6 PROJECT DESCRIPTION

This chapter provides general information on the proposed project, the general location of the speculative seismic survey, and a description of typical seismic surveys.

6.1 GENERAL INFORMATION

6.1.1 Reconnaissance Permit Application

Spectrum as the applicant for the Reconnaissance Permit will also be the operator for the proposed project.

Address: Spectrum Geo Limited
Dukes Court, Duke Street
Woking, Surrey, GU21 5BH
Project Manager: Jevon Hilder

6.1.2 Existing Permit and Right Holders

The proposed Reconnaissance Permit area includes a number of licence blocks off the West Coast of South Africa (see Figure 6-1). Licence block rights/permit holders within the proposed Reconnaissance Permit area are listed in Table 6-1.

Spectrum is required to obtain written consent from the existing exploration right and technical cooperation permit holders within the proposed Reconnaissance Permit area in order to apply for this permit and acquire seismic data across their licence areas. Spectrum is currently in the process of acquiring these consents which will be submitted directly to PASA.

6.1.3 Details of Reconnaissance Area and Survey Extent

The Reconnaissance Permit area is approximately 340 000 km^2 in extent. The western extent of the permit area would be located along the EEZ, more than 480 km offshore. The distance from the coast of the eastern extent of the permit area would range between 20 and 55 km offshore (see Figure 6-1). The co-ordinates of the boundary points of the Reconnaissance Permit area are provided in Table 6-2.

The proposed 2D survey area would cover a single target area located roughly between the Namibian border in the north up to a point approximately 80 km southwest of Cape Point (inshore boundary). The co-ordinates of the boundary points of the proposed survey area are provided in Table 6-3 below. The distance between the eastern boundary of the 2D survey area and the coast ranges as follows:

- From the Orange River Mouth to Port Nolloth it would be located between 30 and 40 km offshore;
- From Kleinzee to Hondeklipbaai it would range between 50 and 60 km offshore;
- From Hondeklipbaai to Elands Bay the distance from the coast varies between 135 and 95 km from the coast; and
- From Saldanha Bay to Cape Point the distance from the coast varies between 40 km at Saldanha Bay to 60 km west of Cape Point.

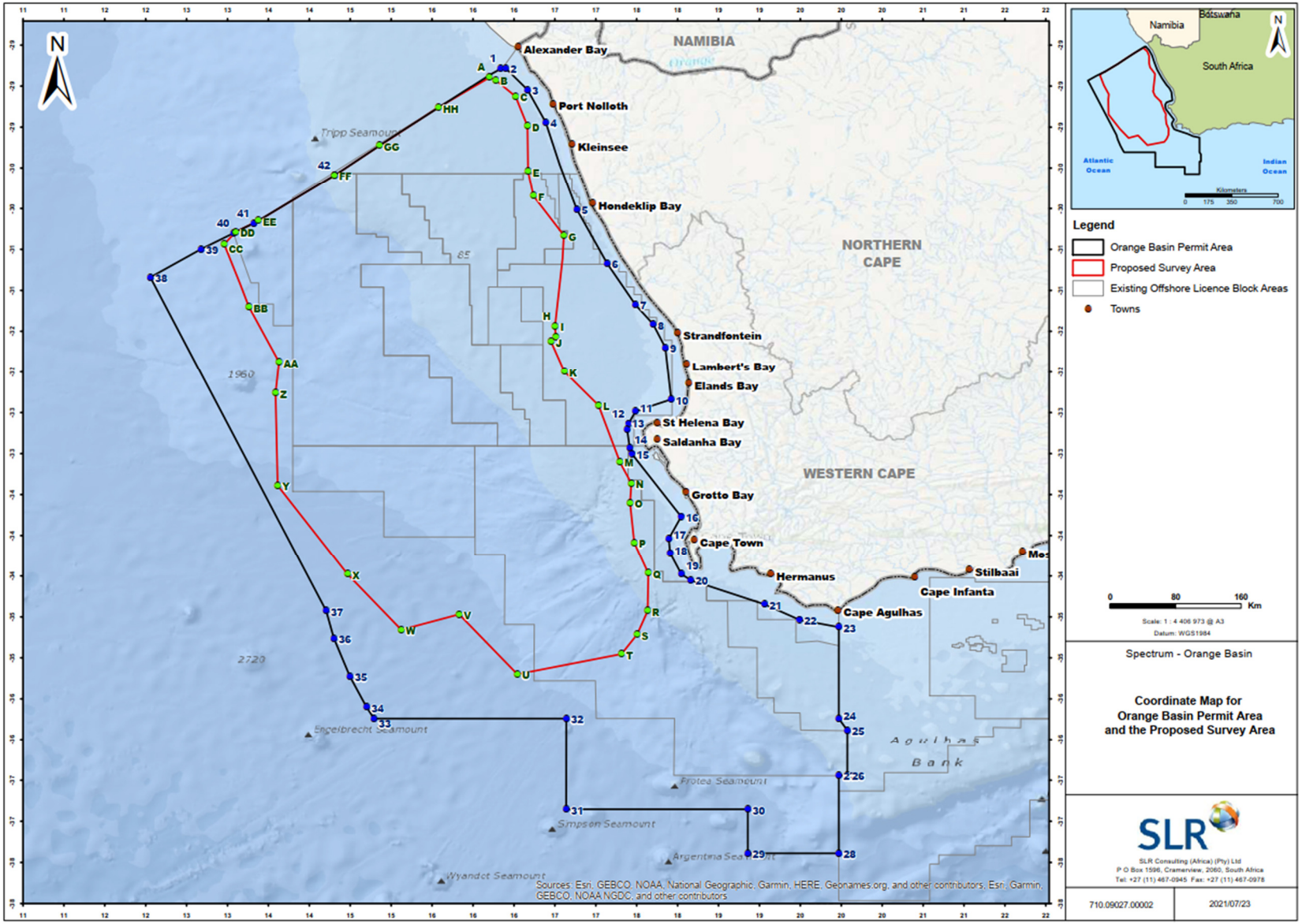

Figure 6-1: Location of the Reconnaissance Permit Application area and proposed 2D survey area in relation to licence blocks

The western extent of the survey area is located between 220 and 440 km from the coast. The total length of the survey would be up to 14 000 km. The proposed survey would follow an evenly spaced survey line grid, with between 13 and 15 lines in a north-south direction and between 26 and 28 lines in an east-west direction. The total proposed 2D survey area, including turning circles, would amount to approximately 193 980 km^2 within the northern portion of the Reconnaissance Permit area. No survey activities are currently proposed between Cape Point and Cape Agulhas.

Actual survey commencement would ultimately depend on a permit award date and the availability of a survey vessel. Should the permit be awarded, it is anticipated that the proposed survey could be undertaken within the 2021/2022 Summer survey window period, commencing in December 2021 at the earliest. The survey is anticipated to take in the order of five months to complete.

A seismic survey would typically include three general project phases, i.e. mobilisation, operation and demobilisation. The anticipated activities related to each of these phases are set out in Table 6-4 below. Details of the 2D seismic survey are provided in Section 6.2.

Table 6-1: List of Right Holders in the Reconnaissance Permit Application area boundary

NO.	RIGHT HOLDER	Block
1.	Kosmos Energy / Shell / OK Energy	Deep Orange Basin – Exploration Right 274ER
2.	PetroSA	Block 2C – Exploration Right 248ER Block 3A/4A – Exploration Right 283ER
3.	Ricocure / Azinam / Africa Oil	Block 3B4/4B – Exploration Right 339ER
4.	Sezigyn	Mid Orange Basin – Exploration Right 340ER
5.	Sunbird / PetroSA	Block 2A – Production Right 003PR
6.	Sungu Sungu	Mid Orange Basin – Exploration Right 228ER
7.	Total Energies / Sezigyn	Deep Orange Basin – Exploration Right 343ER
8.	Total Energies / Impact Africa	Deep Orange Basin – Exploration Right 335ER
9.	Total Energies / Shell / PetroSA	Block 5/6/7 – Exploration Right 224ER
10.	Thombo Petroleum / Main Street / Panoro / Azinam	Block 2B – Exploration Right 105ER
11.	Tosaco Energy	Block 1 – Exploration Right 362ER

Table 6-2: Reconnaissance Permit Application area coordinates

No.	Longitude	Latitude		No.	Longitude	Latitude
1	16°16'41,79"E	28°50'34,081"S		22	19°34'8,65"E	34°55'16,081"S
2	16°20'45,923"E	28°50'34,081"S		23	20°0'16,239"E	34°59'33,063"S
3	16°35'6,812"E	29°4'54,97"S		24	20°0'3,39"E	35°59'56,506"S
4	16°46'40,662"E	29°26'19,879"S		25	20°5'37,467"E	36°8'4,771"S
5	17°7'1,326"E	30°23'56,284"S		26	20°5'37,467"E	36°37'37,945"S
6	17°27'9,14"E	30°59'29,233"S		27	20°0'3,39"E	36°37'37,945"S
7	17°46'12,709"E	31°26'53,917"S		28	19°59'50,541"E	37°28'36,029"S
8	17°57'33,711"E	31°39'19,164"S		29	19°0'5,645"E	37°28'48,878"S
9	18°5'41,976"E	31°54'31,449"S		30	19°0'18,494"E	36°59'41,402"S
10	18°9'20,411"E	32°29'0,153"S		31	17°0'23,004"E	36°59'54,251"S
11	17°45'47,011"E	32°37'21,267"S		32	17°0'23,004"E	36°0'9,355"S
12	17°41'42,878"E	32°45'16,683"S		33	14°53'23,494"E	35°59'56,506"S
13	17°40'25,784"E	32°48'55,118"S		34	14°48'40,814"E	35°52'52,486"S
14	17°42'21,426"E	33°1'46,063"S		35	14°37'45,511"E	35°32'31,822"S
15	17°43'38,52"E	33°5'24,498"S		36	14°26'50,207"E	35°7'28,479"S
16	18°16'37,28"E	33°46'31,523"S		37	14°21'33,263"E	34°48'54,891"S
17	18°7'37,618"E	34°1'30,959"S		38	12°25'37,622"E	31°8'28,895"S
18	18°8'54,713"E	34°11'9,168"S		39	12°59'36,345"E	30°49'55,307"S
19	18°15'58,733"E	34°24'38,661"S		40	13°20'44,121"E	30°39'21,419"S
20	18°22'37,055"E	34°29'8,492"S		41	13°34'9,331"E	30°33'4,512"S
21	19°11'39,496"E	34°44'59,324"S		42	14°27'33,037"E	30°1'5,715"S

Table 6-3: Proposed 2D survey area coordinates

No.	Longitude	Latitude		No.	Longitude	Latitude
A	16°9'46,336"E	28°56'33,856"S		R	17°53'59,56"E	34°49'12,023"S
B	16°13'46,186"E	28°58'33,781"S		S	17°47'8,389"E	35°4'37,158"S
C	16°27'11,395"E	29°9'7,669"S		T	17°36'34,5"E	35°17'28,103"S
D	16°34'53,963"E	29°28'32,653"S		U	16°28'19,924"E	35°30'53,313"S
E	16°35'11,095"E	29°58'31,526"S		V	15°50'4,22"E	34°51'11,948"S
F	16°38'53,812"E	30°14'48,057"S		W	15°11'14,252"E	35°1'11,572"S
G	16°58'53,061"E	30°41'4,212"S		X	14°36'24,133"E	34°25'12,925"S
H	16°52'36,154"E	31°40'44,824"S		Y	13°49'51,598"E	33°26'6,576"S
I	16°53'27,55"E	31°47'18,863"S		Z	13°48'43,069"E	32°25'0,303"S
J	16°50'19,097"E	31°51'1,581"S		AA	13°51'0,126"E	32°4'9,658"S
K	16°59'10,193"E	32°11'0,829"S		BB	13°31'18,01"E	31°28'11,011"S
L	17°21'26,498"E	32°33'0,002"S		CC	13°15'1,479"E	30°47'3,986"S
M	17°35'25,972"E	33°10'41,442"S		DD	13°22'26,914"E	30°38'47,155"S
N	17°43'8,539"E	33°24'40,916"S		EE	13°37'0,652"E	30°31'21,72"S
O	17°42'17,143"E	33°37'48,993"S		FF	14°26'58,773"E	30°0'48,583"S
P	17°45'25,596"E	34°3'48,016"S		GG	14°56'57,646"E	29°41'40,731"S
Q	17°54'33,824"E	34°24'21,529"S		HH	15°36'4,746"E	29°16'15,972"S

Table 6-4: Summary of project phases and activities

Phase	Activity
1. Mobilisation Phase	Application for vessel and other permits, including seaworthiness certificates and vessel insurance
	Appointment of local service providers (e.g. supplies and refuelling)
	Transit of survey and support 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, refuelling and waste management)
	Berthing during crew changes
3. Demobilisation Phase	Survey vessels leave survey area and transit to port or next destination

6.2 SEISMIC SURVEYS

Spectrum is applying to undertake a speculative 2D seismic survey of up to 14 000 km. Any specific seismic survey operation would be limited to the summer survey window period (December to May inclusive). General and specific information on seismic surveys is provided below.

6.2.1 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 shown in Figure 6-2.

During seismic surveys, high-level, low frequency sounds are directed towards the seabed from near-surface sound sources (see Section 6.2.2) towed by a seismic vessel. The acoustic signal, emitted by releasing high-pressure air into the water column, penetrates the seabed and is then reflected based on 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 6.2.3). 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, wherever possible, 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 6.2.5.2).

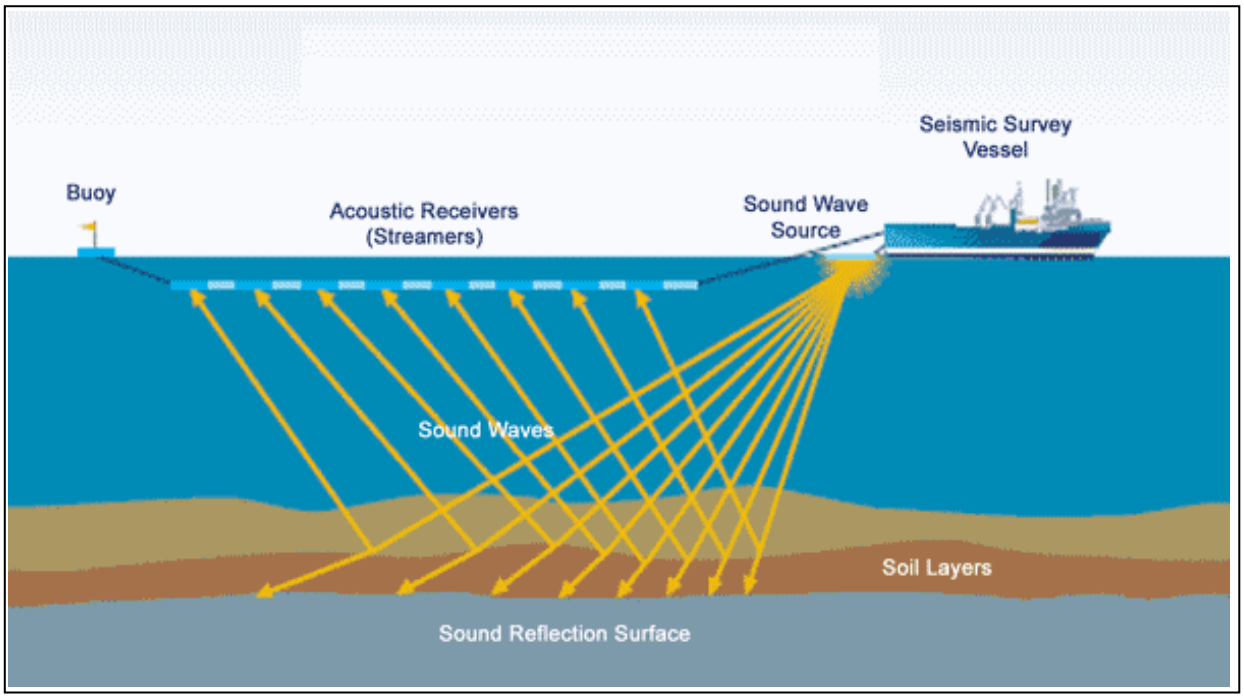

Figure 6-2: Principles of offshore seismic acquisition surveys

Source: https://www.tes.com/

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), often split into sub-arrays, 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 6-3). As mentioned above, Spectrum is applying to undertake a 2D seismic survey up to a 14 000 km line length across the proposed survey area. The survey will also provide more detail on the seabed topography which might be useful in future for offshore cable laying projects as well as potential offshore renewable energy projects (wind).

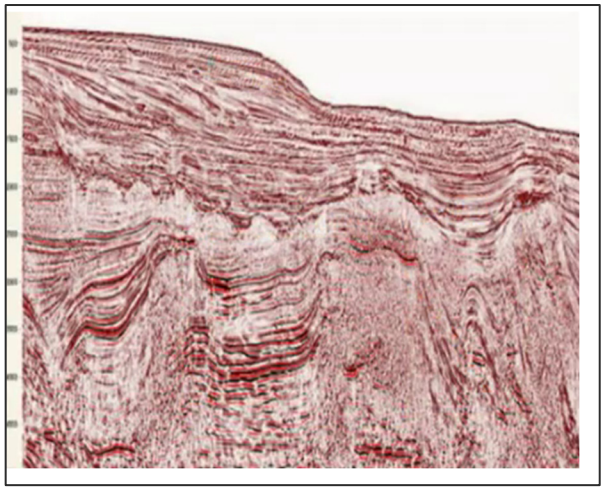

Figure 6-3: Example of a 2D image

Source: TEPSA

6.2.2 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 combined energy of the individual elements to be directed primarily downward (Gisiner, 2016) (see Figure 6-5).

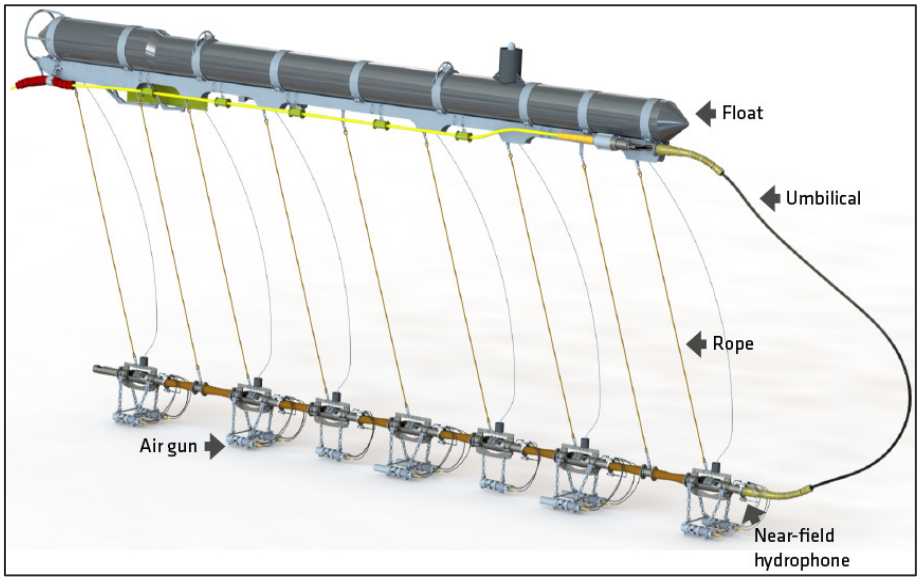

Figure 6-4: A typical seismic source / airgun array
Source: PGS

Figure 6-5: A seismic source (airgun array) being deployed at sea
Source: PGS

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 represent 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 6-6) (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 6-7). 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 6-7.

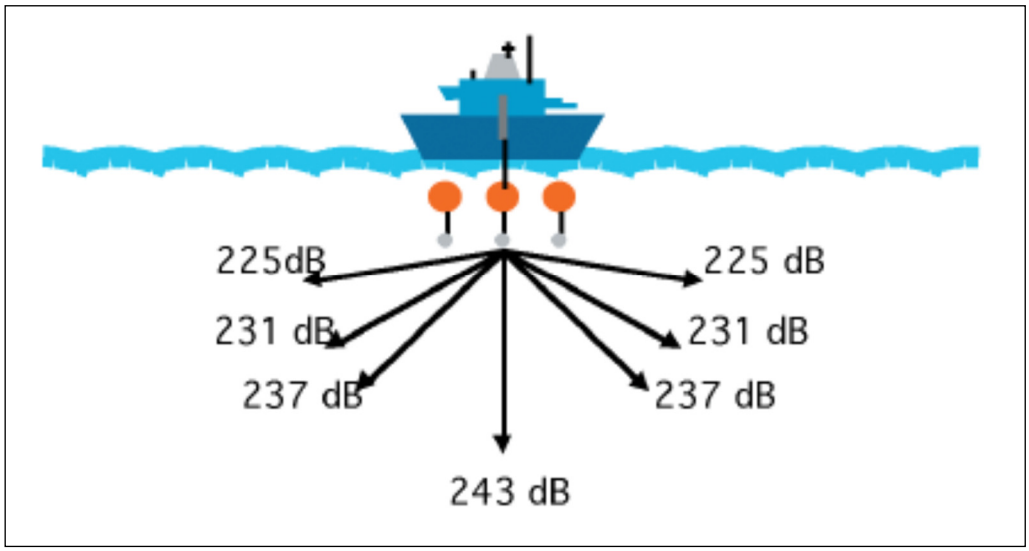

Figure 6-6: Pattern of measurable received sound levels around a schematic representation of an array, assuming a nominal point source level of 260 dB peak sound pressure level (SPL_{peak}) re 1 µPa

Source: Caldwell and Dragoset, 2000 in Gisiner, 2016

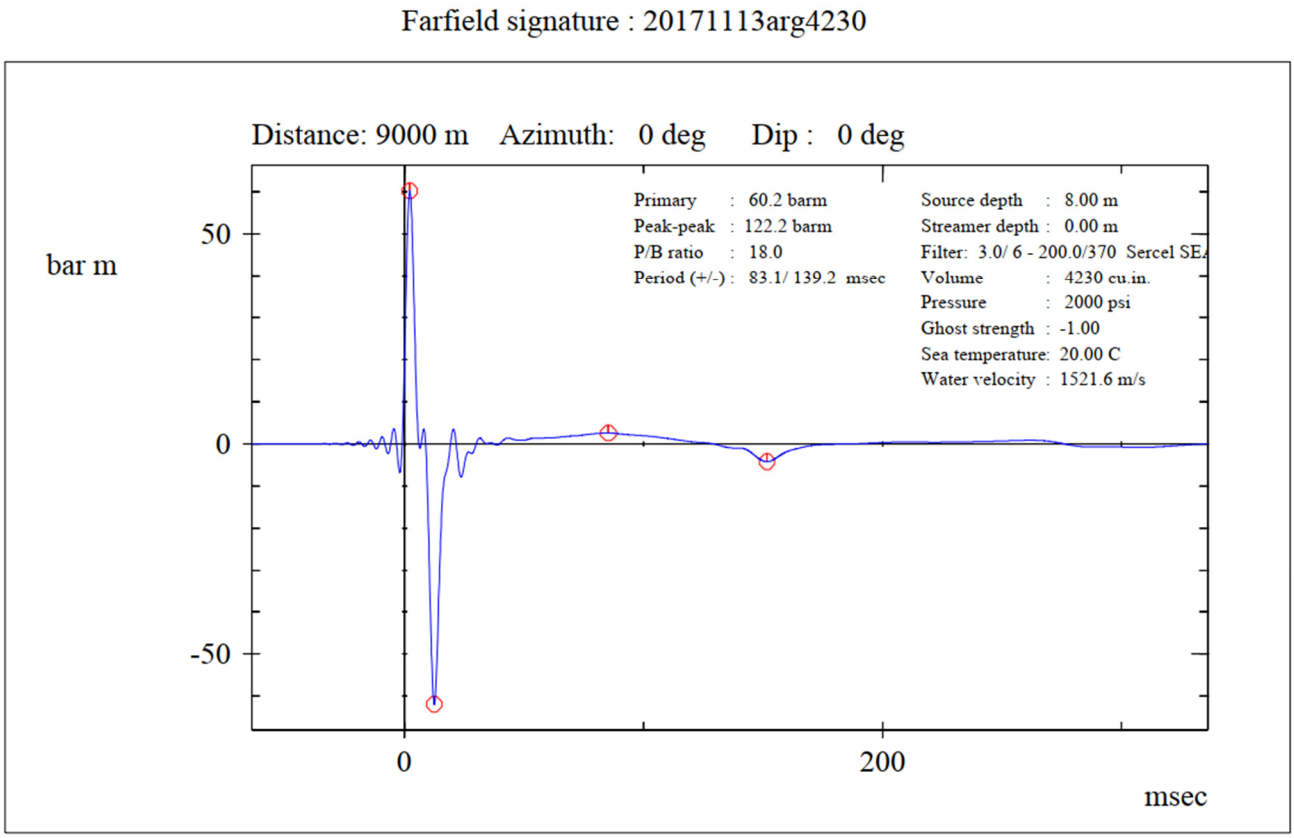

Figure 6-7: A typical pressure signature produced on firing of an airgun
Source: TGS

6.2.3 Recording Equipment and Tail Buoy

Signals reflected from geological discontinuities below the seafloor are recorded by hydrophones mounted inside the streamer cable (see Figure 6-8), 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. Typically only one streamer is used for a 2D survey.

The streamer is towed at a depth of between 6 m and 30 m and is not visible, except for the tail-buoy at the far end of the cable (see Figure 6-9).

Figure 6-8: Example of a hydrophone streamer
Source: (1) TEPSA and (2) https://commons.wikimedia.org/

Figure 6-9: Example of a tail buoy
Source: https://www.shutterstock.com/

6.2.4 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
No. of active airguns	Approximately 36 per array (note: only one active array for each shot point)
Spacings between airgun arrays	50 m to 100m
Towing depth of the airgun	Approximately 8 m
Source volume	Max 4 300 cubic inches each

Operational pressure	2 500 psi
Shot interval	Max every 5 seconds, 12.5 m interval between consecutive shot-points
Hydrophone Streamer	
Types of streamer	Solid
Number of streamers	1
Length of streamer	10 000 m
Depth of streamer	10 to 15 m

6.2.5 Main Project Components for Seismic Surveying

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

- Seismic survey vessel;
- Escort vessel;
- Possible helicopter medical support (only emergency situations); and
- Onshore supply base.

6.2.5.1 Seismic Survey Vessel

Spectrum has not yet identified a contractor to undertake the proposed seismic survey; thus, this section only presents generic specifications of the survey vessel. Specific details of the survey vessel and it certificates of fitness would be provided to PASA ahead of an actual survey.

Depending on the selected contractor, the generic specifications of the survey vessel may vary slightly, but will be of the same order of magnitude as the *MV BGP Pioneer* (see Figure 6-10). Likely seismic survey vessel specifications are provided in Table 6-6.

During the acquisition operations, the survey vessel will receive supplies at sea or at port during crew changes.

Figure 6-10: MV BGP Pioneer
Source: PCRC Marinetraffic.com

Table 6-6: Generic specifications of a 2D seismic vessel

Length	84 m
Width	20 m
Gross tonnage	5 600 Tons
Capacity (accommodation)	60 people
Fuel capacity	1 800 m^3
Cruising speed	13 knots
Acquisition speed	5 knots
Combustible to be used	Heavy Fuel Oil (HFO) + Marine Gasoil (MGO)
Sewage treatment onboard (yes/no)	Yes
Incinerator onboard (yes/no)	Yes

6.2.5.2 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, under the Marine Traffic Act, 1981 (No. 2 of 1981), a seismic survey vessel and its array of airguns and hydrophones fall under the definition of an "offshore installation" and as such it 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 2D surveys are illustrated in Figure 6-11.

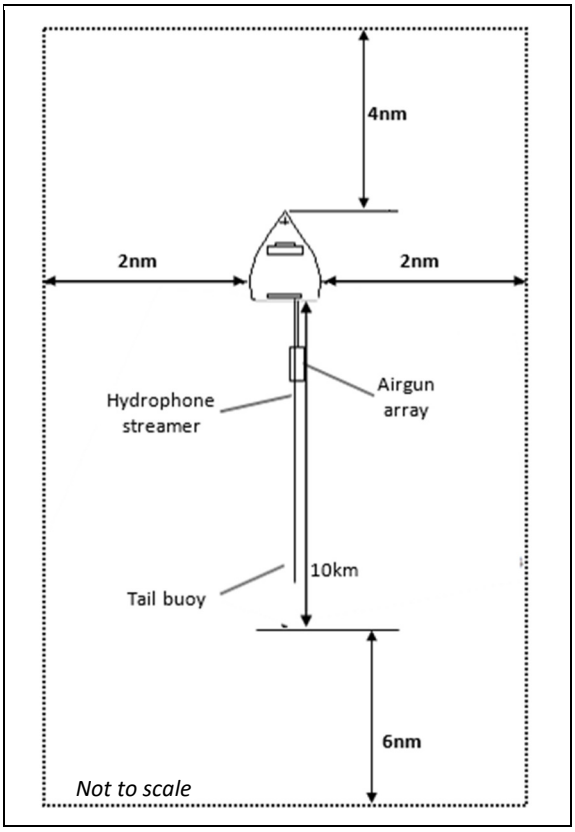

Figure 6-11: Typical configuration and safe operational limits for 2D seismic survey operations

6.2.5.3 Escort ('chase') Vessels

Normally a 2D survey would have one support vessel for each survey. The support vessel would be required to perform logistics support (including crew changes, supply of equipment, fuel, food and water) to the survey vessel (see Figure 6-12). However, for this survey crew changes and re-provisioning/refuelling would be undertaken by the main survey vessel in port. Generic specifications of a typical support vessel are provided in Table 6-7.

The escort (or 'chase') vessel(s) 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) able to speak both English and Afrikaans will be on board the escort vessel to facilitate communication with fishing vessels in the local language.

Figure 6-12: Example of a typical seismic escort vessel (M/V Thor Freyja)
Source: MarineTraffic.com

Table 6-7: Generic specifications of a seismic support vessel

Length	60 m
Width	15 m
Gross tonnage	2 100 Tons
Deadweight	600 Tons
Capacity (accommodation)	60 people
Fuel capacity	1 540 m^3
Cruising speed	13.7 knots
Combustible to be used	Heavy Fuel Oil (HFO) + Marine Gasoil (MGO)

6.2.5.4 Helicopter

Crew changes will not be undertaken via helicopter. Helicopters may, however, be used to transfer personnel to and from the survey vessel in the event of a medical emergency. In these unlikely cases, helicopters would operate from the Port of Cape Town.

6.2.5.5 Staffing and Logistics

The main port of call for the collection of supplies during the survey is likely to be Cape Town. The service infrastructure required to provide the necessary onshore support is already in place at the Port of Cape Town. No additional onshore infrastructure should be necessary for this project.

The survey vessel would accommodate up to 60 people working on 12-hour rotations. In addition, the escort vessel(s) would include a crew of approximately 6 to 10 people. It is currently anticipated that crew changes would be undertaken via the seismic vessel going to port.

The survey vessel would call into port every 30 to 60 days during the survey for supplies (equipment, fuel, food and water) and crew changes as dictated by need. The seismic and escort vessels would occupy the quay for about 24 hours per trip, depending on the quantity of material to be loaded / unloaded.

The methods of refuelling would depend on the contractor and the vessels selected. It is, however, anticipated that the survey vessel would be refuelled in port during crew changes/re-provisioning. Refuelling at sea ('bunkering') by a support vessel may be considered in extenuating circumstances. Such bunkering will be undertaken in a safe zone, taking current strength in the area into consideration, under the supervision of and with approval from SAMSA.

6.2.6 Emissions, Discharges and Wastes

6.2.6.1 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 South African legislation, the MARPOL convention, Spectrum 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, South African legislation and international standards. Licenced waste disposal sites and waste management facilities will be identified, verified and approved prior to commencement of survey operations.

6.2.6.2 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 gas oil (MGO) or heavy fuel oil (HFO) with less than 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 9 275 litres/day and the support vessel 1 400 litres/day. Fuel consumption estimates are presented in Table 6-8 and related estimate of total air emissions is presented in Table 6-9. As per the South African requirements for the reporting of greenhouse gas emissions, the IPCC guidelines were used for the estimation of greenhouse gas emissions.

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 6-8: Estimated fuel consumption

Source	Value*	Units	Estimated No. units	Estimated Consumption of marine fuel (Tons) **
Seismic	9 275	Litres / day	150 days	1 252
Support	1 400	Litres / day	150 days	189
Total				**1 441**

* Values provided by Spectrum, based on previous survey campaigns.

**Assume density of 900 kg/m^3 for HFO

Table 6-9: Estimated total atmospheric emissions

Gas	IPCC Emission factor	Global Warming Potential**	Emitted GHG (tCO_2e)
CO_2	77 400	1	4 506
N_2O	2	2	34
CH_4	7	7	9
Total			**4 550**

* Greenhouse gas (GHG) expressed as $CO_{2\ equivalent}$ (either sum of CO_2 + 265 N_2O + 28 CH_4)

** Global warming potentials provided in Third Assessment Report (IPCC, 2001)

6.2.6.3 Liquid Discharges

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

- Treated grey water[3];
- Treated sewage (black water);
- Treated bilge water[4] used to clean engine rooms and other potentially polluted sources; and
- Engine cooling water.

The survey vessel and support vessel 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

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

[4] 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.

volumes of sewage wastes released from the seismic and support vessel would be small and comparable to volumes produced by vessels of similar crew compliment (up to 70 people in total on the two 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); and
- The treated sanitary effluents discharged into the sea are estimated at around 10 000 litres per day for the duration of the seismic study based on 140 -150 litres per 70-80 persons.

6.2.6.4 **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 the Operator. The disposal of all waste onshore will be fully traceable.

General and hazardous waste landfill sites are located at Cape Town. The services of a waste contractor will be used to collect and transport all operational waste for safe disposal or recycling.

A summary of the typical wastes expected to be generated and their management options are detailed in Table 6-10. It is estimated that approximately 30 m^3 of solid waste per month will be generated during the seismic survey.

Table 6-10: 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) for recycling or disposal to landfill.
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.

6.2.6.5 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), from airgun operations (see Section 6.2.4).

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). The underwater noise study determines transmission loss with distance from the survey area and relative zones of impact by considering the bathymetry of the survey area, sound speed profile within the water column and geo-acoustic properties related to seafloor sediments.

6.2.6.6 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.

6.3 FINANCIAL PROVISION AND INSURANCES

As per the Government Regulations pertaining to Financial Provision (GN No. R1147 of 2015, as amended), an operator is responsible for the management and rehabilitation of guaranteed impacts of an exploration activity. Sufficient financial provision would need to be made to ensure that rehabilitation is undertaken after completion of exploration activities. Such provision does not, however, include the management of unplanned events such as vessel collisions or lost equipment.

As seismic surveys do not have any specific guaranteed impacts that would need to be rehabilitated, no financial guarantees are required in terms of the Financial Provision Regulations. Spectrum and its appointed contractors would, however, need to have the necessary vessel insurances in place in order to manage the consequences of any unplanned event. Proof of such insurances would be submitted to PASA and SAMSA before activities would be allowed to commence.