executed in compliance with the relevant national and international regulations and best practices.
- ❖ Ensure that all the necessary environmental authorisations and permits have been obtained before the implementation of the proposed activities.
- ❖ Assist any contractor / subcontractor and monitoring specialists in finding environmentally responsible solutions to challenges that may arise during the survey.
- ❖ Should the operations manager believe a serious threat to, or impact on the receiving environment may be caused by the seismic survey activities, he/she may stop work and the proponent must be informed of the reasons for the stoppage as soon as possible.
- ❖ The OM has the authority to issue fines for transgressions of basic conduct rules and/or contravention of the EMP.
- ❖ Should any contractor / subcontractor and monitoring specialists or his/her employees fail to show adequate consideration for the environmental aspects related to the EMP, the operations manager can have person(s) and/or equipment removed from the vessel or work suspended until the matter is remedied.

- ❖ Maintain an open and direct lines of communication between the stakeholders and proponent, as well as any other identified Interested and Affected Parties (I&APs) with regards to environmental matters, and.
- ❖ Attend regular meetings / daily briefings and inspections as may be required.

4.5.3 Safety, Health and Environment (SHE) Officer / Environmental Coordinator

The proponent shall appoint a Safety, Health and Environment (SHE) Officer / Environmental Coordinator with responsibilities not limited to the following with respect to the EMP implementation:

- ❖ Assist the OM in ensuring that the necessary environmental authorisations and permits have been obtained and any subsequent fillings are prepared and lodged accordingly.
- ❖ Assist the OM and Contractor in finding environmentally responsible solutions to challenges that may arise.
- ❖ Conduct daily safety and environmental management briefings as per EMP requirements or as may be required.
- ❖ Carry out regular site inspections (on average once per week) with regards to compliance with the EMP. report any non-compliance(s) to the OM as soon as possible.
- ❖ Continuously review the EMP and recommend additions and/or changes to the EMP document as may be required and in consultations with the OM and monitoring specialists.
- ❖ Monitor the Contractor's environmental awareness training for all new personnel joining the operations.
- ❖ Keep records of all activities related to environmental control and monitoring. the latter to include a photographic record of all the major incidents / incidences, and.
- ❖ Attend regular meetings.

4.5.4 Other Contractors and Subcontractors

The responsibilities of the **Contractors and Subcontractors** that may be appointed by the proponent to undertake certain activities of the proposed include but not limited to the following with respect to the EMP implementation:

- ❖ Comply with the EMP provisions of relevant national and international regulations and best practices.
- ❖ Preparation and submission to the proponent through the Project HSE of the following Management Plans:
 - Environmental Awareness Training and Inductions.
 - Emergency Preparedness and Response.
 - Waste Management, and.
 - Health and Safety.
- ❖ Ensure adequate environmental awareness training for senior site personnel.
- ❖ Environmental awareness presentations (inductions) to be given to all personnel prior to work commencement. the Project HSE shall provide the content and topics that should be covered the awareness materials and should not be limited to the following guidance:

- The importance of complying with the EMP provisions.
- Roles and responsibilities, including emergency preparedness.
- Basic rules of conduct (Do's and Don'ts).
- EMP: aspects, impacts and mitigation.
- Fines for failure to adhere to the EMP, and.
- Health and safety requirements.
- ❖ Record keeping of all environmental awareness training and induction presentations, and.
- ❖ Attend regular meetings and environmental reviews /inspections of the operations.

4.5.5 Environmental Monitoring Specialist (MMO and FLO)

The proponent shall appoint a Marine Mammal Observation (MMO) and Fishery Liaison Officers (FLO) with responsibilities not limited to the following with respect to the EMP implementation:

- (i) MMO:
 - ❖ Record a written physical description of a marine mammal.
 - ❖ Log which direction it is travelling in.
 - ❖ Describe its behaviour.
 - ❖ Log the time.
 - ❖ Inform the contractor's seismic observers that they need to stop firing until further notice (which will be when the marine mammal has exited the exclusion zone).
 - ❖ Track the marine mammal and keep the seismic observers informed.
 - ❖ Attend regular meetings and environmental reviews /inspections of the operations, and.
 - ❖ Prepare daily, weekly, monthly / final closure monitoring report as may be applicable.
- (ii) FLO:
 - ❖ Act as the link between fishing vessels in the seismic survey area and seismic vessel.
 - ❖ Work closely with the OM and the fishing industry to minimise any potential impact of the project upon local fishing. The objective is to facilitate as far as possible, an arrangement based on coexistence.
 - ❖ Keeps local fishing vessels informed of ongoing work on major projects within that area. This allows local fishermen to understand the potential hazards and to plan their fishing activities accordingly. It also enables the seismic survey project to proceed unhindered by fishing vessels, saving significant time and money for the client or seismic contractor.
 - ❖ Attend regular meetings and environmental reviews /inspections of the operations, and.
 - ❖ Prepare daily, weekly, monthly / final closure monitoring report as may be applicable.

4.6 Specific Mitigation Measures

4.6.1 Specific Mitigation Measures Implementation

Based on the findings of the impact assessment as detailed in the EIA Report and summarised in Table 3.1 – 3.6 in this report, Table 4.1 - 4.3 provides the detailed specific mitigations measures to be implemented by the proponent with respect to the proposed 3D seismic survey operations. The following is the summary of the key project stages linked to the migration measures provided in Tables 4.1 - 4.3:

(i) **Mobilisation and Pre-Survey Preparations (Table 4.1):**

- ❖ Pre-survey planning.
- ❖ Emergency and Contingency planning.
- ❖ EIA submission and approval.
- ❖ Environmental mitigation.
- ❖ Compliance with EIA and EMP.
- ❖ Notification of and coordination with relevant parties., and.
- ❖ Appointment of MMO and FLO.

(ii) **Actual Survey Operations (Table 4.2):**

- ❖ Adherence to EMP.
- ❖ monitoring of effects and performance assessment.
- ❖ Pollution control and waste management.
- ❖ Equipment management.
- ❖ Airgun operation.
- ❖ Communication and notification to other vessels.
- ❖ Exclusion of other vessels.
- ❖ Prevention of emergencies, and.
- ❖ Emergency management procedures including oil spills.

(iii) **Post Survey Operations (Table 4.3):**

- ❖ Survey vessels to leave.
- ❖ Inform relevant parties of survey completion.
- ❖ Final waste disposal.
- ❖ Final observation reports, and.
- ❖ Close-out reports.

Table 4.1: Mobilisation and Pre-Survey Preparations.

ACTIVITY	RATIONALE and MOTIVATION	COURSE OF ACTION TO FULFIL EMP PROVISOS	DESIGNATED PERSON RESPONSIBLE	CONTROL and VERIFICATION	TIMING	REQUIREMENT FOR "CLOSEOUT" REPORT
Pre-survey Planning	Allocate provisions for Environmental monitoring and Liaison with fishing, mining, petroleum industries and other users of the sea.	<ol style="list-style-type: none"> 1) Make provision for including Marine Mammal Observation (MMO) and Fishery Liaison Officers (FLO) as crew on board the seismic vessel. 2) Notify relevant government departments Ministry of Mines and Energy (MME), Ministry of Environment, Forestry, and Tourism (MEFT), Ministry of Fisheries and Marine Recourse (MFMR) and the Ministry of Work and Transport (MWT) Department of Maritimes Affairs Search and Rescue, Namibian Ports Authority and port captains 3) Determine the extent of local fishing, petroleum and mining activities within the survey area. 4) Notify other marine users, fishing industry (Namibian and foreign), marine petroleum, mineral prospecting and mining licence holders. <ul style="list-style-type: none"> - Notification must include <ul style="list-style-type: none"> ➢ navigational co-ordinates of the survey area ➢ timing and duration of proposed activities ➢ designated safety zone around the seismic vessel (500 m) 5) Finalise negotiations and resolve any conflict over the allocation of user rights prior to the commencement of operation. 6) Charter a local vessel to act as chase boat 	TGS Geophysical Company (UK) Limited, Operations Manager Seismic Contractor Environmental Coordinator		Prior to commencing survey operations	<p>Minutes of meetings</p> <p>Copies of all correspondence</p> <p>MMO / FLO /SHE reports</p>
Emergency and Contingency Planning	Preparation for any emergency that could result in an environmental impact	<ol style="list-style-type: none"> 1) Company (or representative) Emergency Response Plan. 2) Seismic & support vessel Contractor Emergency Response Plan (including. MEDIVAC) 3) Helicopter Operator Emergency Response Plan. 4) Oil Pollution Emergency Plan should refer to the National Marine Pollution Contingency Plan (NMPCP) 5) Ensure there is adequate protection and indemnity insurance cover for oil pollution 6) Produce vessel's seaworthiness certificate and/or classification stamp 	Seismic Contractor SHE Officer	Copies of all correspondence		Confirm compliance and justify any omissions
EIA submission and Approval / Environmental Clearance	Compliance with legislative requirements – Namibian EA Policy	Submit EIA and EMP to Ministry of Environment, Forestry, and Tourism for approval and issuing of Environmental Clearance Certificate (ECC)	TGS Geophysical Company (UK) Limited / Subcontractor		Prior to commencing survey operations	Final EIA and EMP Reports with ECC issued
Environmental Mitigation	Minimise impact on cetaceans and turtles	<ol style="list-style-type: none"> 1) Employ an MMO 2) Use visual monitoring during daytime 3) Use passive acoustic monitoring system for detections. 4) Initiate soft-start procedure. 5) Use 'turtle-friendly' tail buoys. Alternatively, the existing tail buoys should be fitted with either exclusion or deflector 'turtle guards'. 	TGS Geophysical Company (UK) Limited, Seismic Contractor Environmental Coordinator		Prior to commencing survey / appointment contractors	None

Table 4.1: *Cont.*

ACTIVITY	RATIONALE and MOTIVATION	COURSE OF ACTION TO FULFIL EMP PROVISOS	DESIGNATED PERSON RESPONSIBLE	CONTROL and VERIFICATION	TIMING	REQUIREMENT FOR "CLOSEOUT" REPORT
Compliance with EIA and EMP	<p>TGS Geophysical Company (UK) Limited and contractor to fulfil requirements set by MEFT, MME and MARPOL</p> <p>Commit to adherence to EMP</p>	<p>1) Ensure copies of ECC, EIA and EMP reports are onboard throughout survey period</p> <p>2) Ensure that a copy of the EIA report is provided to the Seismic contractor.</p> <p>3) Elucidate all personnel of the EMP requirements and motivation. Assign duties appropriately.</p> <p>4) Ensure availability of relevant personnel and suitable equipment to meet EMP requirements.</p> <p>5) Notify other marine users and promote cooperation to minimise cumulative impacts.</p>	<p>Seismic Contractor Operations Manager, Environmental Coordinator, Equipment Quartermaster, SHE Officer</p>	<p>Minutes of meetings</p> <p>Copies of all environmental awareness training manuals and schedules</p> <p>Self-audit</p>	<p>Prior to commencing survey operations</p>	<p>Minutes of meetings</p> <p>Signed acknowledgment of receipt of EIA by Contractor</p> <p>Confirm compliance and justify any omissions</p>
Notification of and coordination of activities with relevant parties	<p>Ensure that other users are aware of the seismic survey. Promote cooperation and coexistence with other users to minimise cumulative environmental impacts</p>	<p>1) Notify relevant government ministries and departments – MFMR, MEFT, MME and MWT / Maritimes Affairs (SAR)</p> <p>2) Notify other marine users, fishing industry (Namibian and foreign), marine petroleum, mineral prospecting and mining licence holders.</p> <p>- Notification must include</p> <ul style="list-style-type: none"> ➢ Navigational co-ordinates of the survey area ➢ Timing and duration of proposed activities ➢ Designated safety zone around the seismic vessel (500m). <p>3) Notify fishing operators through recognised fishing associations, MFMR, fishing companies, agents or through MME</p> <ul style="list-style-type: none"> ➢ Notify operational fishing vessels directly where required or encountered <p>4) Transmit Daily Radio Navigation Warnings and Notices to Mariners the survey vessel's position and operation progress</p>	<p>Seismic Contractor Operations Manager, Environmental Coordinator</p>	<p>Copies of all correspondence</p> <p>Copies of notices sent</p>	<p>Notice to Mariners at least 24 hours before start of survey</p> <p>Daily positional updates throughout survey</p>	<p>Copies of notices and list of recipients/ addressees</p>
Appointment of FLO / MMO	<p>Ensure compliance with EMP</p> <p>Minimise impacts</p>	<p>Appoint trained FLO who are familiar with fisheries operational in the area and MMO must have experience in seabird, turtle, seal and marine mammal identification and observation techniques.</p>	<p>Seismic Contractor</p>	<p>FLO / MMO contract and reports</p>	<p>Prior to commencing survey</p>	<p>Monitoring reports</p>

Table 4.2: Actual Survey Operations.

ACTIVITY	RATIONALE and MOTIVATION	COURSE OF ACTION TO FULFIL EMP PROVISOS	DESIGNATED PERSON RESPONSIBLE	CONTROL and VERIFICATION	TIMING	REQUIREMENT FOR "CLOSEOUT" REPORT
Adherence to EMP and Industry Best Practices	Operate in an environmentally responsible manner	1) Comply fully with the EMP (compliance means all activities are undertaken successfully and details recorded). 2) Abide by terms of internationally recognised Environmental Management Policy <ul style="list-style-type: none"> ➢ Include environmental awareness training, waste management, environmental monitoring, procedure and data recording. 3) Comply with the Joint Nature Conservation Committee (JNCC) "guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys" 4) Comply with " <i>Environmental Guidelines for Worldwide Geophysical Operations</i> " as issued by the International Association of Geophysical Contractors (IAGC).	Operations Manager and Seismic Contractor, FLO and MMO	Self-audits	During the survey period	Copies of self-audit reports FLO and MMO reports
Helicopters Crew changes, Services or in an event of an Emergency as may be required	Minimise noise impact to coastal fauna	1) Instruct helicopter operator and pilots not to overfly Ramsar sites, islands, coastal reserves, bird and seal breeding colonies. If not possible <ul style="list-style-type: none"> ➢ Minimum altitudes of 600 m over nature conservation/breeding areas ➢ No-fly zone 3km seaward and 1km landward of sensitive area ➢ Avoid seabird colonies on the numerous offshore islands 2) Brief all pilots on the ecological risks associated with flying over seabird and seal colonies and at a low level parallel to the coast. 3) Avoid prolonged coast-parallel flights within 1 nautical mile of the shore) 4) Maintain reasonable altitude over sea (600 m) if cetaceans are spotted. 5) Report any deviations from pre-set flight paths.	Operations Manager Environmental coordinator Helicopter operator	Report deviation from prescribed flight path	Ad Hoc As required	Log of flight paths
Equipment management	Minimise equipment loss overboard and minimise hazards on seafloor or floating	1) Keep a record of all items lost overboard including time and location 2) Inform relevant authorities (MEFT, MFMR, MME), and other users in the area (mining houses, fishing companies). 3) When any items that constitute a seafloor or navigation hazard are lost a standard form must be completed including: <ul style="list-style-type: none"> ➢ Date and cause of loss ➢ Details of equipment (Type, Size) ➢ Vessel ➢ Location ➢ Sea state and weather ➢ Nature of the Seafloor 	Seismic Contractor Operations Manager Equipment quartermaster Environmental officer	Incident records	During the operation	List of lost equipment Copy of record sheet

Table 4.2: Cont.

ACTIVITY	RATIONALE and MOTIVATION	COURSE OF ACTION TO FULFIL EMP PROVISOS	DESIGNATED PERSON RESPONSIBLE	CONTROL and VERIFICATION	TIMING	REQUIREMENT FOR "CLOSEOUT" REPORT
Pollution control and Waste Management	Minimise marine pollution Maximise recycling Adherence to MARPOL 73/78	<p>1) Minimise pollution and maximise recycling by implementing and maintaining a company waste management policy.</p> <p>2) Comply with legal requirements for waste management and pollution control (for air and water quality levels at sea) by educating crew, adhering to MARPOL policies and monitoring practices.</p> <p>3) Ensure all crew is trained in spill management.</p> <p>4) Ensure that a waste disposal contractor disposes of waste returned to port at a licensed landfill site.</p> <p>5) Ensure waste disposal is carried out in accordance with appropriate laws.</p> <p>5) Supply vessels must comply with internationally agreed MARPOL standards</p> <p>MARPOL Procedures and Guidelines</p> <ul style="list-style-type: none"> • <i>General waste:</i> Minimise waste generation -No disposal overboard. • <i>Galley waste:</i> Reduce to < 25 mm prior to disposal overboard if < 12 NM from shore - No disposal within 3 NM of the coast. • Disposal without macerating – vessel must be >12 nautical miles from shore. • <i>Medical waste:</i> Seal in aseptic containers for disposal onshore. • <i>Deck drainage:</i> Use biodegradable, non-toxic cleaning agents • Ensure that weather decks are kept free of spillage. Mop any spill immediately. Collect in oily water separator systems. • <i>Machinery space drainage:</i> Collect used oil and oily water • Filter oily water and release water of < 5ppm oil in water • Dispose of sludge in appropriate facility at port. • Return waste oil to shore for processing • <i>Solid waste:</i> Incinerate onboard or store and transport to port for disposal on land. • <i>Hazardous waste:</i> record volume and type brought onboard • Store in dedicated waste containers • Dispose of in the designated site at port. • <i>Sewage:</i> use approved treatment plants set to MARPOL standards. Discharge only where the high wind and wave energy is expected to result in rapid dispersal. Discharge treated sewage between 4 and 12 NM from the coast. No sewage discharge within 4 NM of the coast. No treatment needed if beyond 12 NM from coast, However, vessel must be moving at ≥4 knots before discharging at a moderate rate. • <i>Metal:</i> Send to shore for recycling or disposal. • <i>Minor oil spill:</i> Use oil absorbent. • <i>Atmospheric emissions:</i> Maintain and tune all hydraulic hoses, engines, motors, generators to minimise soot and unburned diesel. 	Seismic Contractor Operations Manager Environmental coordinator	Self-audit Registers Record books Daily reports	Throughout survey operations	Summary of waste record book Waste disposal schedule Receipts from disposal agents/sites Record destination of waste for on land disposal Report occurrence of minor oil spills

Table 4.2: Cont.

ACTIVITY	RATIONALE and MOTIVATION	COURSE OF ACTION TO FULFIL EMP PROVISOS	DESIGNATED PERSON RESPONSIBLE	CONTROL and VERIFICATION	TIMING	REQUIREMENT FOR "CLOSEOUT" REPORT
Communication and notification to other vessels, Coordination with other users	Minimise disruption to other users. Promote cooperation Promote safe navigation Minimise cumulative impacts	1) Notify relevant government ministries and departments – MFMR, MEFT, MME, Namibian Ports Authority. Port Captains and Commissioner for Petroleum Affairs 2) Notify other marine users, fishing industry (Namibian and foreign), marine petroleum, mineral prospecting and mining licence holders. - Notification must include <ul style="list-style-type: none"> ➢ Navigational Coordinates of The Survey Area ➢ Timing and Duration of Proposed Activities ➢ Designated safety zone around the seismic vessel (500 m). 3) Notify fishing operators through recognised fishing associations, MFMR, fishing companies, agents. <ul style="list-style-type: none"> ➢ Notify operational fishing vessels directly 4) Transmit Daily Radio Navigation Warnings and Notices to Mariners re the survey vessel's position and operation progress 5) Co-operate with other users to minimise disruption of their activities. 6) Co-operate with other legitimate users of the sea to minimise cumulative impacts on marine life.	Seismic Contractor Operations Manager Environmental Coordinator FLO	Copies of written notices and correspondence	Notice to Mariners at least 24 hours before start of survey Daily positional updates throughout survey During survey operations as required	Copies of notices and list of recipients/ addressees/ FLO Reports / notes/ minutes
Exclusion of other vessels	Minimise probability of collision or contact incidents	1) Use communication channels (radio and email) to inform all other potential users about the survey locations, timing, priority of passage, safety exclusion zones. 2) Keep constant watch for approaching vessels during operations. 3) Warn by radio and chase boat if required. 4) Communicate any delays or equipment loss. 5) Record any unusual incidents	Survey Contractor Environmental Coordinator Operations Manager FLO Officer of the watch Chase boat skipper	Daily Reports Copies of written communication Incident Report	During the survey operations	Copies of written communication Incident Reports/FLO Reports / notes/ minutes
Prevention of emergencies	Minimise potential emergency Minimise environmental damage Minimise extraneous costs	1) Prevent collisions by ensuring good communications with relevant parties. 2) Ensure seismic and support vessels display correct signals by day and lights by night (including twilight) 3) Set watches – visual, radar and standby vessel. 4) Identify any long-line activity in survey area and communicate with fishers as to location of gear. 5) Service equipment regularly 6) Conduct weekly emergency drills. 7) Establish lines of communication with emergency response: <ul style="list-style-type: none"> ➢ MEFT, MFMR, MWTC, Sea Rescue Institute of Namibia, Ports Captains. 	Survey Contractor Environmental Coordinator Operations manager FLO Officer of the watch Chase boat skipper	Daily Reports Copies of written communication Incident Report	Throughout survey operations	Copies of written communication Incident Reports/ FLO Reports / notes/ minutes

Table 4.2: Cont.

ACTIVITY	RATIONALE and MOTIVATION	COURSE OF ACTION TO FULFIL EMP PROVISOS	DESIGNATED PERSON RESPONSIBLE	CONTROL and VERIFICATION	TIMING	REQUIREMENT FOR "CLOSEOUT" REPORT
Emergency management procedures (include. Oil Spills)	Minimise environmental damage Minimise distress and tragedy	<p>1) Adhere to code of conduct and Law of the Sea obligations regarding other vessels in distress.</p> <p>2) In the event of an onboard crisis implement health and safety procedures in accordance with emergency plans.</p> <p>3) In the event of an oil spill immediately notify NAMPORT and the Commissioner for Petroleum Affairs. Information required when reporting a spill includes:</p> <ul style="list-style-type: none"> ➤ The type and circumstances of incident ➤ Ship name, type, port of registry ➤ Nearest agent representing the ships company ➤ Location (lat, long), distance offshore and extent of oil spill ➤ Prevailing weather conditions and sea state ➤ Persons and authorities already informed of the spill. <p>Where diesel, which evaporates relatively quickly, has been spilled, the water should be agitated or mixed using a propeller boat to aid dispersal and evaporation.</p> <p>Dispersants are most effective:</p> <ul style="list-style-type: none"> ➤ On fresh crude oils. under turbulent sea conditions (dispersants require mixing). ➤ When applied within 12 hours or at a maximum of 24 hours after the spill. <p>The volume of dispersant application should not exceed 20-30% of the oil volume.</p> <p>Dispersants should not be used without authorisation by MFMR.</p> <p>Dispersants should not be used:</p> <ul style="list-style-type: none"> ➤ On diesel or light fuel oil or on heavy fuel oil. ➤ On slicks > 0.5 cm thick. ➤ On any oil spills within 5 nautical miles offshore ➤ In water depths < 30 m ➤ When spill is so far offshore there is little chance of oil reaching the shore. 	Survey Contractor Environmental Coordinator Operations manager/ SHE Officer of the watch	Daily Reports Copies communication Incident Report	Throughout survey operations	Copies of communication Incident Reports

Table 4.2: Cont.

ACTIVITY	RATIONALE and MOTIVATION	COURSE OF ACTION TO FULFIL EMP PROVISOS	DESIGNATED PERSON RESPONSIBLE	CONTROL and VERIFICATION	TIMING	REQUIREMENT FOR "CLOSEOUT" REPORT
Airgun Operation	Minimise impact of seismic noise on marine fauna	<p>1) Maintain continuous watch for marine life within 500 m of vessel and airgun array. PAM should be used at night and in periods of poor visibility.</p> <p>2) Use of the lowest practicable airgun volume as defined by the operator.</p> <p>3) Implement the following procedures before and during shooting:</p> <ul style="list-style-type: none"> • No seismic activity if birds and/or animals are observed within 500 m of the vessel or the airgun array. • Commence "soft-start" procedures if no animals or diving birds have been sighted within the safe zone (500 m) for at least 30 minutes. If after 30 minutes, small cetaceans (dolphins) and seals are still in area, normal "soft start" procedures may commence • Re-initiate "soft starts" after a cessation in firing of 20 minutes or longer. Ramp-up proportionally if break was shorter than 20 minutes. • Fire low level warning shots during turns and repositioning, unless using PAM. Temporarily terminate seismic shooting when: • Negative behaviour indicating distress directly related to the airgun is observed • Animals and/or birds are observed within 500 m of the operating airgun or the vessel (except dolphins and seals) • Animals and/or birds approach the airgun (except dolphins and seals) • Injury occurs as a direct result of the survey. • Natural avoidance behaviour is over-ridden by feeding response near the seismic array (e.g. Due to the presence of stunned fish) • There is mass mortality or evidence of mass disorientation or injury of fish and/or invertebrates. <p>At night:</p> <ul style="list-style-type: none"> • PAM will be used. • Lighting on board survey vessels should be reduced to the minimum safety levels to minimise the potential stranding of pelagic seabirds • Any stranded seabirds must be retrieved and released according to appropriate guidelines <p>4) Record sightings of any injured or dead protected species, regardless of whether the injury or death was caused by the seismic vessel itself. If the injury or death was caused by a collision with the seismic vessel, the date and location (lat, long) of the strike and the species and a description of the animal and/or bird should be recorded.</p>	Survey Contractor Environmental Coordinator Officer of the watch MMO	Self-audit Daily Reports Shut-down logs IMO/MMO reports Incident Report Records of marine fauna observations and "soft-start" procedures	Prior to and throughout survey operations	IMO/MMO reports Copies of completed marine fauna observation forms and seismic activity log showing "soft-start" Initiation. Log of shutdowns, including all decisions and discussions relevant to the termination.

Table 4.2: Cont.

ACTIVITY	RATIONALE and MOTIVATION	COURSE OF ACTION TO FULFIL EMP PROVISOS	DESIGNATED PERSON RESPONSIBLE	CONTROL and VERIFICATION	TIMING	REQUIREMENT FOR "CLOSEOUT" REPORT
Ongoing monitoring of effects	Ongoing monitoring programmes (in conjunction with government if required)	1) Initiate monitoring programmes as per specific indication by authorities, 2) Monitor performance against objectives and targets 3) Document all activities and findings for internal and external audits 4) Undertake daily monitoring and recording of the following: <ul style="list-style-type: none"> ➤ Marine mammals and sea birds sighted ➤ Record species and numbers in relation to survey activities ➤ Responses of animals and birds to seismic activity ➤ Fish or invertebrate mortality associated with airgun firing ➤ Record sound levels and "soft start procedures" ➤ Record changes in behaviour (swimming motion, feeding, diving patterns, change in swimming direction and speed, startle responses) ➤ Record vessel interaction, particularly if chase boat was used to maintain safe operational zone ➤ Details of unattended fishing gear ➤ Document communication with other vessels 	Seismic Contractor Environmental Coordinator MO	Daily Reports	During survey operations	Daily reports MMO reports
Performance assessment	Ongoing monitoring programme and EMP Performance Assessments	1) Implement the ongoing monitoring programmes and EMP Performance Assessment as determined by MME 2) Submit Environmental Performance Assessment reports to MME and MEFT 3) Performance assessment based on successful implementation of EMP Data recorded should include: <ul style="list-style-type: none"> ➤ Species and numbers ➤ Location (lat, long) ➤ Relation to vessels (distance, approaching/retreating) ➤ Swimming direction and speed ➤ Change in swimming direction/speed as a result of survey activities ➤ Stunning or mortality as a result of survey activities Take note of: <ul style="list-style-type: none"> • Airgun activities, including sound levels, "soft-start" procedures, shut-down and pre-firing regimes, night-time survey, relocation • Meteorological conditions and sea state • Compliance with (MARPOL 73/78 regulations) 4) Submit reports to ministries weekly and to research institutes such as the National Marine Information and Research Centre (NatMirc) in the MFMR for analyses of survey impacts in local waters.	Seismic Contractor SHE FLO and MMO	Daily reports MMO reports	During survey operations and after completion of survey Required regularity of performance assessment to be determined by MEFT and MME	Monitoring reports Provide all recorded information

Table 4.3: Post survey operations.

ACTIVITY	RATIONALE and MOTIVATION	COURSE OF ACTION TO FULFIL EMP PROVISOS	DESIGNATED PERSON RESPONSIBLE	CONTROL and VERIFICATION	TIMING	REQUIREMENT FOR "CLOSEOUT" REPORT
Survey vessels to leave area	Leave area in state that it was prior to survey operations	Ensure that all deployed equipment is retrieved.	Seismic Contractor Operations Manager SHE Equipment Quartermaster	Self-Audit Equipment records	On completion of survey operations	SHE / Environmental Coordinator Report
Inform relevant parties of survey completion	Ensure all relevant parties are aware of completion of survey operations	1) Inform MEFT, MME and MFMR of completion of survey operations 2) Inform other users of completion of survey operations (Fishing Industry Mining Companies) <ul style="list-style-type: none"> Inform fishing companies and vessels through recognised fishing associations. 	Seismic Contractor Operations manager SHE Environmental Officer	Records of communication	Within a fortnight of survey completion	Copies of communication and notification documents
Final waste disposal	Minimise pollution, maximise recycling Ensure correct disposal of all waste brought to port	1) Dispose of all waste retained onboard at a licensed waste site through a licensed waste disposal contractor.	Seismic Contractor operations manager SHE Environmental Officer	Receipts from waste disposal contractor	In port	Receipts from waste disposal contractor and sites
Final observation reports	Share information with interest groups	1) Share faunal observation reports with relevant parties/associations and MFMR, MEFT.	MMO and FLO	Reports	After completion of survey	FLO and MMO monitoring reports
Close-out report	Ensure corrective action and EMP compliance	1) Compile a seismic survey "close-out" report on completion of the survey. 2) Base "close-out" report on the monitoring requirements and the EMP. 3) Provide information / records asked for in "close-out" report column of EMP 4) Submit copies to MEFT and MME	TGS Geophysical Company (UK) Limited / External Consultant such as Risk-Based Solutions (RBS) CC		Three (3) months after survey close	Above information, records and reports

5. MONITORING AND REPORTING

5.1 OVERVIEW

The current Namibian environmental assessment and management procedure requires the submission of biannual Environmental Monitoring Reports (EMRs) or as the Environmental Clearance Certificate (ECC) additional conditions that may be stipulate.

It recommended that the EMRs as submitted when due even if no activities did take place. The EMRs are used to support the renewal of the ECC once it expires after three (3) years.

The EMRs shall comprise the summary description of the activities undertaken for the period under review, the EMP implementation and the submission of the monitoring datasets collected. The regular submission of EMRs and collation of data may facilitate recognition of effects and impacts not previously foreseen and allow for the implementation of precautionary measures and mitigation before the impacts become significant.

The monitoring programme acts as a quality assurance check list on all environmental procedures and environmental performances with respect to the implementation on the EMP. The following is the summary of the key general component of the EMP monitoring framework that shall be monitored and documented in addition to the specific reporting by the SHE / Environmental Coordinators, FLO and MMO activities:

- 1) I&AP consultation and communication records:
 - a. Pre-survey meetings.
 - b. Communication with I&APs, and.
 - c. Notice to Mariners.
- 2) Port calls.
- 3) Vessel operations:
 - a. Fuel consumption.
 - b. Oil consumption, and.
 - c. Water consumption.
- 4) Weather and Climate:
 - a. Atmospheric weather conditions, and.
 - b. Sea state.
- 5) Marine Fauna sightings and interactions
 - a. Invertebrates (sightings / reaction to survey).
 - b. Turtles (sightings / reaction to survey).
 - c. Sea Birds (sightings / reaction to survey /landing on vessel).
 - d. Seals (sightings / reaction to survey).

- e. Baleen whales (sightings / reaction to survey).
 - f. Toothed whales and dolphins (sightings /reaction to survey).
 - g. Cetaceans (sightings /reaction to survey), and.
 - h. Fish / fishing vessel/s (sightings / reaction to survey).
- 6) Incidents involving other marine users:
- a. Daily updates (survey position and progress).
 - b. Fishing industry interaction (incident record – vessels / gear), and.
 - c. Other Vessels (incident record).
- 7) Onboard environmental awareness:
- a. Environmental training.
 - b. Waste management:
 - i. Discharge to atmosphere (volume).
 - ii. Discharge to sea:
 - o Sewage (volume), and.
 - o Galley waste (tonnage).
 - iii. Disposal at port:
 - o Solid waste (tonnage/ disposal site).
 - o Hazardous Waste (volume/ disposal site), and.
 - o Other waste (volume/ disposal site)
- 8) Emergencies:
- a. Service record.
 - b. Major Oil/ Chemical spills.
 - c. Emergency Drills / Training, and.
 - d. Health and Safety Briefings.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 EMP Conclusions

Several specific mitigation measures have been provided in this EMP report based on the findings and recommendations of the EIA Report to mitigate the potential negative impacts that the proposed 3D seismic survey activities may have on the receiving coastal and marine environments (physical, biological, and socioeconomic components). If the mitigation measures are implemented and monitored, any likely negative impacts that the proposed 3D seismic survey activities may have on the receiving environment are likely to be reduced significantly, thereby promoting the coexistence of petroleum exploration activities with natural marine environment and other marine users such as fisheries.

6.2 EMP Framework Recommendations

Based on the results of the EIA Report and the mitigation measures detailed in this EMP Report, it is hereby recommended that the proponent (TGS Geophysical Company (UK) Limited) be issued with Environmental Clearance Certificate (ECC) for the proposed 3D seismic survey activities operations in the Orange and Lüderitz Basins, offshore southern Namibia.

TGS Geophysical Company (UK) Limited and the survey contractor are responsible for ensuring that all the provisions of this EMP implemented and monitored accordingly. The ultimate responsibility rests with the Proponent (TGS Geophysical Company (UK) Limited), for providing all appropriate resources and ensure that all employees, including contractors and sub-contractors are informed of, understand and are familiar with the EMP requirements for the proposed 3D seismic survey activities. The following is the summarised local tailor made EMP prepared for easy incorporation in the project / contract documents with respect to the proposed 3D seismic survey activities over the Orange and Lüderitz Basins, southern offshore Namibia and based on the standard TGS Geophysical Company (UK) Limited EMP framework:

1. Procedure for Commencement of Operations:

(i) Exclusion zone:

- 500 m horizontal radius from centre of source array.

(ii) Visually monitor the exclusion zone:

- In water depths of greater than 200m, for at least 30 minutes prior to activating seismic sources, observer(s) should visually survey the 500 m exclusion zone for cetaceans and sea turtles.
- Observer(s) assigned to visual observations during commencement of operations:
 - Observer(s) should be trained to an acceptable standard.
 - Observer(s) may be crew members, other employees, or third-party contractors, and.
 - All visual observations and operations should be electronically documented and made available for evaluation and study.
- If cetaceans or sea turtles are present within the 500m exclusion zone, delay the start of soft-start procedure until at least 20 minutes after the last sighting of a cetacean or sea turtle, and.
- If there are no cetaceans or sea turtles present, initiate soft-start procedure.

(iii) Soft Start Procedure:

- To achieve the soft start principle of commencing with the smallest volume element in

the array and progressing to the full operating volume of the source over a specified period, the following key elements will be implemented:

- The first stage of soft start will involve activating the smallest volume element in the array.
- Subsequent stages will involve doubling the number of active elements at the commencement of each stage.
- All stages should ideally be of approximately equal length.
- The total duration of the soft start should be at least 20 minutes.
- As there will generally be one stage in which doubling the number of elements is not possible (due to the number of elements in the full array not being, for example, 8, 16 or 32) it is preferable to make this stage the last one of the soft start sequences (as opposed to adjusting the increments of other stages or placing a lower increment early in the soft start sequence).
- To minimise additional noise in the marine environment, a soft-start (from commencement of soft-start to commencement of the line) should not be significantly longer than 20 minutes (for example, soft-starts greater than 40 minutes are considered to be excessive, and an explanation should be provided within the MMO report), and.
- Operators should avoid unnecessary firing at full power before commencement of the line.

(iv) Periods of poor visibility and darkness:

- Initiate soft-start procedure as above, and.
- Use passive acoustic monitoring system for detections.

2. Procedure for Ongoing Operations:

- (i) If seismic sources are silent for 5 minutes or more, use soft-start procedure.
- (ii) Report immediately to MMO or FLO if there is any animal in distress, animal carcasses, etc.
- (iii) The vessels involved in the project must not move towards cetaceans and sea turtles whenever it is possible. Wherever possible the vessels must avoid and distance themselves from these animals.
- (iv) Whenever possible the speed of the project vessels must be limited to a maximum of 13 knots.
- (v) Whenever protected marine mammals are observed within the exclusion zone, **the shots must be interrupted** and thereafter a slow-start procedure followed, and.
- (vi) If marine mammals are detected within 500 metres of the centre of the airgun array whilst the airguns are firing, either during the soft-start procedure or whilst at full power, **there is no requirement to stop firing the airguns.**

3. Procedure for Testing Source Elements:

- (i) If a source test is necessary whereby each source element must be activated individually.
- (ii) Visually monitor the exclusion zone before any instances of gun testing.

- At least 30 minutes prior to activating seismic sources, observer(s) should visually survey the 500m exclusion zone for cetaceans and sea turtles.
- Observer(s) assigned to visual observations during commencement of operations
 - Observer(s) should be trained to an acceptable standard.
 - Observer(s) may be crew members, other employees, or third-party contractors.
 - All visual observations and operations should be electronically documented and made available for evaluation and study.
- If cetaceans or sea turtles are present within the 500m exclusion zone, delay the start of soft- start procedure until at least 20 minutes after the last sighting of a cetacean.
- If cetaceans are absent from the 500m zone, initiate the seismic source, starting with the smallest volume source element and working up to the larger volumes, and.
- If the intention is to test a single airgun on low power, then a soft start is not required.

4. General Practices:

- (i) Environmental awareness programmes must be organised for all crew members to explain the conservation status of the cetaceans and turtles and to highlight the importance of the mitigation measures.
- (ii) Ensure that the support vessel(s) are in watch of the safety zone established around the seismic vessel (5.5km ahead and abeam and 13 km as clearance from the vessel) this measure will allow the reduction of potential safety risks associated with the seismic operations especially with the fishing vessels while working in the shallow waters.
- (iii) High intensity unnecessary noise must be avoided where possible.
- (iv) Any occurrence of large marine mammals should be brought to the attention of MMO or FLO.
- (v) MMO and FLO observations shall always be made when the vessel is moving (not only during seismic acquisition).
- (vi) Regular maintenance must be performed on the project vessels and the maintenance team must pay special attention to the noise produced by the vessels.
- (vii) Whenever possible, ensure that the towed exploration materials (buoys, air cannons, etc.) do not have gaps (or these must be covered or reduced) in which the animals (e.g. turtles) can get stuck.
- (viii) All crew members must be forbidden from killing or causing injuries to marine fauna. Any crew member that deliberately kills or causes any damage to marine fauna must be immediately dismissed, reported to the relevant authorities and sent to shore.
- (ix) There must be someone in the support vessels who is responsible for watching out for the possible occurrence of these animals in the vicinity of ships.
- (x) In the event of entanglement, all activities must stop and the rescue actions to rescue the animal must be put into practice.

- (xi) Through the Petroleum Commissioner in the Ministry of Mines and Energy or directly, request from the Namibian Maritime Search and Rescue (SAR), Department of Maritimes Affairs in the Ministry of Works and Transport in their capacity as the national maritime authority, for instructions on the rules and procedures that shall be adhered to, prior-to and during the seismic operations in Namibian territorial (jurisdictional) waters, and.
- (xii) It shall be ensured that the "Navigation Warnings" are issued and disseminated through the Petroleum Commissioner in the Ministry of Mines and Energy or directly through Namibian Maritime Search and Rescue (SAR), Department of Maritimes Affairs in the Ministry of Works and Transport maritime communications network, as well as through other means of dissemination as may be available while at sea.

5. Pollution Management:

- (i) The procedures for deposition applied must comply with national legislation (e.g., Regulation for the Prevention of Pollution and Marine and Coastal Environmental Protection, Decree No. 45/2006 of 30 November) and international best practices (eg. International Convention for the Prevention of Pollution by Ships – Marpol 73/78).
- (ii) The treatment of sewage must be done before it is discharged into the sea, according to the recommendations by Marpol 73/78.
- (iii) The ships must perform the treatment of the bilge waters onboard or do the transshipment offshore, in compliance with the recommendations by Marpol 73/78.
- (iv) Implement a Pollution Control Programme, including the treatment, adequate disposal and minimizing waste, according to the recommendations by Marpol 73/78.
- (v) The frequent monitoring of the disposed waters, as a means of ensuring that the levels of pollutants are within the recommended standards.
- (vi) The seismic vessel shall possess a manual of procedures to deal with domestic garbage that if correctly applied, prevent and minimize the potential negative effects of this impact.
- (vii) TGS Geophysical Company (UK) Limited must ensure that the seismic vessel possesses a Plan for Domestic Residues Management that is in conformity with Annex V of the MARPOL Convention: Prevention of Pollution by Garbage from Ships.
- (viii) All atmospheric pollution emissions shall comply with the Mozambican Laws and International Guidelines.
- (ix) According to Annex VI of the MARPOL 73/78 Convention, the content of the oils sulphuric shall have a maximum value of 4.5% m/m except in cases that the seismic vessel is equipped with an approved cleaning system for the treatment of exhaustion gases or any other technical method that is verifiable and that reduces the SO₂ emissions to a maximum of 6.0 g/kWh₁, and.
- (x) The incineration of packaged contaminated materials on board the seismic vessel and Polychlorinated Biphenyls (PCBs) is prohibited. Furthermore, the deliberate emission of substances that are prejudicial to the Ozone Layer, including halon and the chlorofluorcarbonates (CFCs) is also prohibited.

6. Spills Management:

- (i) All equipment and machinery that could potentially leak or spill fuel must be regularly maintained, inspected and tested.

- (ii) An Emergency Response Plan for Oil Spills must be prepared and must include, at least, the requirements specified by the World Bank related to Health, Safety and the Environment during Offshore Petrol and Gas operations (World Bank Group, 2015).
- (iii) In the event of fuel spills or other chemicals, an Emergency Response Plan for Oil Spills must be put into action /implemented. The capacity to implement that plan must be proven before the start of any activities.
- (iv) The Emergency Response Plan for Oil Spills must consider the best measure and the state-of-the-art methods for containing spills or loss of fuels, oil and chemical products, in all the vessels involved in the Project.
- (v) Regular adequate training must be provided for all Project workers, related to the prevention, containment and response to spills.
- (vi) All equipment involved in the response to spills must be frequently maintained, inspected and tested.

7. Overall Compliances:

- (i) Compliance to all relevant national, regional and international (MARPOL) marine pollution prevention regulations, standards, guidelines and procedures, and.

8. Adoption of the Precautionary Principles:

- (i) In the absence of any specific mitigation measures being provide in this EMP, the Proponent (TGS Geophysical Company (UK) Limited) and / or Contractor shall always adopt the precautionary approach.

7. REFERENCES / BIBLIOGRAPHY AND FURTHER READING

Refer To the EIA and Annexes Reports