5 NEED AND DESIRABILITY

This chapter describes the need and desirability for the proposed project. "Need and desirability" is the consideration of the strategic context of a development proposal within the broader societal needs and the public interest.

The "need and desirability" of the proposed project from the perspective of wider society and policy 'fit' is addressed in terms of the following:

- White Paper on the Energy Policy (1998);
- Vision 2030;
- The Fifth National Development Plan;
- Namibia's Industrial Policy;
- Regional and local planning guidance; and
- Oil and gas sector history, policy and promotion initiatives.

The above sources are reviewed below and compatibility of 'fit' summarised in Section 5.7.

5.1 WHITE PAPER ON THE ENERGY POLICY (1998)

The White Paper on the Energy Policy (1998) is the overarching policy which guides planning in the energy sector. This White Paper embodies a new, comprehensive energy policy aimed at achieving security of supply, social upliftment, effective governance, investment and growth, economic competitiveness, economic efficiency and sustainability. The legislative framework governing upstream oil and gas is well developed, and the White Paper merely clarifies an accepted policy framework which seeks to optimise national benefits while achieving the necessary balance of interests to attract investment. The focus of the White Paper is on creating a policy and legislative framework, which attracts initial investment into the sector, while maintaining options for competition in the future and the fair distribution of economic rents.

5.2 VISION 2030

In 2004, Namibia adopted Vision 2030, which outlines the country's development programmes and strategies to achieve its national objectives. One of the major objectives of Vision 2030 is to "*ensure the development of Namibia's 'natural capital' and its sustainable utilisation, for the benefit of the country's social, economic and ecological well-being*".

The vision for non-renewable resources is that Namibia's mineral resources are strategically exploited and optimally beneficiated, while ensuring that environmental impacts are minimised. Vision 2030 acknowledges that poorly planned or badly managed mining can result in a great variety of impacts that threaten human health and environmental integrity. Vision 2030 further notes that with EIAs applied during the planning phase and the implementation of ESMPs during operational phase, operations are increasingly better planned and negative impacts can usually be mitigated and localised.

5.3 FIFTH NATIONAL DEVELOPMENT PLAN 2017/18 – 2021/22 (NDP5)

Vision 2030 is being implemented through a series of five-year National Development Plans. NDP5 aims to achieve rapid industrialisation, while adhering to the four integrated pillars of sustainable development:

- Economic Progression;
- Social Transformation;
- Environmental Sustainability; and
- Good Governance.

NDP5 recognises the use of Namibia's natural resources in an efficient and sustainable way to achieve sustainable development and improve the welfare of the nation's citizens. In this regard, it emphasises the importance of partnerships between government, the private sector, communities and civil society in ensuring that economic progress is achieved in an environment of social harmony.

It also plans to achieve economic progression by developing value added industrialisation, substituting imports for locally produced goods, creating value-chains of production, and to accelerate Small and Medium Enterprise (SME) development (NPC, 2017).

5.4 NAMIBIA'S INDUSTRIAL POLICY

In 2012, the then Ministry of Trade and Industry (MTI) developed Namibia's Industrial Policy. Three years after drafting the Industrial Policy, the MTI produced an execution strategy for industrialisation in 2015 called "*Growth at Home"* (MTI, 2015).

The strategy advocates a targeted approach towards industrialisation. In the first phase of Growth at Home, sectors in which Namibia already has some sort of comparative advantage will be targeted (MTI, 2015). Mining (and other extraction) is identified as one of a number of particular sectors to be targeted. The strategy sets out a broad outline of how downstream industries should be developed to ensure that the job creation and socio-economic benefits which stem directly and indirectly from primary production are maximised (MTI, 2015).

5.5 LOCAL AND REGIONAL SOCIO-ECONOMIC POLICY

With respect to regional planning, the socio-economic development objectives of the Erongo Region have a special focus on uplifting the standard of living within the region (ERC, 2015). They include the following:

- ensuring regional and rural economic development;
- creating employment opportunities;
- improving infrastructure, with the delivery of basic services to rural areas a priority;
- co-ordinating training of community members in entrepreneurial skills; and
- educating the community with regard to the prevalence of HIV/Aids and Tuberculosis (TB) cases.

Socio-economic development goals are not readily available for the Karas Region, but the Karas Regional Council notes on their webpage that "[t]*he region still possesses many untapped raw materials, such as offshore natural gas and other minerals that promise new industries*" (KRC, 2015).

The town councils of both Lüderitz and Walvis Bay seek to ensure that its economy is well diversified. The Walvis Bay Town Council has pointed out that Walvis Bay, with its deep-water port, ship repair and logistics handling facilities, is particularly well placed to serve an oil extraction industry which could develop in the wake of a significant oil discovery (WBTC, 2017).

5.6 OIL AND GAS INDUSTRY HISTORY, POLICY AND PROMOTION INITIATIVES

Exploration aims to identify commercially viable reserves of hydrocarbons such as oil and gas. The first step in the search for hydrocarbons is to undertake geophysical surveys. These allow for the evaluation of the structure and composition of subsurface formations. Geophysical surveys include magnetometric, aerial photogrammetric, gravimetric, seismic, radiographic and stratigraphic surveys, all of which provide a more detailed understanding of the likelihood of the existence of commercially viable hydrocarbons. The certainty which can be achieved through surveys is limited and to prove the existence of commercially viable reserves, exploration and appraisal drilling is necessary (UKDTI, 2001).

The first Namibian oil and gas exploration wells were drilled in the 1960s, but it wasn't until 1974 that the presence of hydrocarbons was confirmed through the discovery of the Kudu Gas Field on the northern section of the Orange Basin, directly west of Oranjemund. By 1991, fewer than 10 hydrocarbon wells had been drilled in Namibia, with no commercially viable reserves having been discovered (OGJ, 1991). Following unsuccessful attempts to prove commercially viable reserves, interest in Namibian oil and gas waned.

In recent years there has been a resurgence in Namibian hydrocarbon exploration with major oil companies purchasing exploration licences from the government. Improvements in deep water drilling technology increased the economic viability of what were previously considered sub-commercial reserves. Between 2010 and 2014, 13 wells were drilled in Namibia bringing the total number of offshore hydrocarbon wells drilled in Namibian waters to 32. Of these, 15 have been exploratory wells, seven have been appraisal wells and a further ten have been drilled for scientific research (NAMCOR, 2017a). The collection of survey, seismic and aeromagnetic data has contributed to a substantial geological and geophysical database for the country, and has revealed the existence of four offshore frontier basins of interest to explorers: the Orange, Lüderitz, Walvis and Namibe basins. Commercially viable petroleum reserves are yet to be discovered in Namibia.

Regulation of the Namibian oil and gas industry is the mandate of MME. The fiscal regime is outlined in the Petroleum (Exploration and Production) Act, 1991 (No. 2 of 1991), the Petroleum (Taxation) Act, 1991 (No. 3 of 1991) and the Petroleum Laws Amendment Act, 1998 (No. 24 of 1998). Administrative provisions are also provided in the Income Tax Act, 1981 (No. 24 of 1981). Overall, the tax regime is designed to encourage exploration with a view to increasing production, which is ultimately where the state would generate significant amounts of revenue if a substantial, commercially viable reserve is proven.

Policy advice is provided to MME by NAMCOR, a state-owned company which is also responsible for promoting exploration and production in the country. NAMCOR also has "the mandate to carry out reconnaissance, exploration and production operations either on its own or in partnership with other organisations in the industry" (NAMCOR, 2017b). NAMCOR is actively engaged in identifying prospects and leads, as well as in promoting and marketing the oil and gas potential of Namibia to local and international companies.

5.7 COMPATIBILITY OF 'FIT' OF THE PROJECT

The policy compatibility review suggests that Namibian policy is broadly aimed towards improving socio-economic welfare through the sustainable utilisation of the country's natural resources. NDP5 plans to achieve economic progression by developing value added industrialisation, substituting imports for locally produced goods, creating value-chains of production, and to accelerate SME development. Although Namibian policy is increasingly focussed on beneficiation and the creation of downstream opportunities, it is still recognised that upstream industries involving resource extraction play a key role in the overall goal of realising the full potential which the country's resources can offer. The overall conclusion is that the proposed project will be largely compatible with key socio-economic policies and plans provided environmental and other risks can be adequately mitigated.

The need and desirability for the proposed project is economic and strategic in nature. The project has the potential to benefit the country, society and surrounding communities (Lüderitz and Walvis Bay) both directly and indirectly; although only in the short-term. Direct economic benefits will be derived from employment (although unlikely) and wages, taxes and profits. Indirect economic benefits will be derived from the procurement of goods and services and the increased spending power of employees.

6 PROJECT DESCRIPTION

This chapter describes the project scope and activities, provides technical information on seismic surveys, and summarises the project alternatives.

6.1 EXPLORATION LICENCE HOLDERS

TEPNA holds the majority interest and the operatorship of Blocks 2912 and 2913B (see Table 6-1), with Impact, Qatar Petroleum and the National Petroleum Corporation of Namibia (NAMCOR) holding the remaining interest. TEPNA's contact details are presented in Table 6-2.

TABLE 6-1: STRUCTURE OF LICENCE HOLDING AND SHAREHOLDING

	Licence Blocks	
	2912	2913B
TEPNA	37.77%	40%
Impact	18.9%	20%
Qatar Petroleum	28.33%	30%
NAMCOR	15%	10%

TABLE 6-2: CONTACT DETAILS OF LICENCE HOLDER

Address:	Total E and P Namibia B.V. Physical: 5 Otto Nitzsche Strasse, Klein Windhoek Postal: PO Box 4223, Windhoek
Responsible person:	Adewale Fayemi (Managing Director)
Tel:	+264 61 374 900
Fax:	+264 61 374 912
E-mail:	adewale.fayemi@total.com

6.2 SUMMARY OF SITE INFORMATION

Licence Blocks 2912 and 2913B are located in the deepwater Orange Basin off the coast of southern Namibia (see Figure 1-1 and Figure 6-1). These blocks have a combined area of 18 170 km^2, with water depths ranging from 2 600 m to 3 800 m. Refer to Table 6-3 for additional information pertaining to the individual blocks.

TABLE 6-3: SUMMARY OF LICENCE BLOCKS

Licence Block No.:	2912	2913B
Size of Licence Blocks:	9 955 km^2	8 215 km^2
Water depths across licence area:	3 300 m to 3 800 m	2 600 m to 3 300 m
Distance offshore (at closest point):	290 km	240 km
Locality:	Refer to Figure 1-1 and Figure 6-1	

Coordinates of Licence Blocks (WGS84):	2912	No.	Latitude (⁰) (S)	Longitude (⁰) (E)
		1	29°0'19.822"S	12°1'39.956"E
		2	28°59'57.732"S	12°59'57.559"E
		3	30°21'27.012"S	13°0'19.649"E
	2913B	1	28°59'57.732"S	12°59'57.559"E
		2	28°59'57.732"S	13°29'32.132"E
		3	30°33'43.35"S	13°29'39.495"E
		4	30°39'14.701"S	13°20'19.879"E
		5	30°21'27.012"S	13°0'19.649"E

6.3 PROJECT SCOPE AND ACTIVITIES

The proposal is to undertake a 3D seismic survey in the licence area. A summary of the project phases and anticipated activities is provided in Table 6-4.

TABLE 6-4: SUMMARY OF PROJECT PHASES AND ACTIVITIES

Phase	Activity
1. Mobilisation Phase	Transit of survey vessels to survey area, including routine discharges to sea
	Discharge of ballast water
2. Operation Phase	Seismic acquisition, including the deployment of seismic equipment (sources and streamers) and acquisition operations
	Operation of supply vessels, including routine discharges to sea
	Provision of services from local service providers (e.g. catering and refuelling)
	Berthing during crew changes
	Operation of helicopters during crew changes
	Bunkering at sea
3. Demobilisation Phase	Survey vessels leave survey area and transit to port or next destination

The proposed 3D seismic survey and operational areas are 6 474 km^2 and 9 797 km^2 in extent, respectively (see Figure 6-1), mostly over Block 2912 (78% scheduled), and it is anticipated that the duration of survey acquisition will be in the order of 100 days, excluding any survey-related downtime, operating 24 hours/day and 7 days/week. This EIA will consider the implications of surveying for a period of up to four months (i.e. 120 days) to take account of any downtime. TEPNA proposes to commence with the 3D seismic survey in 2021 / 2022 Austral Summer, subject to obtaining an ECC.

The data collected during the seismic acquisition campaign will be analysed by the Contractor and by TEPNA and the results will be available approximately six to nine months after the seismic acquisition campaign.

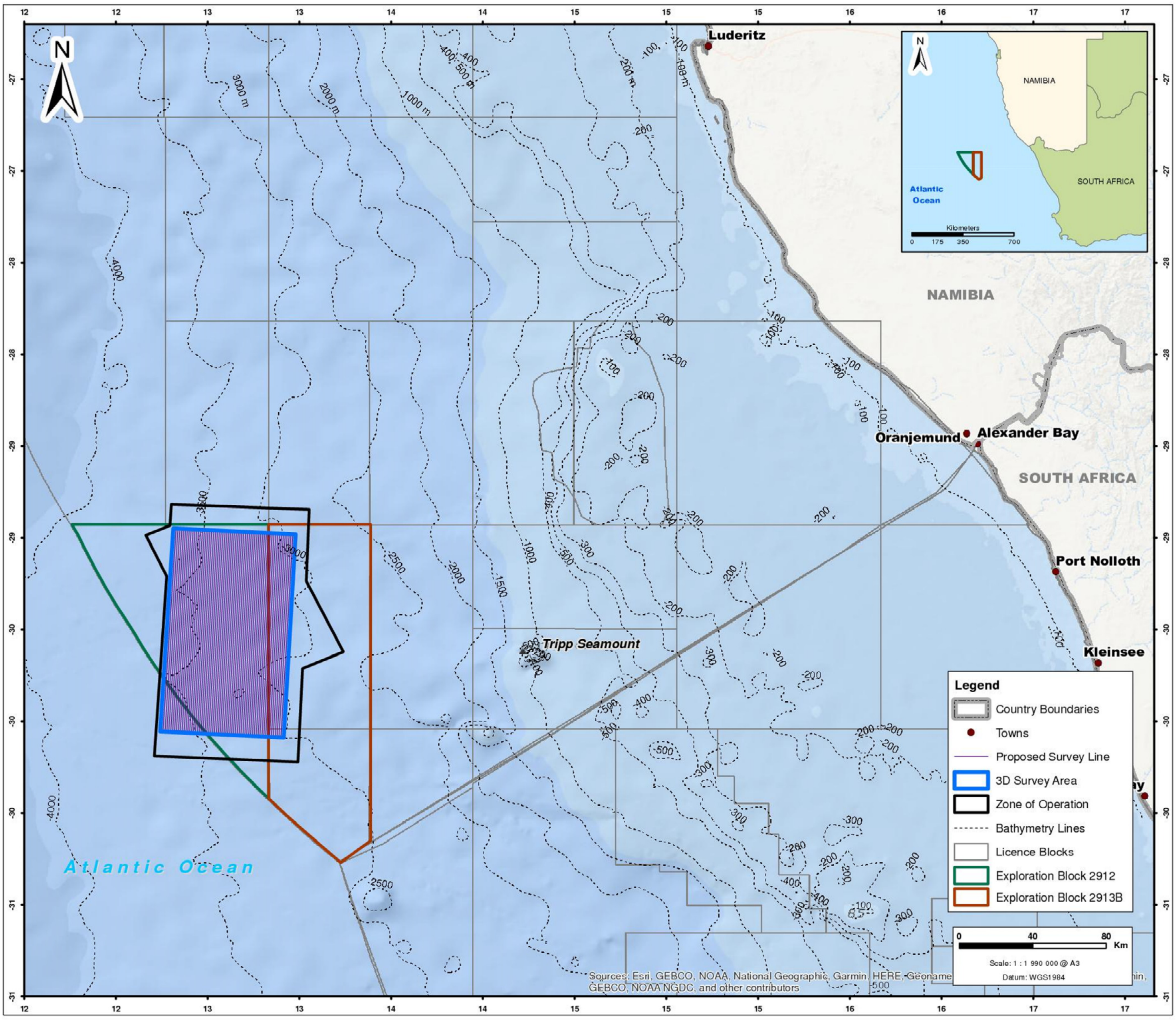


FIGURE 6-1: LOCATION OF LICENCE BLOCKS AND PRPOSED 3D ACQUISITION AREA

6.4 SEISMIC SURVEYS

6.4.1 Principles

Marine seismic acquisition is a geophysical technique using acoustic energy and seismology to map the geological structures beneath the seafloor. This technique makes it possible to identify possible structures in the underground rocks, favourable to the possible discovery of hydrocarbons. The key principles of a seismic survey are showing in Figure 6-2.

During seismic surveys, high-level, low frequency sounds are directed towards the seabed from near-surface sound sources (see Section 6.4.3) towed by a seismic vessel. The acoustic signal, emitted by releasing high-pressure air into the water column penetrates the seabed, is then reflected based to the characteristics of the rock formations encountered. The reflected signals are recorded by multiple receivers (or hydrophones) towed in a single or multiple streamer configuration (see Section 6.4.4). Analyses of the returned signals allow for interpretation of subsea geological formations.

Seismic surveys are usually conducted using a purpose-built seismic vessel. The seismic vessel travels along specific pre-plotted survey lines covering a prescribed grid within the survey area that have been carefully chosen to cross any known or suspected geological structure with a potential for hydrocarbons. During surveying, the seismic vessel would travel on specific line headings at a speed of between four and five knots (i.e. 2 to 3 metres per second). With equipment deployed the vessel would have limited manoeuvrability (see Section 6.5.1.1).

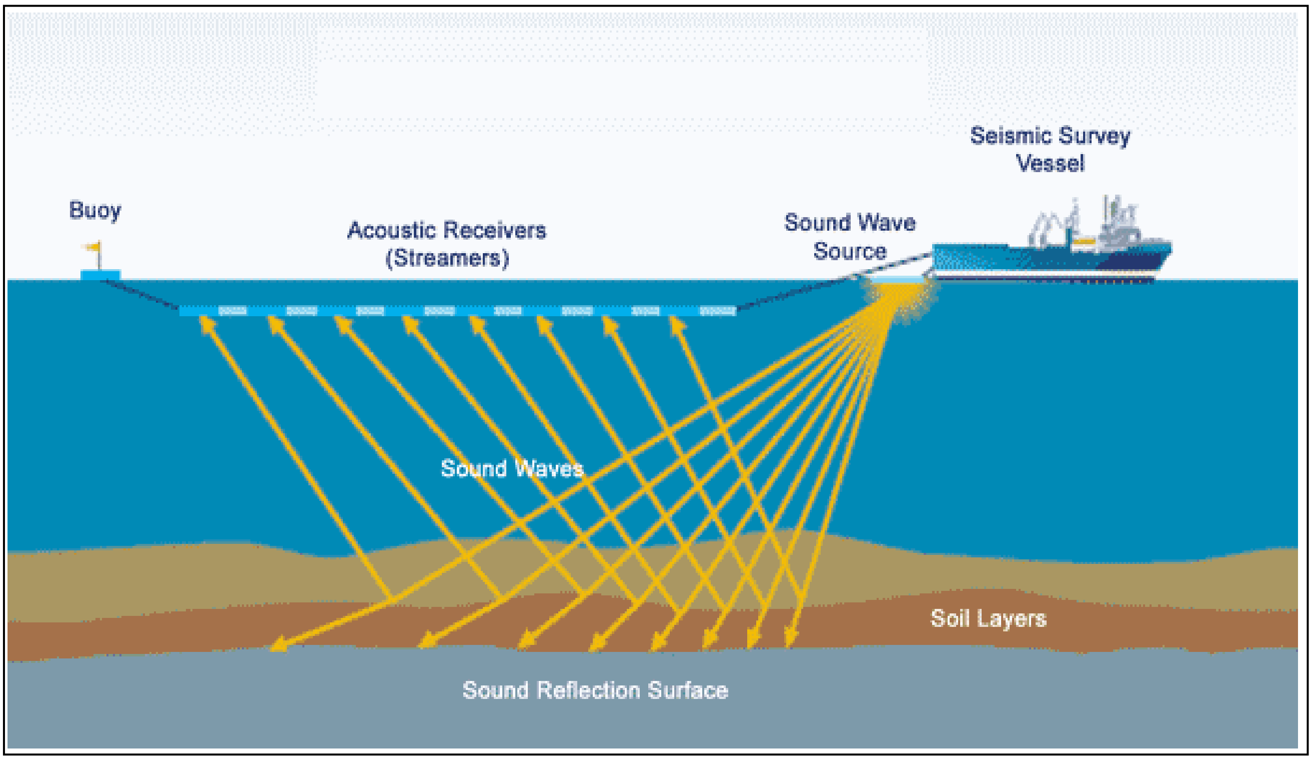


FIGURE 6-2: PRINCIPLES OF OFFSHORE SEISMIC ACQUISITION SURVEYS
Source: https://www.tes.com/

6.4.2 Difference between 2D and 3D seismic acquisition

A seismic data acquisition campaign can be carried out in two or three dimensions (2D or 3D) - depending on the precision of the study sought.

- 2D seismic surveys are typically acquired to obtain regional data over a wider area from widely spaced survey grids (tens of kilometres). A 2D seismic survey would typically involve a single source (airgun array) and a single hydrophone streamer towed by the survey vessel. The data acquired is used to produce a 2D vertical image of the seabed just below the hydrophone streamer (see Figure 6-3a) and obtain a preliminary mapping of the geological structures.
- 3D seismic surveys are typically acquired to confirm structures identified from 2D data and get more details on potential faults, distribution of sand bodies, to estimate oil and gas volumes in place and to define the location of potential future drilling. The 3D seismic acquisition technique requires at least two seismic sources (airgun arrays) and several hydrophone streamers, placed in parallel and separated from each other by several tens of meters. 3D seismic acquisition aims to provide a three-dimensional image of the geology below the seabed (see Figure 6-3b).

For this project, TEPNA is proposing to undertake a 3D seismic survey.

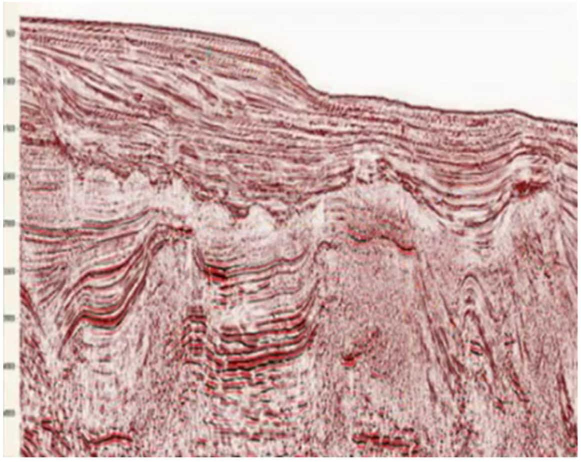
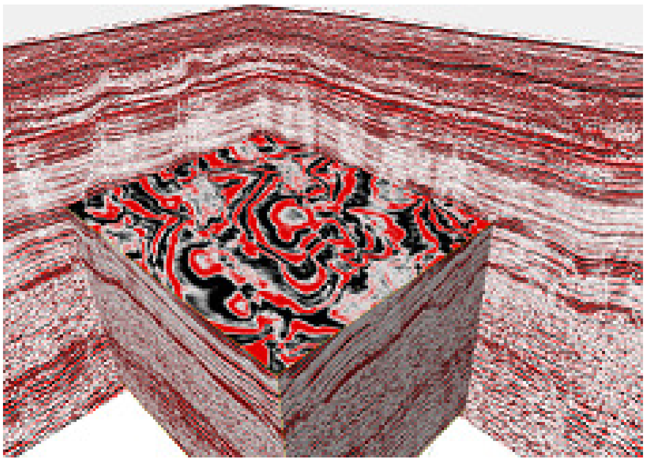
(a)  (b) 

FIGURE 6-3: EXAMPLES OF (A) 2D IMAGE AND (B) 3D IMAGE

Source: TEPNA

6.4.3 Sound Source and Sound Pressure Emission Levels

Airguns are the most common sound source used in modern seismic surveys (see Figure 6-4). The airgun is an underwater pneumatic device from which high-pressure air is released suddenly into the surrounding water. Airguns are normally used in arrays, usually consisting of between 18 and 48 airguns arranged in a rectangular configuration parallel to the sea surface, which enables the added energy of the individual elements to be directed primarily downward (Gisiner, 2016).

The sound produced by a compressed air source is a function of the volume, size and shape of the ports by which the air escapes and the air pressure. An air pressure of 2 000 psi (13 789.5 kPa) is most commonly used, but can range from 1 500 to 3 000 psi (Gisiner, 2016). 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 primary output of an airgun source typically has most of the energy in the frequency bandwidth between 4 and 200 Hz, which is the frequency bandwidth of most interest in seismic surveying (OGP, 2011). The output characteristics of typical seismic source arrays are commonly presented in terms of a “nominal” peak source level or sound pressure level (SPL) in dB re 1 µPa @ 1 m (OGP, 2011). It is, however, important to note that the “nominal” source level will represents the so-called ‘back calculated’. Actual measurable levels around the array are typically 10-20 dB sound pressure level (SPL), which is the pressure level that would be achieved if all the elements in the source were concentrated into a single point (i.e. point source equivalent dimension) (Caldwell and Dragoset, 2000). For example, a nominal source level of 260 dB peak SPL re 1 µPa @ 1 m would produce measurable received sound levels between 225 and 243 dB (see Figure 6-5) (Gisiner, 2016).

One of the required characteristics of a seismic shot is that it is of short duration (the main pulse is usually between 5 and 30 milliseconds in duration). The main pulse is followed by a negative pressure reflection from the sea surface of several lower magnitude bubble pulses (see Figure 6-6). An important reason for using different size seismic sources in an array is the cancellation of sound from oscillating bubbles after the initial formation. Any sound after the initial pulse clutters the return signal. Thus, by using multiple sources of different volumes, the bubbles oscillate at different rates, interfere with each other, and produce a “cleaner” pulse, as seen in the white composite waveform in Figure 6-6.

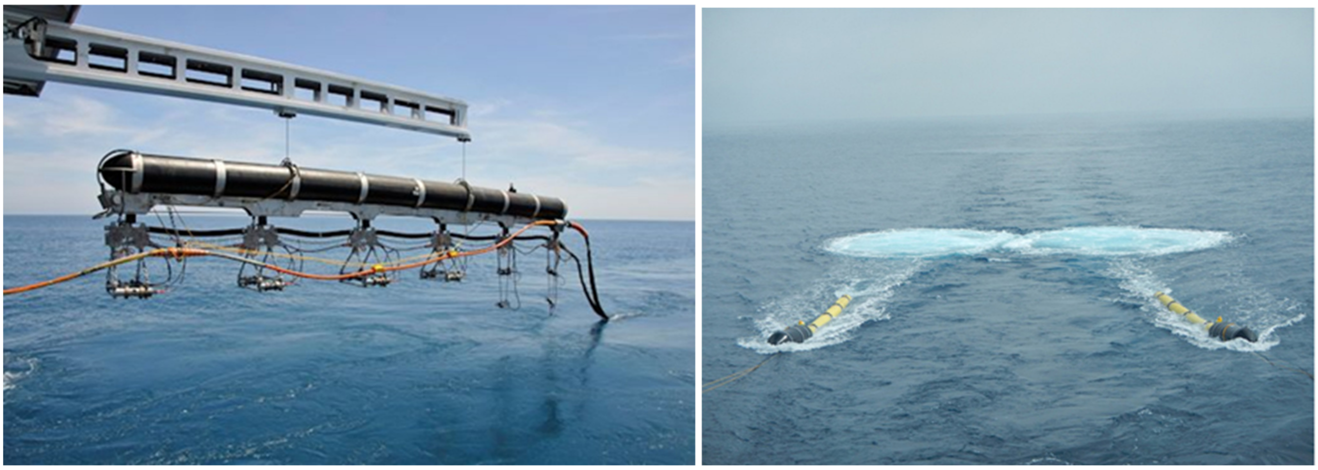


FIGURE 6-4: EXAMPLE OF A SEISMIC SOURCE (AIRGUN ARRAY)

Source: TEPNA

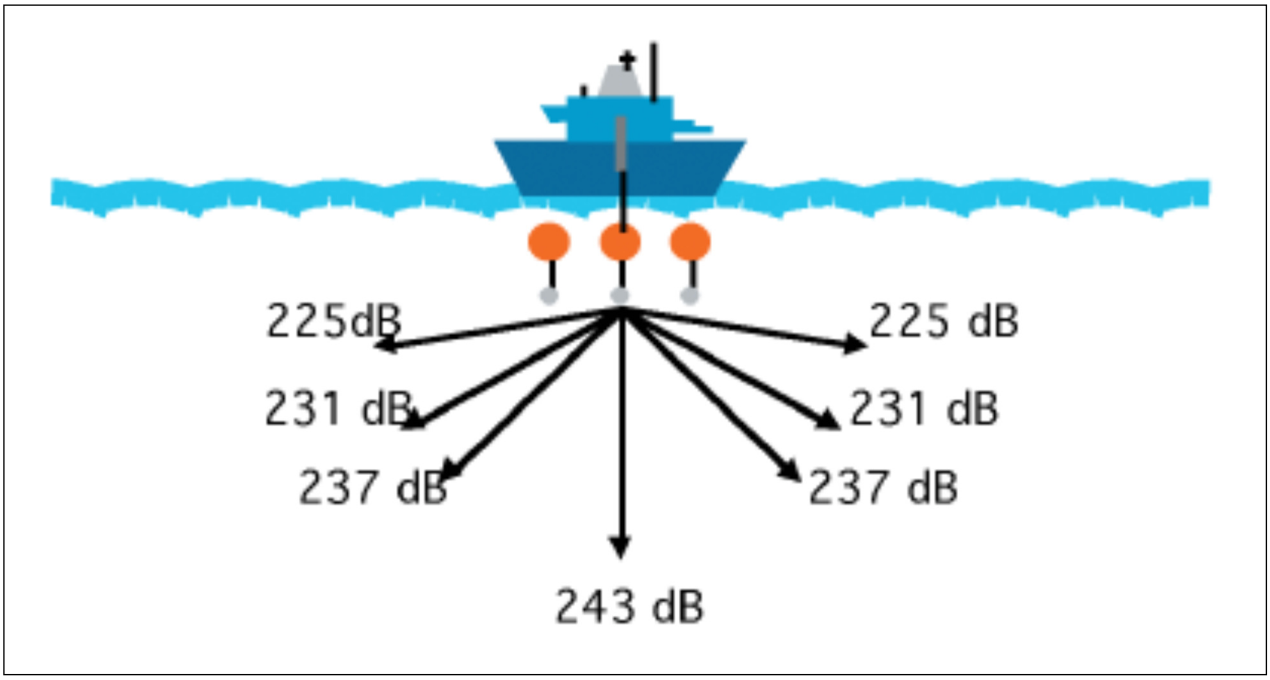


FIGURE 6-5: PATTERN OF MEASURABLE RECEIVED SOUND LEVELS AROUND A SCHEMATIC REPRESENTATION OF AN ARRA, ASSUMING A NOMINAL POINT SOURCE LEVEL OF 260 DB PEAK SOUND PRESSURE LEVEL (SPL_{peak}) re 1 µPa

Source: Caldwell and Dragoset, 2000 in Gisiner, 2016

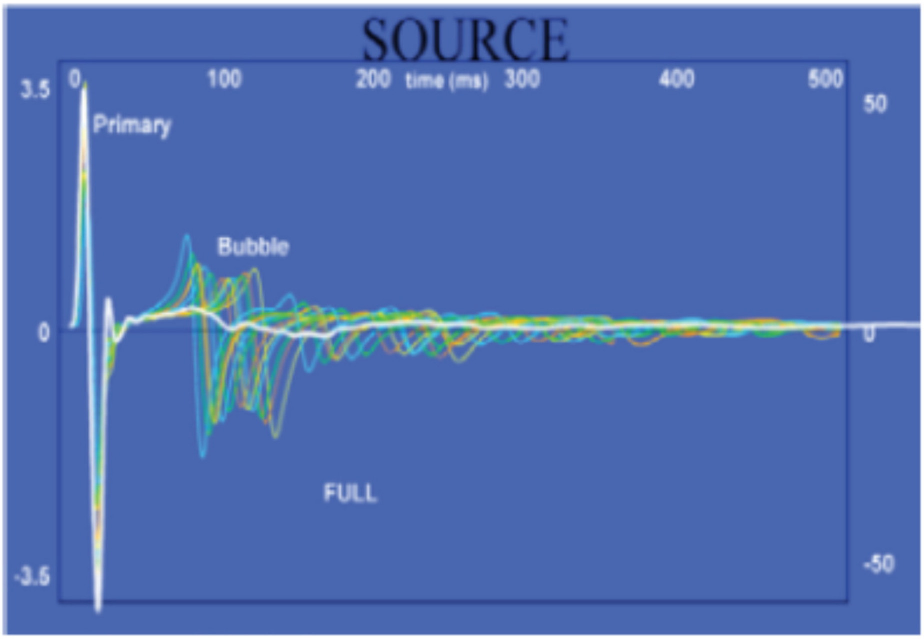


FIGURE 6-6: A TYPICAL PRESSURE SIGNATURE PRODUCED ON FIRING OF AN AIRGUN
Source: Gisiner, 2016

6.4.4 Recording Equipment and Tail Buoy

Signals reflected from geological discontinuities below the seafloor are recorded by hydrophones mounted inside streamer cables (see Figure 6-7), which can be up to 12 000 m long. Hydrophones are typically made from piezoelectric material encased in a rubber plastic hose. This hose containing the hydrophones is called a streamer. The reflected acoustic signals are recorded and transmitted to the seismic vessel for electronic processing. Analyses of the returned signals allow for interpretation of subsea geological formations. As noted earlier, the number of streamers depends on the type of seismic survey; typically one for a 2D survey and up to 16 streamers for a 3D survey.

The streamer(s)s are towed at a depth of between 6 m and 30 m and are not visible, except for the tail-buoy at the far end of the cable (see Figure 6-8).

FIGURE 6-7: EXAMPLE OF A HYDROPHONE STREAMER
Source: (1) TEPNA and (2) https://commons.wikimedia.org/

FIGURE 6-8: EXAMPLE OF A TAIL BUOY
Source: https://www.shutterstock.com/

6.4.5 Technical Characteristics of the Seismic Acquisition

The main technical characteristics of the proposed seismic survey are summarised in Table 6-5 below.

TABLE 6-5: CHARACTERISTICS OF SEISMIC ACQUISITION OPERATIONS (INDICATIVE)

Airgun	
Type of Energy Source	Pressurized air
No. of airgun arrays	2 to 3
No. of active airguns	Approximately 36 per array (note: only one active array for each shot point)
Spacings between airgun arrays	50 m to 60m
Towing depth of the airgun	Approximately 8 m
Source volume	Max 4 000 cubic inches each
Operational pressure	2 000 psi
Shot interval	18.75 m interval between consecutive shot-points
Hydrophone Streamer	
Types of streamer	Solid - Polymer or gel
Number of streamers	10 to 14
Length of streamers	8 600 to 8800 m including 250 m source layback
Spacings between streamers	100 m to 180 m
Max spread	1 100 m to 1 620 m
Depth of streamers	8 to 25 m

6.5 MAIN PROJECT COMPONENTS FOR SEISMIC SURVEYING

This section describes the main project components, these include the following:

- Seismic survey vessels;
- Support and escort vessels;
- Possible helicopter support; and
- Onshore logistics base.

6.5.1 Seismic Survey Vessel

TEPNA has not yet identified a contractor to undertake the proposed seismic survey; thus, this section only presents generic specifications of the survey vessel.

In all cases, there will be a single survey vessel equipped with seismic sources and streamers. Depending on the selected contractor, the generic specifications may vary slightly, but will be of the same order of magnitude as the *Polar Empress* (see Figure 6-9). Refer to Table 6-6 for generic specifications of a seismic survey vessel.

During the acquisition operations, the survey vessel will get supplies at sea. Its ability to manoeuvre is greatly limited by the length of the streamers deployed in the water, which must remain in place parallel to each other.

FIGURE 6-9: POLAR EMPRESS

Source: https://www.gcrieber-shipping.com/fleet/marine-seismic/polar-empress/

TABLE 6-6: GENERIC SPECIFICATIONS OF A SEISMIC VESSEL

Length	**Polar Empress specifications**	112.6 m
Width		25.8 m
Gross tonnage		10 138 Tons
Deadweight		2 700 Tons
Capacity (accommodation)		70 people / cabins
Fuel capacity		3 200 m^3
Cruising speed		18 knots
Acquisition speed		4.3 knots
Average fuel consumption		55 m^3/day + 10 m^3/day
Combustible to be used – Sulphur %		Heavy Fuel Oil (HFO) + Marine Gasoil (MGO)
Sewage treatment onboard (yes/no)		Yes
Incinerator onboard (yes/no)		Yes

6.5.1.1 Survey Vessel Exclusion Zone

The acquisition of high-quality seismic data requires that the position of the survey vessel and the array be accurately known. Seismic surveys consequently require accurate navigation of the sound source over pre-determined survey transects. This, and the fact that the array and the hydrophone streamer need to be towed in a set configuration behind the survey vessel, means that the survey operation has little manoeuvrability while operating.

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part B, Section II, Rule 18), a seismic survey that is engaged in surveying is defined as a "*vessel restricted in its ability to manoeuvre*", which requires that power-driven and sailing vessels give way to a vessel restricted in her ability to manoeuvre. Vessels engaged in fishing are required to, so far as possible, keep out of the way of the seismic operation.

Furthermore, in terms of the Petroleum (Exploration and Production) Act, 1991 (No. 2 of 1991), a seismic vessel is considered an "*offshore installation*" and as such it (including the seismic array) is protected by a 500 m exclusion zone. Unauthorised vessels may not enter the exclusion zone. The temporary 500 m exclusion zone around the survey vessel will always be enforced during operation. The exclusion zone will be described in a Notice to Mariners as a navigational warning.

In addition to a statutory 500 m exclusion zone, a seismic contractor will typically request a safe operational limit (that is greater than the 500 m exclusion zone) that it would like other vessels to stay beyond. Typical safe operational limits for 3D surveys are illustrated in Figure 6-10.

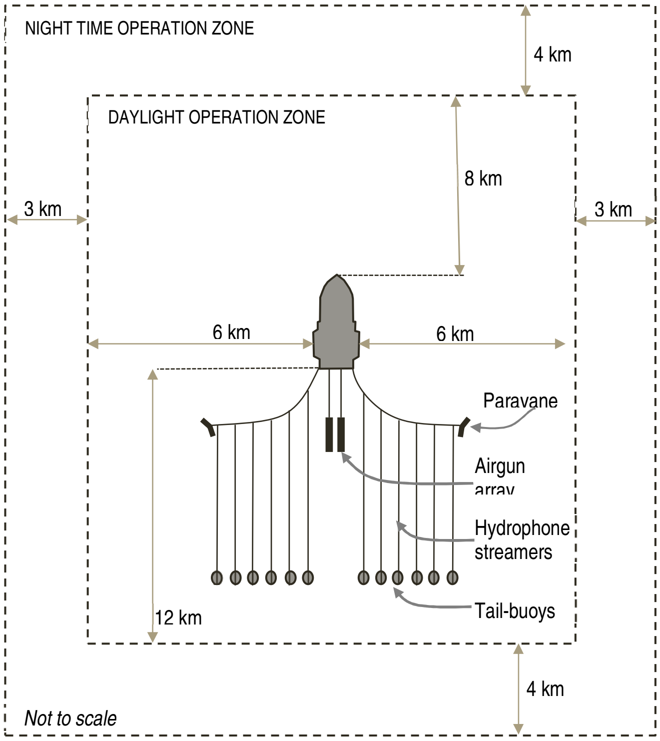


FIGURE 6-10: TYPICAL CONFIGURATION AND SAFE OPERATIONAL LIMITS FOR 3D SEISMIC SURVEY OPERATIONS

Source: SLR

6.5.2 Support and Escort Vessels

Two additional vessels will be commissioned for the survey; one support vessel and one escort vessel (or "chase boat”). The support vessel will be required to perform logistics support (including crew changes, supply of equipment, fuel, food and water) to the survey vessel.

The escort vessel will be equipped with appropriate radar and communications to patrol the area during the seismic survey to ensure that other vessels adhere to the safe operational limits. This vessel would assist in alerting other vessels (e.g. fishing, transport, etc.) about the survey and the lack of manoeuvrability of the survey vessel. At a minimum, one Fisheries Liaison Officer (FLO) person speaking English and Afrikaans will be on board each escort vessel to facilitate communication in the local language with the fishing vessels that are in the area.

6.5.3 Helicopter

Helicopters may also be used to transfer personnel to and from the survey vessel and Lüderitz or a suitable location nearby.

6.5.4 Staffing and Logistics

The onshore logistics base will be in either the Port of Lüderitz or the Port of Walvis Bay. The preferred alternative is Lüderitz due to proximity to the survey area. The service infrastructure required to provide the necessary onshore support is already in place in Lüderitz and Walvis Bay. Thus, no additional onshore infrastructure should be necessary for this project.

The survey vessel will accommodate up to 60 people working on 12-hour rotations. In addition, the support and escort vessels will include a crew of approximately 6 to 10 people each. Depending on the solutions proposed by the contractors, the teams will rotate either by the support vessel or by helicopter, as presented above.

The support vessel will call into port every 22 to 45 days during the survey for supplies (equipment, fuel, food and water) and crew changes. The supply vessels will occupy the quay for about 24 hours per trip, depending on the quantity of material to be loaded / unloaded.

The methods of refuelling will depend on the contractor and the vessels selected. It is, however, anticipated that the survey vessel will be refuelled at sea ('bunkering') by the support vessel, except in the event of extreme weather conditions which would force refuelling at port (mostly likely the Port of Lüderitz).

6.6 EMISSIONS, DISCHARGES AND WASTES

6.6.1 Introduction

This section presents the main sources of emissions to air, discharges to water and waste generated that will result from survey operations (including mobilisation and demobilisation).

All vessels will have equipment, systems and protocols in place for prevention of pollution by oil, sewage and garbage in accordance with Namibian legislation, the MARPOL convention, Total standards, national and international standards, and good international practices. A specific Waste Management Plan (covering all wastes generated offshore and onshore) will be developed in accordance with MARPOL requirements, Namibian legislation and international standards. Waste disposal sites and waste management facilities will be identified, verified and approved prior to commencement of survey operations.

6.6.2 Atmospheric Emissions

The principal sources of emissions to air from the proposed survey will be from vessel engines. The vessels will be supplied with marine gasoil (MGO) or heavy fuel oil (HFO) with less 0.5% sulphur (mass), which will lead to emissions of sulphur oxides (SO_x), nitrogen oxides (NO_x), carbon dioxide (CO_2) and carbon monoxide (CO). These emissions are released during the normal operation of any marine vessel and have the potential to result in a short-term localised increase in pollutant concentrations. They also contribute to regional and global atmospheric pollution.

The fuel consumption by the survey vessel is estimated at 61.1 Tons/day, that of the support vessel at 9.4 Tons/day and that of the escort vessels at 2.8 Tons / day. Fuel consumption estimates are presented in the Table 6-7 and the estimate of total air emissions is presented in Table 6-8. The emissions were estimated based on the emission factors of the methodology proposed by the International Association of Gas and Oil Producers (E&P Forum / UNEP, 1994).

Incineration of certain wastes onboard and compressors associated with energy sources will also produce limited occasional emissions. As with any combustion engine powered by fossil fuels, very limited emissions of unburned hydrocarbons, volatile organic compounds and particles are also likely to be generated by the propulsion system of the vessels.

TABLE 6-7: ESTIMATED FUEL CONSUMPTION

Source	Value	Units	No. units	Consumption of marine fuel (Tons)	Kerosene consumption (Tons)
Seismic	61.1*	Tons / day	120 day	7 332	-
Escort 1	2.8*	Tons / day	120 day	336	-
Support	9.4*	Tons / day	120 day	1 128	-
Helicopter (possible)	0.5	Tons / hr	16 journeys (3.5 hrs each)**		28
Total				**8 796**	**28**

* Values provided by TEPNA, which are based on previously survey campaigns.

** Assumptions: One journey per week over the 120-day (16 weeks) campaign. Distance to centre of survey area is approximately 400 km (i.e. 800 km return). Travel speed (250km/hr). Warm-up times 2x10 minutes. Consumption 0.5 tons / hr is based on the Super Puma characteristics (https://www.swisshelicopter.ch/fr/a-propos-de-nous/flotte/super-puma-as-332-c1).

TABLE 6-8: ESTIMATED TOTAL ATMOSPHERIC EMISSIONS

Gas	Emission factor (marine fuel) t/t	Emission factor (kerosene) t/t	Emitted GHG (marine fuel) Tons	Emitted GHG (kerosene) Tons	Emitted GHG- total - Tons
CO_2	3.2	3.2	28 147.2	89.6	28 236.8
CO	0.008	0.0052	70.4	0.1	70.5
NO_x	0.059	0.0125	519.0	0.4	519.4
N_2O	0.00022	0.00022	1.9	0.0	1.9
SO_x	0.008	0.008	70.4	0.2	70.6
CH_4	0.00027	0.000087	2.4	0.0	2.4
VOC	0.0024	0.0008	21.1	0.0	21.1
Greenhouse gas (GHG) expressed as $CO_{2\ equivalent}$ (either sum of CO_2 + 265 N_2O + 28 CH_4)					**28 807.5**

* Greenhouse gas direct expressed in $CO_{2\ equivalent}$ - Values retained for the Global Warming Potential from IPCC, 2014, Fifth Assessment Report.

6.6.3 Liquid Discharges

The following main effluents will be discharged into the marine environment:

- Treated grey water[1)];
- Treated sewage (black water);
- Treated bilge water[2)] used to clean engine rooms and other potentially polluted sources; and
- Engine cooling water.

[1] Grey water: water from the kitchen, washing and laundry activities and non-oily water used for cleaning.

[2] Bilge water: water collected in the lower sections of the vessel. One of the main contributors to bilge water is the cleaning of the engine rooms of the vessel. These waters can, therefore, be contaminated by hydrocarbons and other substances, some of which are likely to be toxic if discharged directly into the marine environment.

The survey vessel and support vessels will be equipped with a water treatment system. Different types of effluents will be treated according to the following prescriptions:

- The disposal into the sea of food waste is permitted, in terms of MARPOL Annex V, when it has been comminuted or ground to particle sizes smaller than 25 mm and the vessel is *en route* and located more than 3 nautical miles (approximately 5.5 km) from land. Disposal overboard without macerating can occur greater than 12 nautical miles (approximately 22 km) from the coast when the vessel is sailing. The volumes of sewage wastes released from the seismic and support vessels would be small and comparable to volumes produced by vessels of similar crew compliment (up to 80 people in total on all three vessels). Sewage would not be discharged instantaneously but at a moderate rate when the vessel is *en route* and travelling at no less than 4 knots.
- Bilge water will be treated by a hydrocarbon separator certified in accordance with MARPOL. In accordance with MARPOL Annex I, bilge water will be retained on board until it can be discharged to an approved reception facility, unless it is treated by an approved oily water separator to <15 ppm oil content and monitored before discharge. The residue from the onboard oil/water separator will be treated / disposed of via the vessels' waste incinerator (depending on specifications) or onshore at an approved hazardous landfill site.
- Grey water and sewage will be discharged intermittently throughout the survey and will vary according to the number of persons on board. All sewage discharges will be in compliance with MARPOL Annex IV.
    - a biological oxygen demand (BOD) of <25 mg l^{-1} (if the treatment plant was installed after 1/1/2010) or <50 mg l^{-1} (if installed before this date);
    - minimal residual chlorine concentration of 0.5 mg/l; and
    - no visible floating solids or oil and grease.
- Deck drainage consists of liquid waste resulting from rainfall, deck and equipment washing (using water and an approved detergent). Deck drainage will be variable depending on the vessel characteristics, deck activities and rainfall amounts. In areas where oil contamination of rainwater is more likely, drainage is routed to an oil/water separator for treatment before discharge in accordance with MARPOL Annex I (i.e. 15 ppm oil and grease maximum). There will be no discharge of free oil that could cause either a film, sheen or discolouration of the surface water or a sludge or emulsion to be deposited below the water's surface. Only non-oily water (i.e. <15 ppm oil and grease, maximum instantaneous oil discharge monitor reading) will be discharged overboard. If separation facilities are not available (due to overload or maintenance) the drainage water will be retained on board until it can be discharged to an approved reception facility. The oily residue from the onboard oil/water separator will be treated / disposed of via the vessel's waste incinerator (depending on specifications) or onshore at an approved hazardous landfill site.
- The cooling water and surplus freshwater are likely to contain a residual concentration of chlorine (generally less than 0.5 mg/l for freshwater supply systems).

The treated sanitary effluents discharged into the sea are estimated at around 16 000 litres per day for the duration of the seismic study based on 200 litres per 80 persons.

6.6.4 Solid Waste

Several other types of wastes generated during the survey will not be discharged at sea, but – depending the incinerator specification - can be incinerated (e.g. paper waste, food waste, wood, oily residues and plastics) or transported to shore for ultimate disposal (e.g. glass, metal and ash from incinerators). All onboard waste will be segregated, duly identified and transported to shore for disposal at a licenced waste management facility approved by TEPNA. The disposal of all waste onshore will be fully traceable.

General waste landfill sites are located at Walvis Bay, Swakopmund and Lüderitz; the closest of which to the licence area is Lüderitz. The landfill site at Walvis Bay is also designated to accept hazardous waste; whilst the Lüderitz site is not. TEPNA will, however, evaluate the suitability of this site prior to the start of operation and will decide on the best waste facilities to be used according with international best practices and Namibian legislation. The services of a waste contractor will be used to collect and transport all operation al waste for disposal or recycling.

A summary of the typical wastes expected to be generated and their management options are detailed in Table 6-9. It is estimated that approximately 14 m^3 of solid waste per month will be generated during the seismic survey. For a program lasting almost four months, this implies a total volume of waste of the order of 56 m^3.

TABLE 6-9: SUMMARY OF POTENTIAL SOLID WASTE STREAMS

Waste stream	Main sources	Main possible constituents	Comment
Garbage	Various	Packaging materials, paper, cans, etc.	The vessel will be equipped with an incinerator. The metals will be stored on the vessel, all other fuels will be incinerated (depending on incinerator specifications). Some waste will be transported ashore (including metallic waste, and other waste such as glass and incinerator ash).
Medical waste	Dressings, clinical and cleaning materials	Pathogenic organisms, plastic, glass, drugs, needles	A syringe box will be made available onboard to collect medical equipment which will be disposed of by incineration (depending on incinerator specifications) or at an approved facility ashore.
Potentially hazardous waste	Batteries, paint cans, lubricating oils, etc.	Hydrocarbons, metals, acids, etc.	Transferred to land for disposal by an approved facility. There will be no discharge of hazardous waste at sea.

6.6.5 Noise Emissions

The key sources generating underwater noise are vessel propellers, with a contribution from the hull (e.g. noise originating from within the hull and on-deck machinery), and from airgun operations (see Section 6.4.5). Helicopters will also form a source of noise, which can affect marine fauna both in terms of underwater noise beneath the helicopter and airborne noise.

The extent of project-related noise above the background noise level may vary considerably depending on the specific vessels used, the number of supply vessels operating and the airgun array. It will also depend on the variation in the background noise level with weather and with the proximity of other vessel traffic (not associated with the project). A "*Noise Assessment*" will be undertaken during the next phase of the EIA, which will *inter alia* determine the noise transmission loss with distance from the survey area and relative zones of impact.

6.6.6 Light Emissions

Operational lighting will be required on the survey vessels for safe operations and navigation purposes during the hours of darkness. Where feasible, operational lights will be shielded in such a way as to minimise their spill out to sea.

6.7 SUMMARY OF PROJECT ALTERNATIVES

Table 6-10 describes the project alternatives considered by TEPNA in the development of the proposed seismic survey programme.

TABLE 6-10: SUMMARY OF THE PROJECT ALTERNATIVES

No.	Alternatives	Description
1. Site / location alternatives		
1.1	Survey area	Since TEPNA is the holder and operator of an Exploration Licence for Blocks 2912 and 2913B, seismic surveying area will be limited to these licence blocks, except for a small area in international waters south-west of Block 2912. The proposed survey area is targeting various prospects identified based on previous exploration activities (see 2.1 below). Although a survey area has been identified, it is indicative. Thus, this EIA has taken the fact that the final survey layout may change slightly into consideration.
2. Activity alternatives		
2.1	Exploration alternatives	Previous exploration activities undertaken in Blocks 2912 and 2913B included a 2D seismic survey. This survey was undertaken by TGS (previously Spectrum) over the area (mainly Block 2912) in 2019. This data (1 097 km) was purchased and analysed by TEPNA. Based on the analysis of this data, TEPNA is currently planning to drill an exploration well tentatively in Q3 2021. The ECC for well drilling was issued in 2019. The proposed 3D seismic acquisition is an essential step in the overall exploration programme to collect additional geological data necessary for the exploration of these licence blocks. This EIA only assesses the potential impacts related to the proposed 3D seismic survey.
3. Design alternatives		
3.1	Scheduling	Although TEPNA propose to commence with surveying in 2021 / 2022 Austral Summer, this EIA considers the implications of surveying at any time during the year. If the survey extends into the key cetacean breeding and migration period from the beginning of June to the end of November encounters with humpback whales to and from breeding grounds in equatorial West Africa are highly likely, which could result in a more significant impact.
3.2	Survey duration	The duration of the survey will be reduced as far as possible in order to maximise data collection and minimise time spent in the survey area. This will reduce survey costs, as well as potential impacts (specifically the noise impact - the longer the length of the survey, the longer the duration of noise transmission into the marine environment). Conservatively, it is anticipated that the duration of survey acquisition will be in the order of 90 to 100 days, excluding any survey-related downtime, operating 24 hours/day and 7 days/week. This EIA considers the implications of surveying for a period of up to four months (i.e. 120 days) to take account of any downtime.

No.	Alternatives	Description
3.3	Onshore logistics base	An onshore logistics base would be located in either the Port of Lüderitz or the Port of Walvis Bay (refer to Section 6.5.4). The location of the onshore logistics base would ultimately be based on discussions with Namport and if there is sufficient berthing space to accommodate the support vessel. This EIA assesses the potential impacts related to a logistics base located in either Port of Lüderitz or the Port of Walvis Bay. The Port of Lüderitz and the Port of Walvis Bay are located approximately 400 km and 750 km from the centre of the survey area, respectively. Although the costs associated with travelling a further distance to Walvis Bay could be more significant, the impacts are considered to be similar.
3.4	Support and chase vessels	The number of support or escort vessels may differ from survey to survey depending on the type and location of survey and anticipated activity of other vessels in the area. The number of vessels will ultimately have an impact on the project costs, as well as potentially resulting in more significant impacts on the marine environment (e.g. discharges to sea, noise, etc.). For the proposed project, TEPNA conservatively anticipate that two additional vessels will be commissioned for the survey (one support vessel and one escort vessel - see Section 6.5.2). This EIA assesses the potential impacts related to the survey vessel and two additional vessels (i.e. three in total) operating in the survey area and to / from port.
4. Technology / process alternatives		
4.1	Sound source	Airguns are the most common sound source used in modern seismic surveys (see Section 6.4.3), due to their reliability and reduced impact on the marine life, compared to other traditional acoustic sources (e.g. explosives). The type and number of sound sources used may affect the source volume, which could result in a more significant impact on marine fauna. For the proposed project, the size and number of sources (two to three sources) were chosen according to the water depth constraints, between 2 600 m to 3 800 m. The EIA assesses the potential impacts associated with indicative specifications presented in Table 6-5.
4.2	Source volume	The volume of an energy source determines how deep the acoustic signal produced can penetrate geological formations under the ocean floor, as well as the sound level produced, and the quality of the data collected. As the volume of the source increases, the acoustic signal produced is greater and can travel a greater distance within the geological formations and the data thus obtained are of better quality. The total volume of energy sources to be used has been selected to ensure good data quality, while minimizing its potential impact on the environment. The use of three energy sources of average power instead of a single more powerful energy source will make it possible to shoot less powerful and will potentially have less impact on marine fauna. The EIA assesses the potential impacts associated with indicative specifications presented in Table 6-5.
4.3	Hydrophones	Data from seismic acquisition campaigns can be recorded in two different ways: by towed streamers or by means of sensor nodes or cables laid on the bottom. The sensors placed on the ocean floor (Ocean Bottom Sensors, OBS) are receivers equipped with hydrophones (6) and geophones (7) placed on the bottom to detect the waves reflected from the sound source. The nodes / cables must be laid, raised and repositioned several times during the study to cover each section of the survey grid. This repositioning process takes time and increases the duration and cost of the study. Studies using OBS are primarily used for oil and gas exploration in small areas and moderately deep water, although ocean floor nodes are known to have been used to depths of the order of 2 000 m.

No.	Alternatives	Description
		Considering the water depths of Block 2912 and 2913B, the only possible technique involves the use of streamers. This EIA thus assesses the potential impacts related to streamers only (see in Table 6-5).
5. No-Go alternative		
5.1	No-go	The No-Go alternative represents the option not to proceed with the proposed 3D seismic survey, which leaves the project areas of influence (i.e. offshore licence blocks, Lüderitz and Walvis Bay) in their current state except for variation by natural causes and other human activities, as well as that caused by the planned exploration well drilling (for which and ECC has been issued). It thus represents the current status quo and the baseline against which all potential project-related impacts are assessed. If the proposed project is not carried out, TEPNA will have to reconsider its strategy for the development of offshore oil and gas reserves in Licence Blocks 2912 and 2913B, which could lead to plans being abandoned exploration and future development. Without the data obtained by 3D seismic acquisition, the exploration phase and then the development phase cannot be envisaged. This EIA assesses the no-go alternative (see Section 8.7).