4 Project Description

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4.1 Introduction

This Chapter of the Environmental and Socio-Economic Impact Assessment (ESIA) describes the activities associated with the proposed Shallow Water Absheron Peninsula (SWAP) 3D Seismic Survey including:

- An overview of the project and seismic survey methods (Sections 4.2 to 4.3);
- A description of the planned survey activities and equipment to be used (Sections 4.4 to 4.5);
- A description of logistics and support activities (Section 4.6);
- A summary of estimated emissions, discharges and wastes associated with the 3D Seismic Survey (Section 4.7); and
- An outline of the operational and design controls which are included within the survey design and contribute to minimising potential environmental and socio-economic impacts (Section 4.8).

The information presented in this Chapter provides the basis for the assessment of impacts undertaken in Chapters 8 and 9 of this ESIA.

4.2 Project Overview

The objective of the 3D Seismic Survey is to collect geophysical data on the subsurface hydrocarbon reservoirs within the SWAP Contract Area (Figure 4.1). The data will be used to inform potential further exploration and development of the area. Part of the proposed 3D Seismic Survey includes acquiring seismic data outside of the SWAP Contract Area; this data is required to gain sufficient information to allow the subsurface targets to be characterised.

The 3D Seismic Survey Area comprises 5 individual Priority Areas[1] covering a total area of 1,520km^2 and includes both offshore and onshore elements (Figure 4.1). The onshore element covers approximately 90km^2 as follows:

- Priority Areas 1 – 10km^2;
- Priority Area 2 – 20km^2; and
- Priority Area 3 – 60km^2.

The water depth of the offshore element ranges from 0 to approximately 25m and has been subdivided into 3 zones for each Priority Area based on water depth (Figure 4.2):

- Transition Zone - 0m to 2m;
- Very Shallow Water Zone - between 2 and 5m; and
- Shallow Water Zone - greater than 5m (up to a maximum of approximately 25m).

As shown in Figure 4.1 it is not planned to undertake any survey activities within the Absheron National Park however survey activities are planned within the Absheron National Park Buffer Zone (Figure 4.1)[2].

Surveying within the Buffer Zone allows a subsurface area of approximately 135km^2 of the SWAP Contract Area to be imaged, which has not previously been characterised. This is considered to be essential in terms of understanding the exploration potential of the SWAP Contract Area.

The 3D Seismic Survey will be undertaken by Geokinetics, a specialist seismic survey contractor, and will be conducted in compliance with relevant national and international laws, regulations and standards (refer to Chapter 2).

[1] "Priority" in this context refers to the exploration priority with Priority Areas 1 and 2 considered to be of highest potential for hydrocarbon exploration, based on existing data on subsurface geology. Priority Area 3 and 4 are considered to be of moderate exploration potential based on existing data with Priority Area 5 of the lowest potential.

[2] It is expected that survey vessels will remain approximately 500m to 1km from the coastline of the Absheron National Park due to shallow water depths.

The 3D Seismic Survey is anticipated to commence in March 2016 and is estimated to last up to 9 months, dependent on weather conditions. The proposed acquisition schedule is provided in Table 4.1.

Pre-survey activities (outside the scope of the ESIA) will include:

- Mobilisation of specialist survey equipment and vessels from the United States and Malaysia by sea freight and expat specialist personnel;
- Mobilisation of other local vessels, equipment and survey personnel based within Azerbaijan;
- Onshore reconnaissance and offshore side scan, magnetometer, multi-beam bathymetry and seabed hazard surveys of the Survey Area to inform survey planning; and
- Renovation and upgrade of Hovsan Port to provide worker facilities, an appropriate fuel storage area and a dedicated access road to the Port.

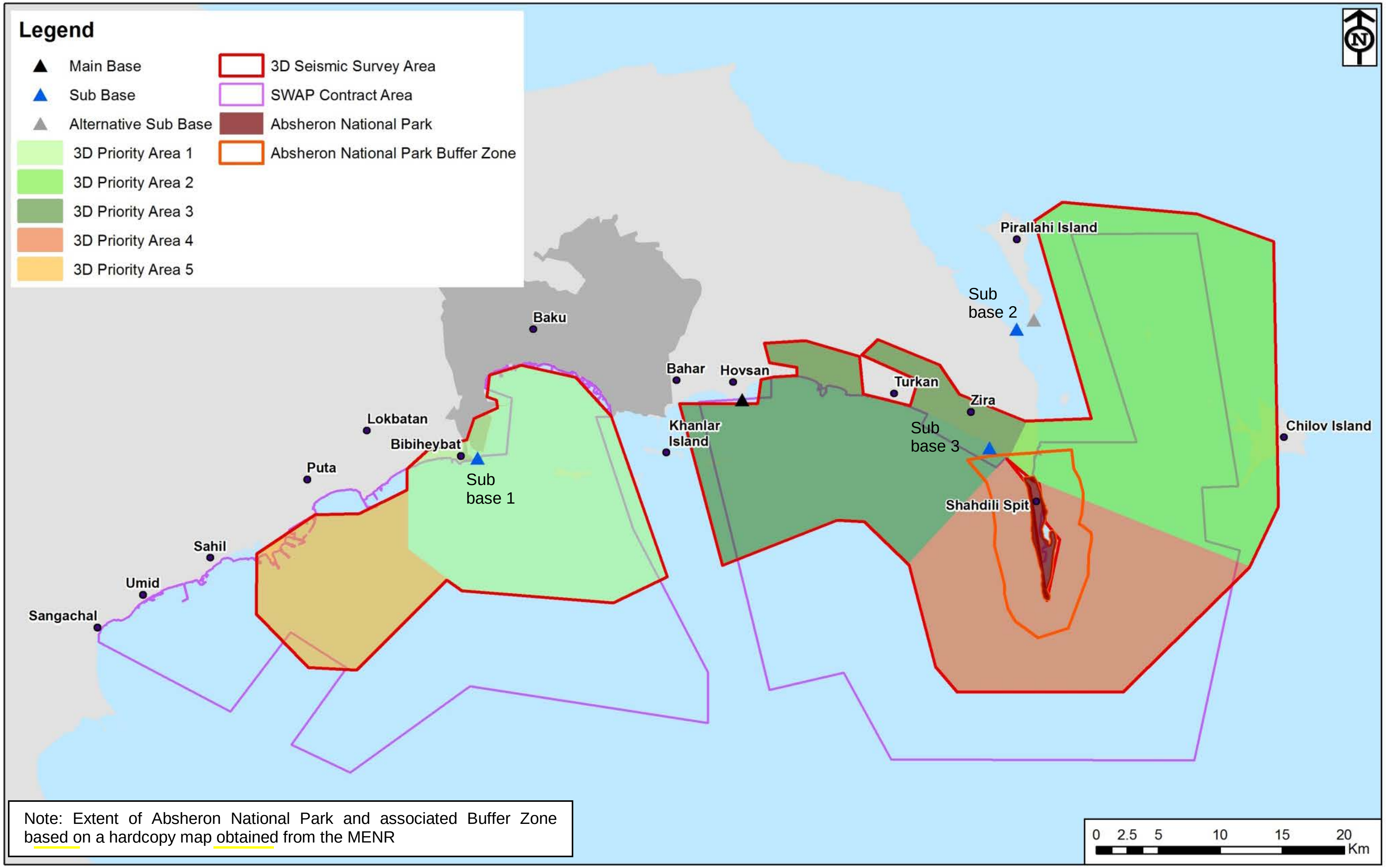
Onshore facilities will be used to support the onshore and offshore survey activities. The main base camp will be located at Hovsan Baku Sea Fish Port (BSFP) (hereafter referred to as Hovsan Port) with additional 3 sub-bases located within existing developed sites equipped with jetties along the coastline.

Table 4.1: Provisional 3D Seismic Survey Schedule

Priority Area	Survey Duration (days)	Indicative Start Date	Indicative End Date
1	49	1-Mar-16	18-Apr-16
Block Move	5	19-Apr-16	23-Apr-16
3	46	24-Apr-16	08-Jun-16
Block Move	5	09-Jun-16	13-Jun-16
2	80	14-Jun-16	01-Sep-16
4	57	02-Sep-16	28-Oct-16
Block Move	5	29-Oct-16	02-Nov-16
5	22	03-Nov-16	24-Nov-16

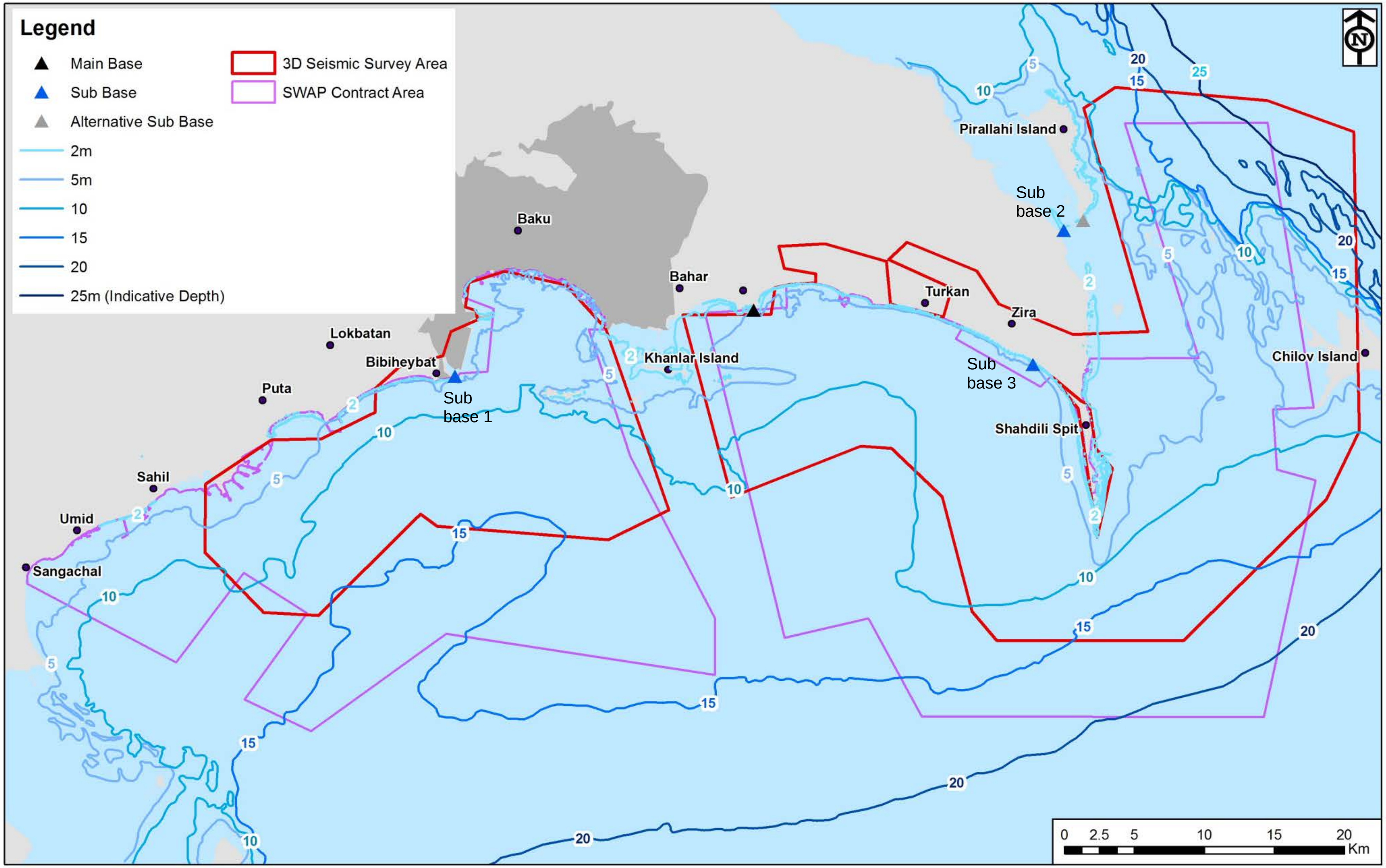
Data acquisition will be completed in each Priority Area prior to moving onto the next Priority Area (refer to Section 4.4 for further detail on the survey activities). However, due to the 170˚ orientation of the survey lines, data acquisition may occur in more than one Priority Area at the same time, for example, survey lines simultaneously cross through Priority Areas 3 and 4.

Figure 4.1: 3D Seismic Survey Area (Consists of 5 Priority Areas) and Location of Main Base Camp and Sub-Bases



Note: Extent of Absheron National Park and associated Buffer Zone based on a hardcopy map obtained from the MENR

Figure 4.2: Offshore Water Depth Zones



4.3 Overview of Seismic Survey Methods

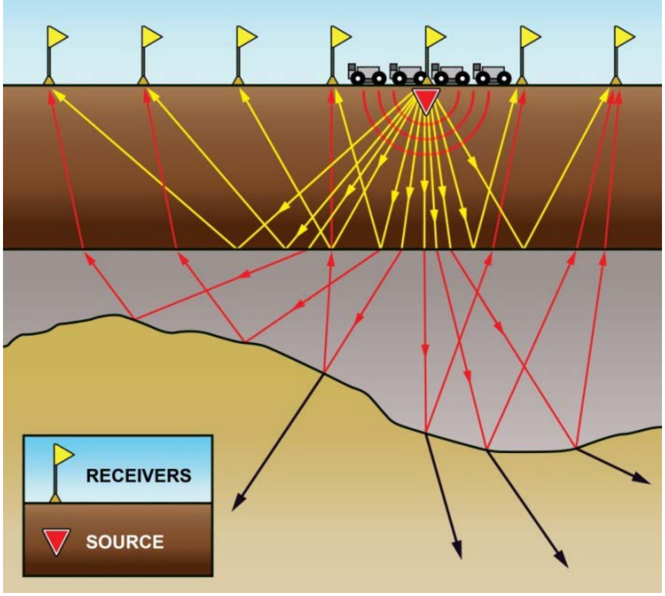
4.3.1 Introduction

Seismic data acquisition is the most common geophysical technique used to identify potential oil and natural gas deposits in the geologic structures within the Earth. Seismic surveys are based on discharging directionally focused energy pulses into the subsurface by a seismic energy source. These acoustic low frequency waves propagate into the subsurface (more than 6,000m deep) and are refracted or reflected back to the surface where they are detected by seismic receivers (for example, nodes). The two main types of seismic exploration used both onshore and offshore are:

- **Seismic Reflection** – This method is based on the analysis of reflected waves. When a wave reaches a boundary between two different soil or rock layers the wave is reflected back to the surface. This information is recorded by a seismic receiver and interpreted by the seismic acquisition system to identify and assess subsurface geological structures, and the potential presence and extent of any associated oil and gas deposits. The proposed SWAP 3D survey will use the Seismic Reflection method. An illustration of this method is provided in Figure 4.3.
- **Seismic Refraction** – This method is based on the analysis of refracted waves, where a proportion of the seismic energy will travel along the surface of the geological formation as a direct wave. When this wave encounters a boundary between two different soil or rock layers a portion of the energy is refracted and the remainder will propagate through the layer boundary at an angle. The refracted energy is recorded by a seismic receiver and interpreted by the seismic acquisition system.

From a spatial perspective, seismic data can be acquired in two-dimensions (2D) or three-dimensions (3D) format. 2D data is effectively a single vertical slice down through the rock layers underneath the receiver line. 3D acquisition uses very tightly spaced 2D lines. This allows data to be collected from between the receiver lines to produce a three dimensional volume of data. A 3D seismic survey is more capable of accurately imaging reflected waves because it utilises multiple points of observation. Use of multiple energy sources and receivers allow a range of different angles and distances to be sampled resulting in a greater volume of seismic data being collected. This allows a more detailed and accurate delineation of the boundaries and extent of subsurface geological structures.

Figure 4.3: Illustration Showing Onshore Seismic Reflection Method



Note: Sound wave signals generated by the seismic source travel though the various sub surface rock layers and at points where the rock type changes, reflect back to the surface (red and yellow lines). Similarly, in the offshore environment, sound waves travel through the water column before being reflected by different geological strata underling seabed.

The proposed 3D Seismic Survey will be undertaken using the Independent Simultaneous Sources (ISS)™ method as described in Section 4.3.2 and deploy the following techniques and equipment:

- **Onshore -** Vibroseis trucks and Onshore Synchronised Electrical Impulsive Source (OnSeis) units as energy sources (using vibrator and electrical impulsive systems respectively) and using autonomous nodes as receivers; and
- **Offshore -** Ocean Bottom Seismic (OBS) method using energy sources (known as airguns) towed behind survey vessels and autonomous nodes deployed on the seabed as receivers.

A general description of these techniques is provided in Table 4.2.

Table 4.2: Overview of Onshore and Offshore Seismic Survey Techniques

Offshore
Ocean bottom seismic (OBS) is the most common data acquisition technique in coastal areas characterised by tides, currents, breaking waves, shallow bathymetry and difficult access. OBS provides access to areas not open to conventional streamer[3] operations by separating the seismic source from the receivers. Placing the receivers on the seafloor also eliminates the main factors which affect both data quality and operational performance of towed streamer surveys i.e. : • Sound arising from towing the sensors through the water; and • Sound induced by the movement of the sea surface, so called weather sound. The OBS acquisition typically uses either a seabed cable recording system or nodes which may or may not be connected by cables. Numerous types of energy sources may be used including: high pressure air sources (airguns), vibrators or explosive charges depending on the site specific conditions. OBS operations in shallow water and transition zones are often performed using small craft both to deploy the receivers and to undertake the survey. Specialised terrain vehicles and equipment typically support the survey from the shore.
Onshore
Onshore seismic operations are similar to offshore operations in that they rely on the use of an energy source (impulsive or non-impulsive) and receivers. The receivers are typically geophones (cables or nodes) which are placed at the surface to record the reflected energy following operation of the energy source. Non-impulsive energy sources include the use of vibrators or vibroseis trucks. Typically a vibroseis survey involves the use of trucks with vibrating plates that stop at regular intervals along predetermined survey lines. The truck vibrator plates are compressed against the ground using hydraulic power and vibrated to send energy waves into the sub surface. Because vibrator trucks can operate in urban areas and can be equipped with special tyres or tracks for use in environmentally sensitive areas, hydraulic seismic vibrators are commonly used in onshore seismic surveys. Where vibroseis methods are not suitable a number of impulsive energy sources may be used instead. These include explosives, weight drop thumper technique (i.e. thumper truck, accelerated weight drop (AWD)) or electric sources (such as OnSeis). Typically a survey using explosives as the energy source involves a crew for drilling shot holes, motorised vehicles, a crew for detonation, a shot hole plugging crew, and clean-up personnel. In inaccessible areas, the drilling crew may move a portable drilling system from point to point by helicopter. Similarly, use of thumping techniques, while potentially less damaging to the environment than use of explosives, can result in long term to damage to surface conditions and potentially to subsurface assets. In comparison, OnSeis, which uses electrical signals as the energy source, is a significantly less intrusive and more flexible technique. Onshore surveys in urban, developed and/or agricultural areas are generally planned with particular care with implementation of seismic operations designed to ensure sensitive buildings, above ground and below ground assets (e.g. pipes) are protected and disruption to drainage is minimised.

[3] A streamer comprises a marine cable, usually a buoyant assembly of electrical wires approximately 5m below the sea surface that connects hydrophones and relays seismic data to the recording source vessel.

4.3.2 Independent Simultaneous Sources (ISS) Methodology

The ISS^{TM} method allows seismic sources (survey vehicles/vessels) to operate independently without the requirement to synchronise their activity; any interference between signals can be removed later by advanced data processing. The advantage of the method is that ISS can deliver very high fold data at high efficiencies within reasonable timescales, enabling seismic survey time and costs to be significantly reduced compared to conventional acquisition methods. It is understood that there is no limit to the number of sources that can be operated simultaneously. The technology is suited for surveys in different environments including difficult terrain, or where radio communication is challenged.

The 3D Seismic Survey will combine the ISS^{TM} methodology with the use of autonomous nodes which will reduce the weight and volume of equipment required, as well as the number of people and vehicles needed to conduct the Survey.

4.4 3D SWAP Survey Activities

The proposed 3D Seismic Survey will comprise of the following key activities:

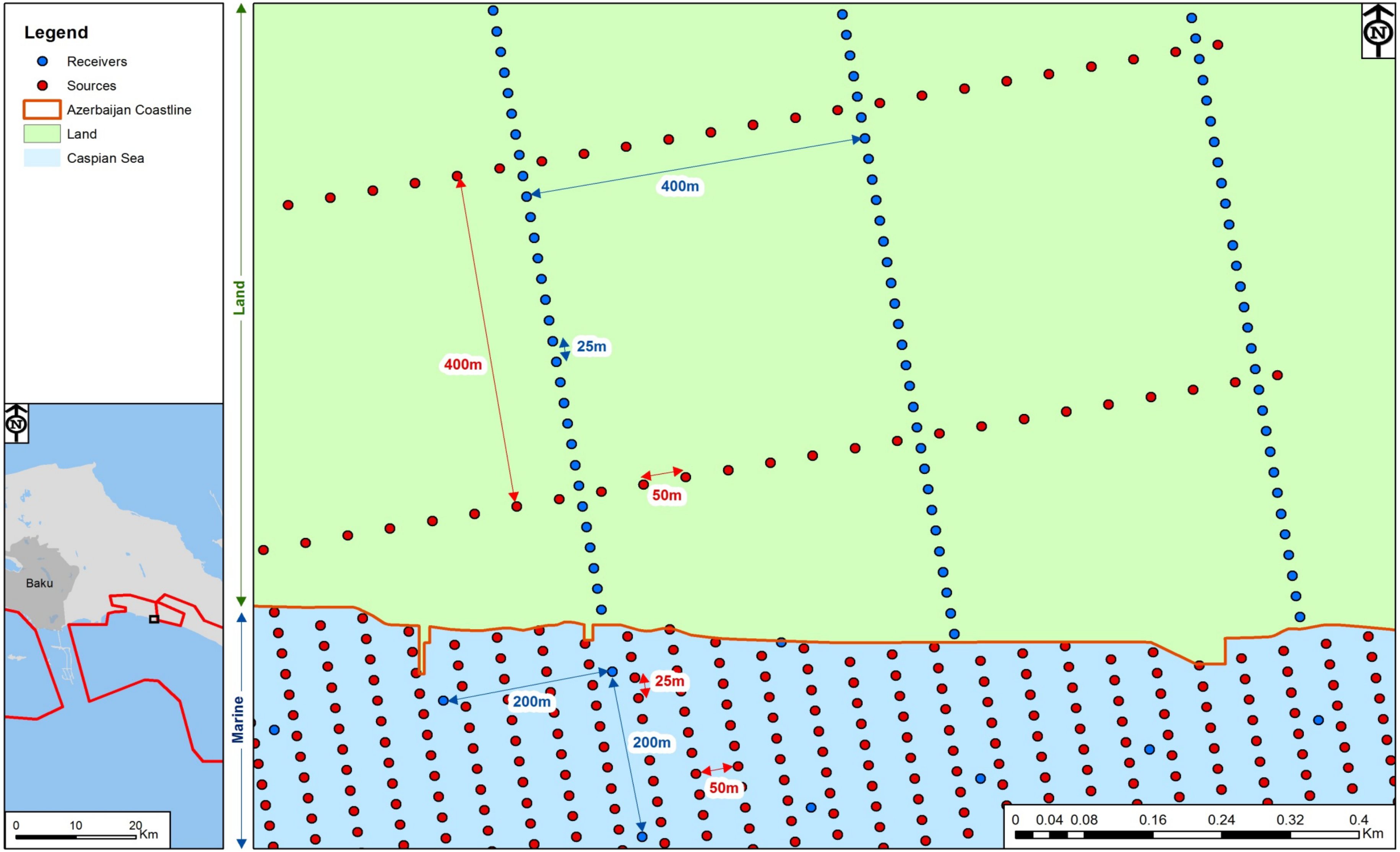
- **Mobilisation** - involves obtaining environmental approval and relevant permits, undertaking risk assessments, Environmental, Health and Safety (EHS) planning and mobilisation of survey personnel and equipment as well as establishing the main base camp (at Hovsan Port) and the three sub-bases. Survey equipment (i.e. vessels, vibrators, etc.) will be mobilised to the survey area after the completion of pre-mobilisation checks and Health Safety and Environment (HSE) audits.
- **Deployment of Survey Equipment** - autonomous nodes (receivers) will be deployed in a grid of lines spaced at 200m offshore and at 400m onshore; and source vessels / vehicles and other source OnSeis units will be positioned ready to commence operation.
- **Data Acquisition** – acquisition will commence at the start of each line with the activation of the energy source. Data will be recorded at regularly spaced intervals by the receivers as shown in Figure 4.4. Offshore, multiple source vessels will operate across different water depths within each Priority Area. This will allow the rate and extent of data acquisition to be optimised. As the 3D Seismic Survey has been designed based on the ISS^{TM} methodology, all source vessels, trucks and OnSeis units will operate autonomously. The onshore and offshore surveys will progress simultaneously within each Priority Area to optimise data acquisition and to ensure that sufficient data is acquired in the region where land meets water.
- **Demobilisation** - On completion of all survey activities, all survey equipment will be removed from the 3D Seismic Survey Area, main base camp and the sub-bases. Waste and any residual materials (e.g. unused chemicals, supplies etc.) associated with the survey activities will be handled as described within Section 4.7.3 below.

It should be also noted that prior to the Seismic Survey commencing a programme of onshore and offshore reconnaissance and seabed hazard surveys will be undertaken, including marine side scan, magnetometer, and multi-beam bathymetry surveys. These activities will inform Seismic Survey design, including further informing the positioning of survey lines and which of the proposed onshore methods are suitable for which areas (i.e. vibroseis or OnSeis). The presence of waterbodies within the onshore areas planned to be surveyed where vessels may be required to complete surveys will also be confirmed (see Section 4.5.2.1 below).

The offshore survey in the Transition Zone and Very Shallow Water Zone (i.e. 0-5m water depths) and the onshore survey will be undertaken during daylight hours only. Survey activities will be conducted on a 24 hour basis in water depths greater than 5m (Shallow Water Zone). In total it is planned that the onshore survey energy sources will operate at a total of approximately 3,700 source points across the 90km^2 onshore area. It is estimated that approximately 200 source points will be surveyed each day.

The indicative receiver (node) and source activation points onshore and offshore are illustrated in Figure 4.4.

Figure 4.4: Indicative Seismic Line Grid for Onshore and Offshore Data Acquisition



4.5 Survey Equipment

The majority of the survey equipment, including source vessels, onshore sources and nodes, will be mobilised from the USA to Poti, Georgia by sea freight, and then transported by rail or road to Azerbaijan. It is also planned to transport one of the survey vessels from Malaysia. Suitable equipment located within Azerbaijan that is fit for purpose and available, such as trucks, vans and support vessels will also be used where possible. All equipment will be delivered to the main base camp located within Hovsan Port and undego audits and checks before the survey commences. On completion of the 3D Seismic Survey, all vessels and equipment will be returned to Hovsan Port to be decommissioned and packed for shipment out of Azerbaijan.

The 3D Seismic Survey will involve simultaneous use of onshore and offshore seismic crews and equipment as detailed in Sections 4.5.1 and 4.5.2 below.

4.5.1 Offshore

During the offshore data acquisition, there will be up to 17 vessels in use as source vessels, node vessels (deploying and collecting seabed nodes) and support vessels. Table 4.3 provides the specifications of these vessels with supporting photos provided within Figure 4.5. If vessels are unavailable e.g. due to malfunction or maintenance, up to 4 spare vessels (of similar specification) will be available to allow the survey to continue as planned.

Source vessels will operate concurrently but independently in each Priority Area. The maximum number of source vessels operating in each Priority Area at any time will vary according to bathymetry and time of the day. During daylight hours there could be up to 5 source vessels operating at the same time. During night time hours only the two vessels in the Shallow Water Zone will be operational.

In addition to the vessels presented in Table 4.3, a number of chase and supply vessels, chartered locally within Azerbaijan, will also be used.

Table 4.3: Source, Node and Support Vessel Specifications

Parameter	Unit	Specifications								
		Source Vessels			Node and Source Vessels					Support Vessels
Name	-	3 x VSGA[1] vessels (TZ3225 / 3226 / 3227)	Bubbles SB4201	GeoTiger2/ GeoTiger4	TZ3203/ 3209/ 3215[2]	TZ3218/ 3228/ 1701/1702[2]	TZ402/ TZ401	GeoTiger 3	Wild Thing	2x fast boat (client and crew change)
Owner	-	Geokinetics								
Operational depth	*m*	0-2	2-5	>5	0-5	0-5	0-5	>5	>5	variable
Operation time	-	Daylight hours	Daylight hours	24h (2 shifts)	Daylight hours	Daylight hours	Daylight hours	24h (2 shifts)	24h (2 shifts)	Daylight hours
Vessel type	-	32' DIB[3]	42' DIB	Catamaran	32' DIB	32' DIB	40' DIB	Catamaran	West coaster	24' RIB[3],[4]
Vessel length	*m*	10	12.8	19	10	10	12	19	17.4	7
Draft (mean)	*m*	-	-	0.76	-	-	-	0.76	0.6	0.56
Tonnage (gross)	*metric tonnes*	12	25	52	12	12	8	52	41	2
Cruising Speed	*knots*	10	10	12	10	10	15	12	15	15
Acquisition Speed	*knots*	1-3	3	3.45	1-2	1-2	1-2	2	2	NA
Max Crew size	-	3 each	4	8	3	3	4	5	5	1 each
Fuel Tank Size	*l*	300	2 000	10 000	300	300	1 500	10 000	4 400	300
Fuel Consumption	*l/h*	30	60	57	30	30	40	57	200	30
Endurance	*days*	<1	48h	48h	<1	<1	<1	48h	48h	<1
Refuelling	-	At onshore support facilities [5]		Offshore	At onshore support facilities [5]			Offshore		At onshore support facilities [5]

Notes: (1) Very Shallow Gun Array (VSGA) vessels; (2) Can be used as Node or source vessel; (3) Rigid Inflatable Boat; (4) Demaree Inflatable Boat; (5) Offshore bunkering by the support vessel might be required if the vessel is located away from the base facilities.

4.5.1.1 Source Vessels

Source vessels will tow energy sources along the survey lines as shown in Figure 4.4 above. In each case the energy source comprises airguns arranged in arrays (refer to Section 4.5.1.4 below).

The Geotiger 2 and 4 vessels will operate in the Shallow Water Zone (greater than 5m water depth) on a 24 hours basis in 12 hour shifts. Crew changes will either be at sea using a boat to boat transfer, at the main base at Hovsan Port or at the closest sub-base at the time.

In the Shallow Water Zone (2 to 5m water depth), the Bubbles vessel will operate during daylight hours only. The vessels will return to either the main base at Hovsan Port or the closest sub-base at the end of each day. ‘Bubbles’ is designed to operate in shallow water areas where manoeuvrability may be restricted.

In the Transition Zone (0 to 2m water depth) where manoeuvrability is limited, two 32 foot (ft) DIB Very Shallow Gun Array (VSGA) vessels will be used. These vessels will be operating during daylight hours only and as with the ‘Bubbles’ vessel, they will return to the main base at Hovsan Port or the closest sub-base at the end of each day.

4.5.1.2 Node Vessels

Node vessels will be used for the deployment and retrieval of receiver nodes. As shown in Table 4.3, it is planned that there will be 6 vessels dedicated to the deployment and retrieval of nodes including 32ft and 40ft Demaree Inflatable Boats (DIB) vessels for the Transition and Very Shallow Water zones (0 to 5m water depth). The vessels will operate during daylight hours only and will return to the main base at Hovsan Port or the closest sub-base at the end of each day. The 32ft and 40ft DIB vessels can carry up to 10 nodes and 50 nodes respectively, which, based on the spacing of the nodes, equates to approximately 2 kilometres (km) and 10km worth of nodes respectively.

The larger capacity node vessels (Geotiger 3, Wild Thing) will be primarily responsible for node deployment and retrieval within the Shallow Water Zone (greater than 5m water depth) and will operate on a 24 hour basis with crew changes made either at sea, at the main base at Hovsan Port or the closest sub-base. The Geotiger 3 and Wild Thing each have the capacity to carry up to 96 nodes, equating to more than 20km worth of nodes.

The maximum number of nodes deployed per day will be 242 nodes; the numbers deployed by each vessel will vary daily depending on operational conditions and location.

4.5.1.3 Support Vessels

It is planned to use vessels currently located in Azerbaijan to support the survey. These vessels will provide logistical support (including crew change and supplies), and to maintain a safety Exclusion Zone around the source vessels. The support vessels will be suited for use within variable water depths based on their design, size and speed.

Figure 4.5: Photographs Showing Proposed Vessels to be Used for the 3D SWAP Seismic Survey

32' Demaree Inflatable Boats – Survey and Node Vessels

32' Demaree Inflatable Boats – Survey and Node Vessels

40' – Node Vessel

'Bubbles' – Source Vessel

Geotiger 2 and 4 – Source Vessel

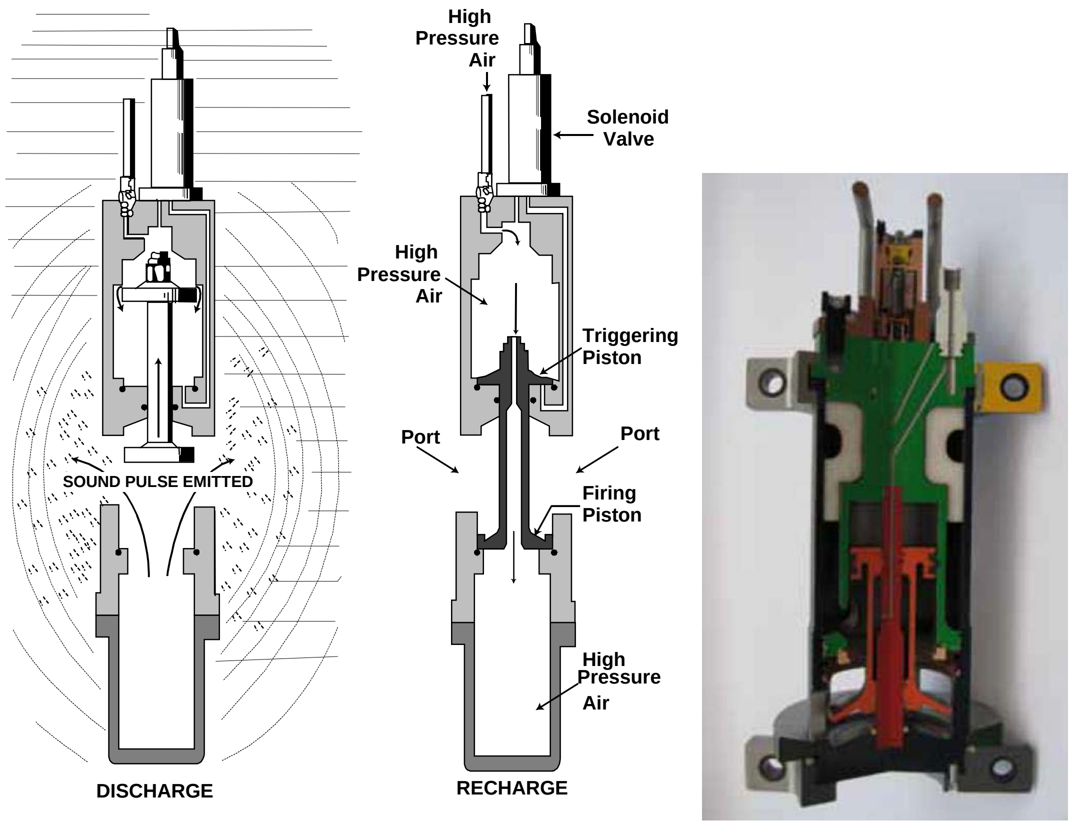
'Geotiger 3' – Node Vessel

Small Rigid Inflatable Boat (RIB) - Support Vessel

4.5.1.4 Energy Source

An airgun is a common energy source used in offshore seismic surveys usually arranged in arrays. These are underwater pneumatic devices that expel a bubble of air under high pressure into the water (Figure 4.6). Once in the water, the bubble collapses and may oscillate several times. The acoustic signal thus produced consists of a sequence of positive and negative pulses that are proportional to the rate of change of volume of the air bubbles.

Figure 4.6: Schematic Representation of a Typical Airgun (left) and Airgun Cross Section (right)



The energy source operates as follows:

- Compressed air at high pressure is supplied continuously to the energy sources from air compressors on the source vessel. It forces the piston downwards, and the chambers fill with high-pressure air while the piston remains in the closed position;
- When triggered, at pre-determined time or distance intervals, the solenoid valve opens and the piston is forced upwards; and
- Compressed air in the lower chamber flows rapidly out. An air-filled cavity is produced in the water that expands and then collapses, then expands and collapses again and continues cyclically. This oscillation creates pressure waves releasing the energy (sound) into the water column.

The source arrays for the proposed 3D Seismic Survey will comprise either sub-arrays or single strings of multiple airguns, and will be towed several metres behind the vessel at a depth of approximately 0.7 to 5m below the water surface level depending on the operational water depth. The seismic source specifications for the different Zones (as defined by water depth) are summarised in Table 4.4.

Table 4.4: Energy Source Specifications

Parameter	Unit	Energy Source Specification		
		0-2m depth	2-5m depth	>5m depth
Total array volume	*cu in*	300	680	1370
Airgun type	-	Geokinetics G0300, VSGA	Geokinetics G0680	Geokinetics G1370
Number of arrays	-	2	3	4
Number of sub arrays	-	1	2	2
Sub-array separation distance	*m*	-	2	2
Number of airguns per array	-	1	2	4
Nominal operating pressure	*cu in*	2000	2000	2000
Array length	*m*	1.5	4	6
Array width	*m*	4	4	6
Tow depth	*m*	0.7 - 1.5	1.5 - 3.0	1.5 - 3.0
Distance from stern	*m*	1.5	2	1.5
Peak-to-peak Sound Pressure Level	*dB re 1 µPA @ 1m*	185.4[1] 191.8[2]	219.4[1] 226.9[2]	228.8[1] 237.9[2]

Notes:
1. Near field source level
2. Back propagated source level from far field data.
The calculated near field and far field characteristics of the 3D seismic survey arrays are presented within Appendix 8A: Underwater Sound Study of this ESIA.

4.5.1.5 Seabed Nodes

Seabed autonomous nodes with Four-Component (4C) sensors and built in recording capacity will be used for data acquisition throughout the offshore survey. These nodes are self-contained and do not need to be connected to recording vessels or buoys by cables. They therefore occupy a small footprint, which is logistically advantageous for deployment in sensitive environments and obstructed areas. Figure 4.7 shows the model of node planned to be used for the offshore survey.

Figure 4.7: Photograph of Seabed Node Model Geospace OBX

Approximately 5,000 seabed nodes are expected to be used in total during the offshore survey. The nodes will be positioned in a grid as shown within Figure 4.4. The final location of the nodes will be determined prior to mobilisation and will be dependent of the Contractor's final survey design, which will take into account the technical survey requirements in addition to any hazards identified during the seabed hazard surveys. The technical specification of the nodes that are planned to be used is detailed in Table 4.5.

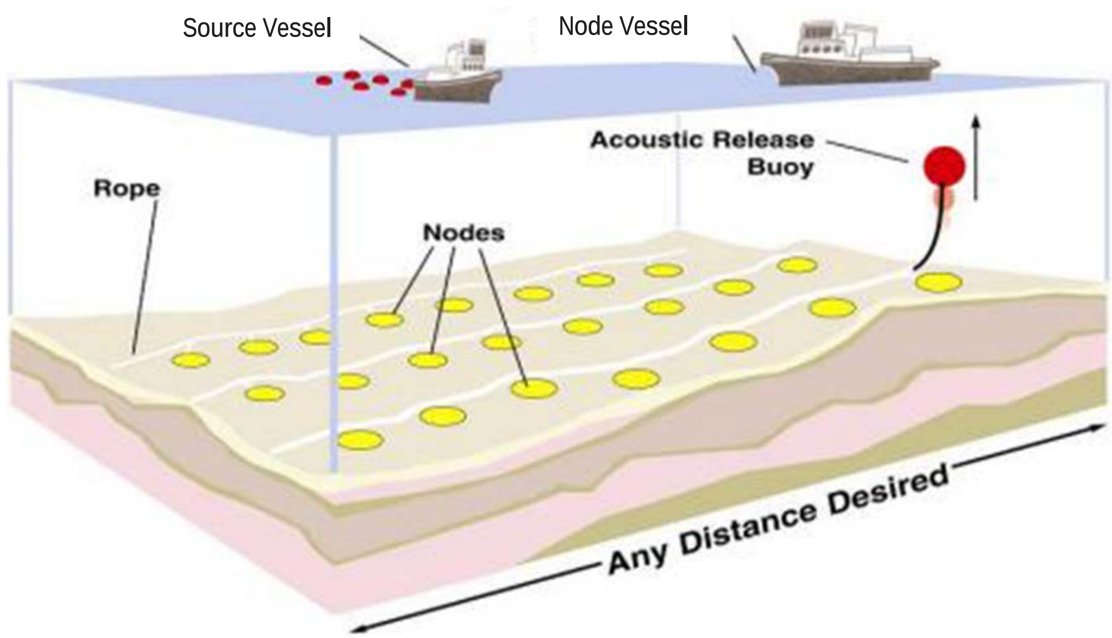
Table 4.5: Seabed Node Specifications

Parameter	Unit	Specification
Manufacturer / Model	-	Geospace OBX
Number of seabed nodes	-	5,000
Spacing	*m*	200m x 200m
Dimensions	*in*	475mm (L) x 208.3mm (W) x 106.3mm (H)
Weight	*kg*	In air 15.9kg In water 9kg
Duration Left on Seabed	-	in the western part (Priority Areas 3 and 5) 10-15 days, and the eastern part (Priority Areas 2,3,4) 15-20 days on average

The nodes will be deployed by dedicated node vessels using a pre-measured deployment rope which allows the node to be placed at the correct spacing on the sea floor. The positioning of the nodes will be checked using acoustic transponders fixed to either the deployment rope or the node itself. This will either be done once deployment is complete, or in real time using Ultra Short Base Line (USBL) underwater positioning systems.

Once the survey is completed, the deployment rope will be retrieved by the node vessel with the node crew grabbing the buoy attached to the deployment line. The nodes will be recovered using a hydraulic winch. The interval between deployment and collection of the nodes is based on the rate the survey progresses but may vary depending on weather and water depths. It is anticipated that this period will be between 10 and 20 days. Figure 4.8 provides an illustration is an Ocean Bottom Seismic Survey using autonomous nodes.

Figure 4.8: Illustration of an Ocean Bottom Seismic Survey using Autonomous Nodes



After nodes are picked up from the lines, they will be plugged into data collection and charging racks (located at Hovsan Port and the support bases and onboard Geotiger 3 and Wild Thing) for data download and battery recharge**.**

4.5.2 Onshore

4.5.2.1 Energy Source

It is planned to use three types of source equipment for the onshore 3D Seismic Survey, dependant on type of terrain encountered and access limitations:

- Vibroseis truck AHV-IV (as shown in Figure 4.9) - for use on flat open areas;
- Vibroseis small scale UNIVIB trucks (as shown in Figure 4.10) - for use in restricted or heavily urbanised areas due to its increased manoeuvrability in narrow spaces; and
- OnSeis unit (as shown in Figure 4.11) - for use in areas of difficult terrain and limited access including environmentally sensitive areas. A comparison of the size difference between the OnSeis unit and a vibroseis truck is shown in Figure 4.11.

As stated within Section 4.4 above, the proposed onshore reconnaissance survey will confirm the presence of waterbodies onshore in areas where source activation points are planned. Should it be necessary to use an energy source within any waterbodies identified, VSGA vessels will be used. Based on satellite imagery and the preliminary walkover data available for the onshore elements of the 3D Seismic Survey Area it is considered this is unlikely to be required.

Table 4.6 provides specifications for each of the three different source types. Safety distances between the seismic sources and existing infrastructure will be defined by the seismic contractor prior to the survey (during the mobilisation phase) in line with the current IAGC Minimum Offset Guidelines for Land Seismic Surveys[4].

Ground conditions within the onshore elements of the 3D Seismic Survey Area are considered adequate for data acquisition without the need for ground preparation. Vehicles and OnSeis units will use the existing road network to travel to the survey locations, where possible. In addition, the survey itself will be undertaken along, across and adjacent to existing roads. Vehicles will need to travel off-road, where necessary, to access receiver / source points. However, it is not planned to remove fence line boundaries. In addition, road closures are not planned; however, if road closures are necessary, they will be temporary and limited to the minimum time necessary to complete the operation safely. Road closures will be organised in close liaison with relevant authorities; and will only take place after permission for the road closure has been granted.

The aim of the survey will be to obtain data along the survey lines illustrated within Figure 4.4. Significant pre-planning as described within Section 4.9.1.2 below will be undertaken to ensure existing infrastructure, potential hazards or other physical constraints are identified during mobilisation such that the survey locations and survey lines can be adjusted accordingly to avoid these. It is expected that the survey will be undertaken in areas of differing land use and land type including bare ground, vegetated areas, agricultural, commercial, industrial, municipal, urban and coastal areas including beaches. Vegetation clearance is not planned as part of the survey. Temporary access to all land included within the onshore survey will be arranged between Geokinetics and the landowner prior to the survey commencing.

[4] International Association of Geophysical Contractors, 2007, Minimum Offset Guidelines for Land Seismic Surveys

Figure 4.9: Photograph Showing INOVA Vibroseis Truck: AHV-IV

Figure 4.10: Photograph Showing Small Scale UNIVIB

Figure 4.11: Photograph Showing OnSeis Unit (left) and Size Comparison With a Vibroseis Truck (right)

Table 4.6: Onshore Energy Source Specifications

Parameter	Unit	Specification		
Manufacturer	-	INOVA	INOVA	Kubota
Model	-	AHV-IV	UNIVIB	OnSeis
Number trucks	-	4	4	2
Spacing Between Trucks	m	12.5	1.5	25
Distance Between Source Points	m	50	50	50
Distance Between Source Lines	m	400		
Source Description	-	Vibroseis	Vibroseis	Electrical Impulsive Source
Min / Max Force Per Source Unit	llbs / Newtons	60 000	26 000	Charge: 850V DC
Number of Sweeps	-	To be determined after field tests at mobilisation		
Sweep Duration	Secs	4 x 20 seconds (subject to testing)		
Bandwidth Frequency of Sweep	Hz	5-60Hz (subject to testing)		
Baseplate Area	m^2	2.5	1.02	0.3

Sources such as vibroseis trucks rely on stacking (over imposing) multiple shots together to achieve the desired signal strength and penetration. Vibrators have a relatively long sweep time[5], up to 20 seconds in some cases, followed by the listening time which represents the desired length of time over which the receivers record the data reflected back from the sub surface layers.

The OnSeis units also rely on stacking, but there is no associated sweep time with this technology so the time required to obtain each distinct record comprises the listening time only. As outlined in Table 4.2, the OnSeis units are also much lighter and smaller than the vibroseis trucks, meaning the technique is less intrusive and resulting in less disturbance to the surrounding environment.

The different types of source equipment described above can be deployed simultaneously within any given Priority Area.

Additional vehicles anticipated to be used during the 3D Seismic Survey include:

- 1 service truck vibrator and 1 fuel truck vibrator;
- 2 Toyota land cruiser or equivalent for project management support;
- 1 ambulance (on standby);
- 15 Toyota Hilux or equivalent for source and recording crew transport;
- 3 Toyota Hilux or equivalent and 2 people carrier to be used at sub-bases; and
- 1 Hyundai Tucson or equivalent to be used at main office.

Onshore seismic activities are planned to be undertaken seven days per week during daylight hours only. All source vehicles and OnSeis units and support vehicles will depart from and return daily to either the main base camp at Hovsan Port or one of the 3 sub-bases.

[5] Sweep length defines the amount of time required for the vibrator to transverse the frequency range between the start and stop frequencies. As sweep length is increased, more energy is put into the ground because the vibrator dwells longer at each frequency component.

4.5.2.2 Onshore Receivers

Approximately 3,500 autonomous nodes of the type shown in Figure 4.12 will be used for the onshore 3D Seismic Survey. As the survey progresses, nodes will be re-deployed ahead of the operating source vehicles and OnSeis units at 50m intervals along the receiver lines spaced at 400m apart (Figure 4.4). Table 4.7 provides the technical specifications of the onshore node.

Figure 4.12: Photograph Showing Example of Onshore Node – Fairfield ZLand

Table 4.7: Onshore Node Specifications

Parameter	Unit	Specification
Manufacturer / Model	-	Fairfield Zland Generation I
Number of sensor nodes	-	3,500
Distance Between Receiver Points	*m*	50
Distance Between Receiver Lines	*m*	400
Number of Receivers per Line	-	variable but 176 for nominal patch
Number of Receivers per Patch	-	176 x 16 = 2816
Maximum Area of Patch	*m x m*	8800 x 6000
Maximum Endurance of Receivers in the Field	*Days*	10 to 15

Nodes will be deployed on foot and from support vehicles at pre-determined locations (as shown in Figure 4.4) by the layout crews prior to the arrival of source vehicles or OnSeis units. Nodes may be buried where ground conditions allow using small hand shovel primarily for security purposes.

A dedicated crew will travel behind the layout crew to verify that the deployed nodes are operating correctly before the energy sources are operational and acquisition commences. There will be up to 5 teams (with 3 people in each team) working simultaneously with designated vehicles undertaking the deployment and recovery of the nodes and mobilisation of the nodes to new areas prior to the arrival of the seismic source vehicles and OnSeis units, to ensure a continuous operation. At the end of each day the recovered nodes will be returned to either the main base camp at Hovsan Port or to one of the 3 sub-bases to allow the collected data to be downloaded and the batteries to be recharged overnight.

4.6 Logistics and Support Activities

4.6.1 Support Facilities

As shown in Figure 4.1 the main support base will be located at Hovsan Port with 3 sub-bases located along the coastline to support both the onshore and offshore survey activities. Hovsan Port was previously used as a fishing port and has since been transformed into a container facility. It comprises six universal moorings from 110m to 250m in length and 6m deep.

Hovsan Port, centrally located between the Priority Areas, will provide the necessary direct support for the survey activities and will be where all survey equipment (imported into Azerbaijan – refer to Section 4.5) will be delivered. Prior to the 3D Seismic Survey commencing the following upgrade works are, at the time of writing, in progress at Hovsan Port in liaison with the Hovsan Port operator:

- Installation of pre-fabricated accommodation and welfare facilities;
- Above and below ground works to connect the new facilities to main supplies (i.e. electricity, gas, water and telecommunications);
- Upgrade and resurfacing of an existing but disused access road to provide dedicated access to the Port; and
- Installation of a dedicated fuel storage area, with an impervious base and appropriate bunding.

Pre-mobilisation at Hovsan Port will also include renovating the following existing facilities to a suitable standard for the project for use by the 3D Seismic Survey team:

- Jetty space (to be used as the main jetty for vessel maintenance);
- Rail link (to be potentially used for equipment transfer);
- Hard standing areas;
- Storage and warehouse facilities;
- Lodging and offloading facilities
- Bulk liquid storage facilities (equipped with secondary containment);
- Medical/clinical facilities; and
- Offices facilities.

In addition the necessary works to complete fit out of vessels prior to operation and subsequent inspection and audit will be completed within Hovsan Port.

During the survey, all supplies required will be distributed from the main base at Hovsan Port which will house the main maintenance facility, survey / navigation office, offices for quality control (QC) processing and data recording and download, mechanical workshops and offices for crew management and administration. All survey support activities based at the Hovsan Port will make use of the existing utilities (i.e. electricity, gas, water and telecommunications). In addition to the facilities listed above a dedicated waste segregation area will be established at the Port and used throughout the survey. The 3 sub-bases have been selected based on the availability of existing infrastructure; good vehicular access; proximity to existing transport links and ease of access into the Priority Areas. The sub-bases, situated within the existing industrial built up environments, include existing jetties and other infrastructure (as shown in Figure 4.13) which will be maximised where possible to provide refuelling facilities for vessels and maintenance areas, and office and welfare facilities as required. Mobile workshops (containers) are planned to be installed, but no new permanent facilities will be constructed at any of the sub-bases as part of the SWAP 3D Seismic Survey activities. All support activities based at the sub-bases will make use of the existing utilities (i.e. electricity, gas, water and telecommunications).

Table 4.8 summarises the planned activities at the sub-bases.

Table 4.8 Location and Summary of Planned Activities and Facilities at Sub-Bases

Sub-Base	Location	Planned Activities and Facilities
1	Existing SOCAR Port - 3km north from the Absheron National Park	Vessel crew changes Field camp for onshore survey activities Area for mobile marine mechanic workshop Small vessel refuelling* Ambulance and paramedic services Secure storage facilities
2	Western edge of Pirallhi Bridge	Vessel crew changes Area for mobile marine mechanic workshop Small vessel refuelling* Ambulance and paramedic services
2 (Alternative Option**)	South-east side of Pirallhi Island	
3	South Dock/ATA Yard	Vessel crew changes Vessel maintenance Small vessel refuelling* Vehicle refuelling
Notes:* Vessel refuelling will be undertaken using a certified and recognised refuelling vehicle ** A decision between sub-base 2 and sub-base 2 (alternative option) will be made based on security considerations and accessibility to the Caspian Sea.		

Figure 4.13 Photographs Showing Jetties and Berthing Areas at Proposed Sub-Bases


Sub-base 1


Sub-base 2


Sub-base 2


Sub-base 3

4.6.2 Workforce

Approximately 176 personnel employed to undertake activities associated with 3D Seismic Survey will be active at any given time, and with an additional 139 employed personnel on standby, giving a total workforce of 315. The numbers of personnel involved in each element of the survey are provided below with the numbers that will operate on rotation in 12 hour shifts shown in brackets:

- Onshore survey: 67 people (59 on rotation);

- Offshore survey - Transition Zone (0-2m water depth): 43 persons (30 on rotation); and
- Offshore survey - Very Shallow and Shallow Water zones (greater than 2m water depth): 66 persons (50 on rotation).

The survey crews will consist of a core team of international specialists supplemented by Azerbaijani personnel. BP and the seismic contractor will aim to meet the local content targets defined under the SWAP Production Sharing Agreement (PSA) which comprise 90% unskilled labour and 10% of skilled labour. It is expected that the following roles will be mostly undertaken by local non-professional staff:

- Onshore drivers;
- Offshore vessel crew;
- Catering personnel;
- Cleaning personnel; and
- Security guards.

4.6.3 Accommodation

Accommodation for workers will be provided within Hovsan Port and at local hotels. It is anticipated that a number of local workers employed to undertake survey activities will commute from their homes on a daily basis; transport will be provided from a central location(s) to either Hovsan Port or one of the sub-bases, as required.

Final accommodation provisions are subject to agreement with the various business operators and will be finalised prior to the commencement of activities.

4.6.4 Provision of Supplies

Most general provisions are available locally in country, with the seismic contractor’s Baku office providing logistical support to the crew. Specialist equipment and supplies which are not available in Azerbaijan will be imported. Equipment and supplies will be sent to the Hovsan Port and distributed to the field operations.

Catering (including packed lunches) for both offshore and onshore crews will be provided by the catering supplier at Hovsan Port.

4.6.5 Re-fuelling

Small source vessels, node vessels and support vessels will be refuelled daily at either Hovsan Port or one of the 3 sub-bases. Larger vessels (Geotigers 2, 3 and 4) will be refuelled at sea every 2 to 3 days from the local supply vessel.

All source vehicles and OnSeis units will return to either Hovsan Port or one of the 3 sub-bases, depending on location, on a daily basis for refuelling and maintenance. Light vehicles will be refuelled at public fuel stations and larger vehicles will be either refuelled from a fuel tank at Hovsan Port in a dedicated refuelling area or by fuel truck at one of the sub-bases. The refuelling area at Hovsan Port will be located on an impermeable surface and will include a bund wall capable of holding the content of the fuel tank. The refuelling area will be located away from storm water sewers, channels and water courses and will be protected from weather conditions. The refuelling procedure at the sub-bases will be conducted using drip-trays. Hazardous fuels, oils and chemicals will be securely stored in clearly marked containers in a contained area to prevent pollution.

4.6.6 Transport Coordination

There will be dedicated transport co-ordinators to control and coordinate both onshore and offshore vehicles and vessels. Their responsibilities will include ensuring mechanical suitability of all vehicles and vessels, driver quality and day to day coordination of transport traffic. The transport coordinators will work closely with the base camp radio operators. Journey management systems will be implemented to efficiently track and plan all movements, while a vehicle tracking system will be employed to aid in this purpose.

4.7 Summary of Emissions, Discharges and Waste

4.7.1 Emissions to Atmosphere

The main source of atmospheric emissions during the 3D Seismic Survey offshore activities will be from burning of fuel to power the engines, compressors and electrical generators on-board the source, node and support vessels. Onshore the combustion emission will be associated with operation of seismic equipment and vehicles.

Gases emitted from the fuel combustion processes will comprise:

- Carbon dioxide (CO_2);
- Nitrogen oxides (NO_x, N_2O);
- Sulphur oxides (SO_x);
- Methane (CH_4)[6];
- Volatile organic compounds (VOC);
- Carbon monoxide (CO), and
- Particulate matter.

All shipboard emissions will be in compliance with MARPOL 73/78 Regulations for the prevention of air pollution from ships (Annex VI), aiming to reduce global emissions of SOx, NOx and particulate matter. Low sulphur fuel will be used where possible.

Table 4.8 summarises the estimated greenhouse gases (GHG: i.e. CO_2 and CH_4 [7]) and non GHG emissions due to onshore and offshore survey activities.

Table 4.8: Estimated GHG and Non GHG Emissions Associated with the Onshore and Offshore 3D Seismic Survey Activities

Emission	Estimated Volume (tonnes)		
	Offshore	Onshore	Total
CO_2	12210	3090	**15300**
CO	31	11	**42**
NO_x	225	47	**272**
CH_4	1.0	0.2	**1.2**
NMVOC	9	5	**14**
SO_x	31	2	**33**
GHG	12231	3094	**15325**

Basis of Estimate:
1. Emission Factors for vessels were taken from the E&P Forum Report (No. 2.59/197);
2. Emission Factors for vehicles were taken from European Environment Agency EMEP/CORINAIR Emission Inventory Guidebook - 2007. Group 8;
3. Number of vessels has been calculated based on Section 4.5.1. Calculations assume simultaneous operation of 5 Source vessels, 10 Node vessels and 2 support vessels for the duration of the offshore survey;
4. Number of survey vehicles has been calculated based on Section 4.5.1. Calculations assume simultaneous operation of 4 INOVA AHV-IV, 4 INOVA UNIVIB5, 2 Kubota - OnSeis, 1 service truck, 1 fuel truck, 2 Toyota Land Cruisers, 1 Ambulance, 18 Toyota Hiluxes and 1 Hyundai Tucson for the duration of the offshore survey
3. Duration of survey is assumed to be 9 months
4. Vessel daily operational hours and hourly fuel consumption volume is based on Table 4.3
5. Calculations assume that onshore survey will be undertaken only in daylight hours only (12 hours per day)
6. Daily fuel consumption rate for each vessel has been calculated by multiplying hourly fuel consumption rate to the number of operational hours specified for each type of vessel in Table 4.3
7. Daily fuel consumption rate for each vehicle has been calculated using technical specifications of the engine of each vehicle type planned to be used during the survey.

[6] Greenhouse Gas (GHG)
[7] To convert to CO_2 equivalent the predicted volume of CH_4 is multiplied by a global warming potential of 21.

4.7.2 Discharges to Sea

With the exception of deck drainage runoff there will be no planned discharges to sea associated with the offshore survey vessels.

4.7.3 Hazardous and Non-Hazardous Waste

The types of wastes that are expected to be produced during the seismic survey are summarised in Table 4.9 along with the planned disposal routes.

Offshore all waste streams (including sanitary waste) will be appropriately segregated, stored in fit for purpose containers/tanks on-board the vessels and transferred to waste facilities provided at the main base and the sub-bases.

Aqueous discharges associated with the onshore seismic survey activities will include sewage, grey and drainage waters generated at the Hovsan Port and sub-bases. These effluents will be discharged to the existing municipal drainage systems in accordance with relevant existing site permits**.**

Hazardous materials from the survey operations will include fuel (diesel), hydraulic and other utility oils, paints and solvents, batteries, refrigerants and cleaning chemicals. Strict handling procedures will be in place for all of the hazardous materials and survey crews will be trained in waste and chemical management.

Both hazardous and non-hazardous wastes will be segregated and stored in designated areas and fit for purpose containment at the main base and sub-bases. They will then be sent to BP approved waste management facilities for recycling/reuse, treatment and /or disposal under rigorous Duty of Care protocols.

Waste management will be undertaken in line with the national regulatory requirements, good international industry practices, BP's AGT Regional Waste Manual and 3D Seismic Survey Waste Management Plan.

Table 4.9: Anticipated Types of Waste Streams Produced During the Seismic Survey Activities and Handling and Disposal Route[8]

Waste Category	Main Constituents	Handling and Disposal Route
Non Hazardous Waste		
Domestic/office wastes	Non-recyclable plastics, Styrofoam, glass, metal, packaging and food wastes	Waste generated offshore is segregated, compacted and stored onboard vessels to be transferred to the main base and sub bases. Waste generated onshore is segregated, compacted and stored at the main base and sub bases along with waste from offshore until transfer to BP approved waste management facilities for disposal.
Paper and cardboard	Uncontaminated office paper, documents and cardboard packaging	Waste generated offshore is segregated, compacted and stored onboard vessels to be transferred to the main base and sub bases. Waste generated onshore is segregated, compacted and stored at the main base and sub bases along with waste from offshore until transfer to BP approved waste management facilities for recycling.
Plastics - recyclable (HDPE)	High Density Polyethylene plastic material	
Wood	Uncontaminated wood waste and timber	Generated onshore. Segregated, compacted and stored at the main base and sub bases until transfer to BP approved waste management facilities for recycling.
Oils - cooking oil	Oil, grease or fat used for cooking food	

[8] Waste streams listed in the table have been categorised based on AGT Region Waste Manual

Waste Category	Main Constituents	Handling and Disposal Route
Hazardous Waste		
Water - oily	Drainage waters, bilge waters, tank washings and wildlife washings/cleaning	Waste generated offshore will be stored on board the vessels and transferred onshore for treatment and disposal at licensed waste facilities. Waste generated onshore will be stored at the main base and sub bases until transported for treatment and disposal at licensed waste facilities.
Sewage - untreated	Liquid and solid sanitary waste	Waste generated offshore will be stored on board the vessels and transferred onshore for treatment and disposal at main base and sub bases.
Tank bottom sludge	Oily sludge from storage tank bottoms	Waste generated offshore is segregated and stored separately onboard vessels to be transferred to the main base and sub bases. Waste generated onshore is segregated and stored separately along with waste from offshore until transfer to BP approved waste management facilities for disposal. Hazardous waste streams will be stored separately offshore and onshore to prevent contact between incompatible waste streams.
Container - metal	Empty metal drums and cans (cleaned or uncleaned)	
Container - plastic	Empty plastic drums and cans (cleaned or uncleaned)	
Acids	Acids refer to substances and mixtures with a pH less than 7	
Solvents, degreasers and thinners	Organic solvents used as industrial cleaning solutions (degreasers) and paint thinner	
Paints and coatings	Water-based liquid paints and oil/solvent based liquid epoxy resin paints, lacquers and varnishes.	
Contaminated materials	Various materials that are lightly contaminated with oils, chemicals, etc.	
Adhesives, resins and sealants	Solvent based adhesives	
Oils - fuel	Diesel from generators, etc. that cannot be reused due to contamination	
Oils - lubricating oil	Used refined petroleum distillates including engine lubrication oil, motor oil, transmission oil and hydraulic fluid	
Oily rags	Cotton and man-made fibre rags, oil or water saturated absorbent boom (soft) that cannot be cleaned or reused	
Pressurized containers	Compressed gas bottles and cylinders ranging in size from 1.5 to 150 litres	
Clinical waste	Includes damaged or out of date medicines, used syringes and scalpels or other 'sharps' and 'soft' soiled absorbents or dressings	
Batteries - dry cell	General purpose batteries	
Batteries - wet cell	Batteries with electrode grids containing lead oxides	

4.8 Operational and Design Controls

The proposed 3D Seismic Survey will be conducted in compliance with the requirements of applicable national regulations, BP's and Geokinetics' corporate policies and procedures, and will follow good international industry practices promulgated by the International Marine Organization (IMO), International Association of Geophysical Contractors (IAGC), The UK Joint Nature Conservation Committee (JNCC) and International Association of Oil and Gas Producers (IOGP).

Survey specific management plans, as described within Chapter 11, will be designed to minimise and manage potential impacts to identified receptors, focusing on aspects including transport, waste, nuisance, environment management and spills

4.8.1 Operational Controls

4.8.1.1 Offshore

Experience shows that impacts from the physical presence of vessels and equipment can be avoided by adhering to good management practices and operational protocols. Specific control measures that will be implemented to minimise interference with other sea users will include:

- Notifications regarding the survey programme will be issued to the relevant maritime and port authorities, as well as directly communicated with sea users where necessary, in advance of the survey;
- All vessels will operate in compliance with national and international maritime regulations for avoiding collisions at sea, use of signals and lights;
- All vessel movements will be under the control of the seismic contractor Logistics Control Room (LCR) who has the complete authority for directing vessels when they are offshore. Clear lines of communication and operational procedures will be established between all survey and support vessels before the start of surveying;
- Advanced positioning equipment will be used to maintain communications with other vessels and provide accurate information on the position of the source vessel and associated equipment;
- Safety exclusion zone will be maintained around source vessels to minimise the risk of collision;
- The seabed hazard and bathymetry surveys conducted prior to the seismic data acquisition will improve understanding of the seabed topography and infrastructure and provide accurate water depths which will ensure operational and navigational safety, and help prevent any accidental events;
- Support vessels will be utilised throughout the seismic survey programme. These will be responsible for helping to keep the source vessel and equipment safe from hazards such as other vessels and manmade obstructions along the survey lines. Support vessels will also provide additional safety cover to the source vessels and can assist in the event of an emergency, whether health and safety or environmental;
- Survey will be only undertaken if pre-established operating criteria for weather conditions (e.g. wind, waves and visibility) is met;
- Vessels will undergo HSE audits/checks prior and during the survey; and
- Ensure limited/restricted use of airguns during line change (if line change takes longer than 20 minutes).

4.8.1.2 Onshore

Given the complexity and density of onshore infrastructure across the survey area, a comprehensive planning of survey activities will take place ahead of survey crews being deployed to the field. Pre-acquisition activities will include reconnaissance surveys, scouting and permitting activities. Preliminary survey operations will include a static control survey and associated integrity confirmation sites, setup of a communication network, mapping the extents of the obstructions and sensitive receptors, identifying and marking access routes, as well as permitting and public relations with local communities, landholders and Government Officials.

Throughout operations the following controls will be in place, which contribute to minimising potential for disturbance to the local community and potential effects on community health and safety:

- Monitoring of safety performance will be undertaken by crew management and operational supervisors in line with corporate procedures and industry good practices;
- Transport equipment will be subject to stringent checks to ensure mechanical and safety road-worthiness. All vehicles will be fitted with appropriate safety equipment;
- Risks associated with road transport will be managed through the implementation of a Journey Management Plan, detailing actions for improving driver and vehicle safety, enforcement of speed limits at all times, among others;
- The worker accommodation and welfare facilities at Hovsan Port will be established and maintained according to appropriate standards, with good housekeeping practices being enforced; and
- Hazardous materials will be stored in clearly marked containers at safe locations that are fenced and admittance restricted to authorized personnel.

Specific measures to prevent and minimise structural impacts to the local infrastructure and hence interruption to services or damage to public or private buildings or assets will include:

- Pre-survey planning activities will include contacting the relevant authorities to obtain the available information on the locations of existing above and below infrastructure to minimise the risk of physical impact to critical above and below infrastructure (e.g. mains supply pipework);
- Avoiding sites of high sensitivity (cultural heritage sites, sewage and water supply pipe work etc.). Seismic lines will be offset to maintain safety distances from sensitive receptors calculated using relevant guidance and project specific parameters;
- Every effort will be made by the survey team to minimise disruption to local communities and avoid damage to existing infrastructure, assets, structures (whether private, public or historic) and crops. The seismic contractor will be required to maintain a record of any damage that occurs;
- Establishing and implementing a grievance procedure to enable public and stakeholder concerns to be addressed in effective and timely manner; and
- In the event of infrastructure damage being caused by survey activities, appropriate compensation will be paid in line with established BP compensation procedures..

4.8.2 Communications

The seismic survey programme will be diligently planned and potential interference with land and sea users will be minimised through effective communications with the relevant authorities and stakeholders prior to and during the survey. All appropriate permits and compliance conditions will be sought and obtained well in advance of the operations.

A dedicated Government Relations Adviser (GRA) will maintain communications between BP / seismic contractor and relevant governmental bodies, negotiate with different Government sectors and request for assistance from them, if necessary.

The establishment and maintenance of good community relations will be crucial to the success of the operations. The public, including the local community, will be informed of the execution and timing of the work whenever necessary and educated in the hazards associated with the working environment to ensure a safe and smooth operation. Community Liaison Officers (CLOs) will arrange meetings with community leaders, farmers and property owners and will provide information to the local people about the seismic operations, request permission for the seismic team to enter the area, relay information between the seismic crew and the public and address any grievances.

4.8.3 Soft Start Procedure

A soft-start procedure is a process whereby airgun operation is slowly ramped up until the full working capacity is reached. Because power is built up slowly from a slow energy start-up over at least 20 minutes, it is believed that marine mammals and adult fish should have adequate time to leave the vicinity of the seismic operation.

Provided no marine mammals are sighted within the mitigation zone[9] over a period of at least 30 minutes before seismic source activation, a ‘soft start’ procedure of the airguns will commence. If marine mammals are detected within this zone, the soft-start of the seismic sources should be delayed until their passage, or the transit of the vessel, results in the marine mammals being at a distance greater than the mitigation zone distance away from the source. In both cases, there will be a 20 minute delay from the time of the last sighting to the commencement of the soft-start, in order to determine whether the animals have left the area. If marine mammals are detected within the mitigation zone 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.

[9] The area where trained vessel crew keeps watch for marine mammals (and delays the start of activity should any marine mammals be detected). This area is usually defined as 500m from the centre of the airgun array but is dependent on, and informed by, project specific underwater sound modelling.