5 Environmental Description

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5.1 Introduction

This Chapter describes the environmental baseline conditions relevant to the Shallow Water Absheron Peninsula (SWAP) 3D Seismic Survey. The purpose of the chapter is to provide sufficient information to allow the potential impacts of the SWAP 3D Seismic Survey activities to be assessed in accordance with the assessment methodology as set out in Chapter 3 of this Environmental and Socio-economic Impact Assessment (ESIA). The scope and content of this Chapter has therefore been determined based on the anticipated environmental interactions identified during the SWAP 3D Seismic Survey scoping process. As described within Chapter 1 of this ESIA the 3D Seismic Survey Area has been subdivided into five Priority Areas. Seismic survey activities are proposed in all Priority Areas however onshore survey activities will be undertaken in the onshore 3D Seismic Survey Area (within Priority Areas 1, 2 and 3) only as shown in Figure 5.1 below.

This Chapter provides relevant information on the following relating to environmental baseline conditions:

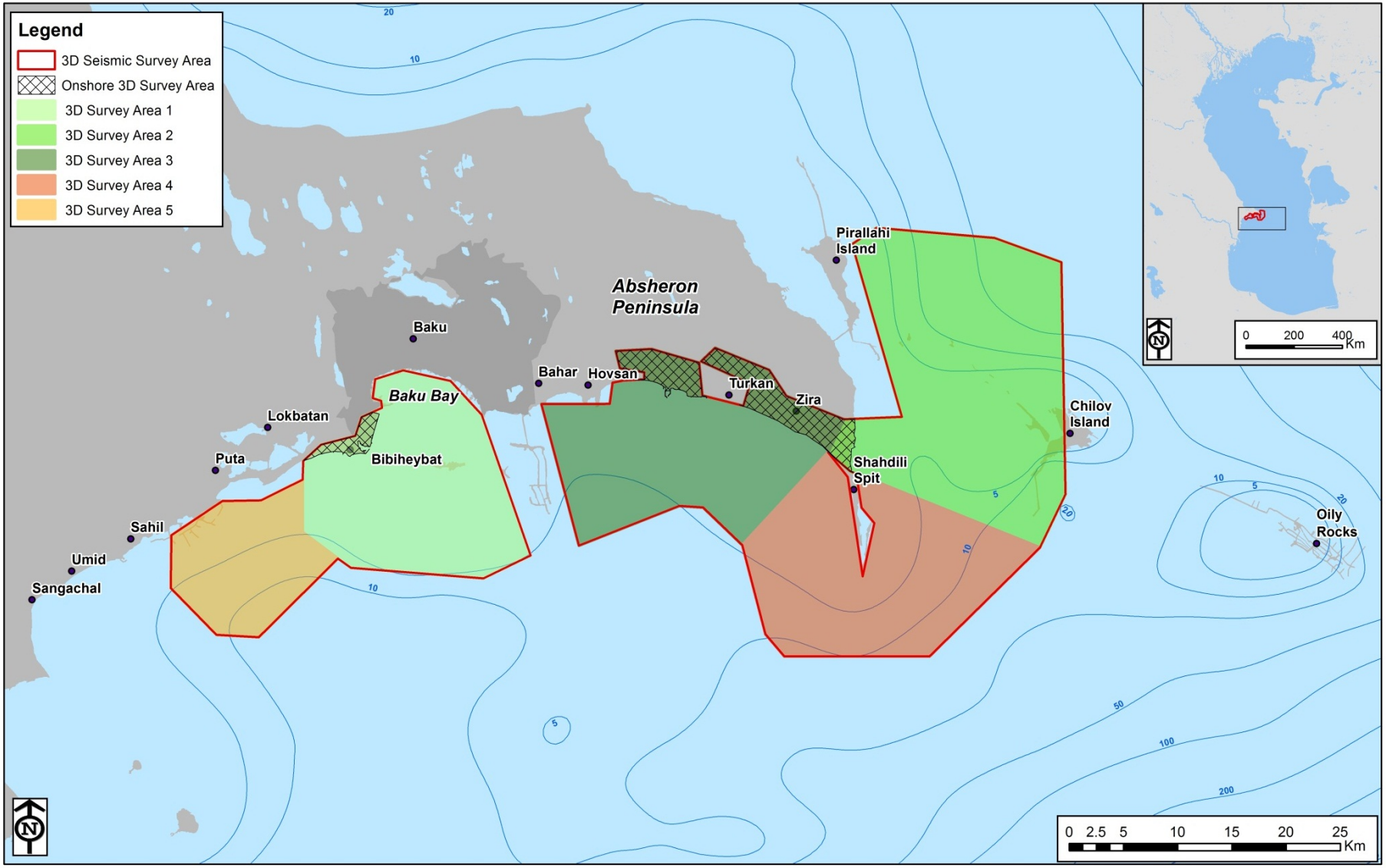
- Physical setting including a summary of seismicity, geology, meteorology and climatic conditions relevant to Caspian region as a whole (i.e. the entire geographic area in which the Caspian Sea is located) and to the 3D Seismic Survey Area;
- Terrestrial environment comprising an overview of the setting, soils and ground conditions, surface and ground water and air quality relevant to the Absheron region and to the onshore 3D Seismic Survey Area (within Priority Areas 1, 2 and 3). Information is also provided on the current background noise environment across the onshore 3D Seismic Survey Area and specifically in the vicinity of the proposed main base and sub bases associated with the 3D Seismic Survey along with an overview of the main habitat types, key flora and fauna, protected species and protected areas present within and in the vicinity of the onshore 3D Seismic Survey Area and along the Caspian Sea coastline;
- Marine environment including an overview of bathymetry and oceanography within the Southern basin of the Caspian Sea in which the 3D Seismic Survey Area is located and within the 3D Seismic Survey Area itself and the summary of the seabed and water column physical, chemical and biological/ecological conditions within the 3D Seismic Survey Area and in the surrounding area including offshore locations known to be of importance for fish and seals (including haul out areas) during sensitive periods (i.e. during migration, spawning and feeding); and
- Cultural heritage comprising a summary of the marine and onshore archaeological and cultural heritage sites known and potentially present within and immediately adjacent to the 3D Seismic Survey Area.

The geographic scope of the data presented has been determined based on the anticipated nature and scale of the potential impacts associated with the 3D Seismic Survey activities onshore and offshore with regional and national information provided where relevant.

The socio-economic baseline conditions relevant to the SWAP 3D Seismic Survey activities are presented within Chapter 6 of this ESIA.

Figure 5.1 shows the location of the SWAP 3D Seismic Survey Area relative to the Absheron Peninsula and the Absheron region, the city of Baku, the man made Oily Rocks industrial settlement and other key coastal locations including the towns of Sangachal, Umid, Sahil Puta, Lokbatan, Bibiheybat, Bahar, Hovsan, Turkan, Zira and Chilov and Pirallahi Islands.

Figure 5.1: SWAP 3D Seismic Survey Area in the Context of the Absheron Region



5.2 Data Sources

This Chapter has been prepared based on the following:

- Review of other available BP and third party ESIAs completed for projects in the Absheron region and in the Azerbaijan sector of the Caspian Sea, specifically within or in close proximity to the SWAP 3D Seismic Survey Area (see Chapter 1 Figure 1.1), including:
    - Azeri Chirag Guneshli (ACG) ESIAs and Environmental Technical Notes (ETNs). The ACG subsea export pipelines connect five production platforms in the offshore ACG Contract Area to the onshore Sangachal Terminal. The ACG subsea pipeline corridor passes to the east and south of the 3D Seismic Survey Area. ACG ESIAs and ETNs reviewed include:
        - ACG Regional Seismic EIA, 2015[1]
        - East Azeri 4D Seismic Survey EIA, 2011[2]
        - Chirag Oil Project ESIA, 2010[3]
        - ACG Phase 1-3 ESIAs, 2002 - 2004[4,5,6]
    - Shah Deniz (SD) ESIAs. The SD Contract Area is located south east of the SWAP 3D Seismic Survey Area, in deeper waters. Currently one operational platform is present in the SD Contract Area, exporting hydrocarbon products to the Sangachal Terminal via the SD1 subsea export pipelines. An additional offshore platform complex, export pipelines and an associated expansion of the Terminal is planned as part of the SD Stage 2 Project. SD ESIAs reviewed include:
        - SD Stage 1 and Stage 2 ESIAs, 2002 & 2013[7,8]
    - Bahar Gum Deniz ESIA[9]. The Bahar Gum Deniz Contract Area is located between the east and west sections of the SWAP Contract Area. An ESIA was prepared to obtain permission to undertake explorative activities (e.g. seismic survey, drilling of an exploration well and geotechnical investigations) and included primary data gathering.
    - Hovsan Wastewater Treatment Plant (WTP) Sea Outfall Construction[10.] Located within the 3D Seismic Survey Area along the coastline adjacent to Hovsan. In 2009 an EIA was prepared associated with the construction of a treated sewage outfall pipeline approximately 9km in length. As part of the EIA a survey was undertaken along the proposed pipeline route extending to 8km offshore to characterise sediment and water quality.
    - AARP III: Large Scale Oil Polluted Land Clean-Up Project[11]. The Bibiheybat oil field, located within the 3D Seismic Survey Area, was selected along with two other locations for remediation works required because of significant historic pollution. An EIA was prepared describing the baseline conditions, the proposed remediation work and to identify potential future uses of the land.

- Primary data provided by SOCAR for seabed and water column biological monitoring surveys undertaken in 2012 and 2014. Those surveys that provide information most relevant to the SWAP 3D Seismic Survey area and in areas where data has not been collected by BP include surveys completed for the Gurgan-Deniz offshore field (located within Priority Area

[1] AECOM, 2015, ACG Regional Seismic Environmental Impact Assessment (EIA)
[2] Azerbaijan Environmental and Technology Centre (AETC), 2011, East Azeri 4D Seismic Survey EIA
[3] URS, 2010, Chirag Oil Project Environmental and Socio-Economic Impact Assessment (ESIA)
[4] URS, 2002, Azeri, Chirag and Gunashli Full Field Development Phase 1 ESIA
[5] RSK, 2002, Azeri, Chirag and Gunashli Full Field Development Phase 2 ESIA
[6] URS, 2004, Azeri, Chirag and Gunashli Full Field Development Phase 3 ESIA
[7] URS, 2002, Shah Deniz Stage 1 Project ESIA
[8] URS, 2013, Shah Deniz Stage 2 Project ESIA
[9] Ekol on behalf of Bahar Energy Ltd, 2012, Bahar Gum-Deniz Project EIA
[10] Seureca-ASPI, 2009, Environmental Impact Assessment Study for Hovsan Wastewater Treatment Plant Sea Outfall Construction
[11] Ministry of Emergency Situations, 2008, Environmental Management Framework for APR I,

2)[12], 8 Mart offshore field (located on the south west boundary of the SWAP 3D Seismic Survey area)[13] and within Baku Bay (within Priority Area 1)[14].

- Primary data provided by the Ministry of Emergency Situations relating to a baseline survey completed for Baku Bay in 2012. The Environmental Baseline Study (EBS) report completed by DHV[15] included the results of a comprehensive sediment and water quality survey (approximately 300 samples) completed in the Bay and its immediate surroundings.

- Primary data held by BP associated with the studies and surveys undertaken to support the BP ESIAs listed above and ongoing operational monitoring data collected as part of the Environmental Monitoring Programme (EMP). The EMP provides a consistent, long-term set of data in the vicinity of BP's operations in Azerbaijan and includes regular monitoring of physical, chemical and ecological characteristics in the marine environment at established sample stations offshore and within Sangachal Bay. In addition terrestrial monitoring is also undertaken (soil, flora and fauna, terrestrial noise, air quality, surface and ground water quality) onshore in the vicinity of the Sangachal Terminal. For the SD2 Project this was supplemented with additional surveys including geotechnical, dust, wetland and archaeological surveys.

- Primary data gathered as part of the Baku Dredge Spoil Site Project[16]. A survey of 10 sample stations undertaken in 2004. The site is located east of Baku Bay.

- Primary data collected during earlier coastal sensitivity mapping exercises completed in 2003[17] and 2014[18].

- Secondary data collected through consultation with local specialists including:
    - Review of available bird data relevant to the 3D Seismic Survey Area and along the Absheron-Gobustan Coastline of the Caspian completed by Ilyas Babayev of Institute of Zoology; and
    - Review of the most recent available data relating to Caspian Seals completed by Tariel Eybatov of Natural History Museum.

- Secondary data collected through consultation with local governmental and other organisations including:
    - The Ministry of Environment and Natural Resources (MENR);
    - Caspian Shipping Company;
    - Institute of Archaeology and Ethnography (IoAE);
    - The Ministry of Culture and Tourism (MoCT);
    - Azerbaijan Committee of Urban Planning and Architecture;
    - Azerbaijan Fisheries Research Institute;
    - The State Oil Company of Azerbaijan Republic (SOCAR); and
    - Temiz Sheher.

- Secondary data and literature publically available on the internet including reports published by Azerbaijan State Committee of Land and Mapping, United Nations Educational, Scientific and Cultural Organization (UNESCO), International Union for Conservation of Nature (IUCN); United Nations Environment Programme Global International Waters Assessment (UNEP / GIWA) and the World Bank.

[12] SOCAR, 2014, Gurgan Deniz Oil and Gas Production Field (part of Absheronneft Oil and Gas Production Field) Biological Survey Report
[13] SOCAR, 2014, 8 Mart Oil and Gas Production Field Biological Survey Report
[14] SOCAR, 2012, Baku Bay Biological Survey Report
[15] Royal Haskoning DHV, 2012. Environmental Baseline Study Baku Bay. Draft report, for the Ministry of Emergency Situations
[16] BP, 2004, Dredged Sediment Disposal Site Assessment Report
[17] AmC & Envision Mapping, 2003, Azerbaijan Coastal Sensitivity Study - Envision Mapping
[18] AECOM, 2014, Azerbaijan Coastal Oil Spill Sensitivity Atlas Mapping Version 1.2

A number of specific surveys for the SWAP 3D Seismic Survey Project have been undertaken to gather additional environmental data. These surveys, undertaken between July and November 2015 included:

- ***Offshore Shallow Water Environmental Survey*** – this survey involved water column and sediment sampling within areas of the 3D Seismic Survey area where there was insufficient data available from other sources. In total 8 water column and 24 sediment samples were taken and physical, chemical and biological analysis undertaken;
- ***Terrestrial Ecology*** – a survey was undertaken along transects within the onshore 3D Seismic Survey Area to provide an overview of typical habitats and the presence and potential presence of protected flora and fauna within the survey area. During this survey, which was supported by local ecological specialists, observations were made with regard to location of surface water features, location of any visible surface contamination and general observations relating to geographic features;
- ***Noise*** - a survey was undertaken at 23 locations across the onshore 3D Seismic Survey Area to allow the baseline noise environment to be characterised. Locations were selected in the vicinity of the proposed base and sub-bases and in locations representative of typical land use areas (e.g. residential, rural, industrial) across the survey area**;** and
- ***Terrestrial Cultural Heritage –*** a survey was undertaken, supported by the archaeologists from the IoAE, to identify the actual or likely presence of potentially important archaeological and cultural heritage sites across the onshore 3D Seismic Survey Area.

The results of the surveys are incorporated into the relevant sections below with supporting information provided within Appendices 5C and 5D**.**

5.3 Physical Setting

5.3.1 Geology and Seismicity

5.3.1.1 Tectonic Setting

The dominant geological structures of the Caspian region were formed during the period of tectonic movement between the Arabian and Indian continental plates that resulted in the formation of the Caucasus Mountains and the associated basin and plateau structures that form the Caspian and adjacent onshore regions. Subsequent periods of tectonic compression (mainly during the Late Pliocene period) resulted in the production of a number of folded structures within the region, forming a number of anticlines (upward thrusting folds).

The Caspian Basin represents one of the largest continental lake systems in the world. The Absheron Ridge, which separates the Southern and Central Caspian Basins (refer to Section 5.5.1 below), is considered to be the sea floor expression of the Absheron-Prebalkhan Uplift Zone, which lies along and defines the northern margin of the South Caspian Basin.

5.3.1.2 Regional Geology

Geological data obtained from surveys undertaken in 2002[4,5] indicated that the area south of Baku Bay is likely to comprise the Pleistocene aged Absheron formations, underlain by the upper Pliocene aged Akchagyl Formation. Deposits from the Absheron and Akchagyl Formations primarily comprise grey to green claystones and marls interbedded with minor layers of siltstones and sandstones. Below these formations are the Pliocene hydrocarbon-producing deposits of the Surakhany (anhydrites), Sabunchi, Balakhany and Pereriv formations.

The Pliocene geological sequence is characterised by the deposition of fluvial deltaic sandstones and lacustrine shales. Fluctuations in lake level (driven primarily by climate change) resulted in rapid large scale avulsion of the Volga Delta and the deposition of laterally continuous lacustrine Shales and sands into a low gradient lacustrine basin. Approximately 8km of sediment was deposited into the basin over six to ten million years during this period.

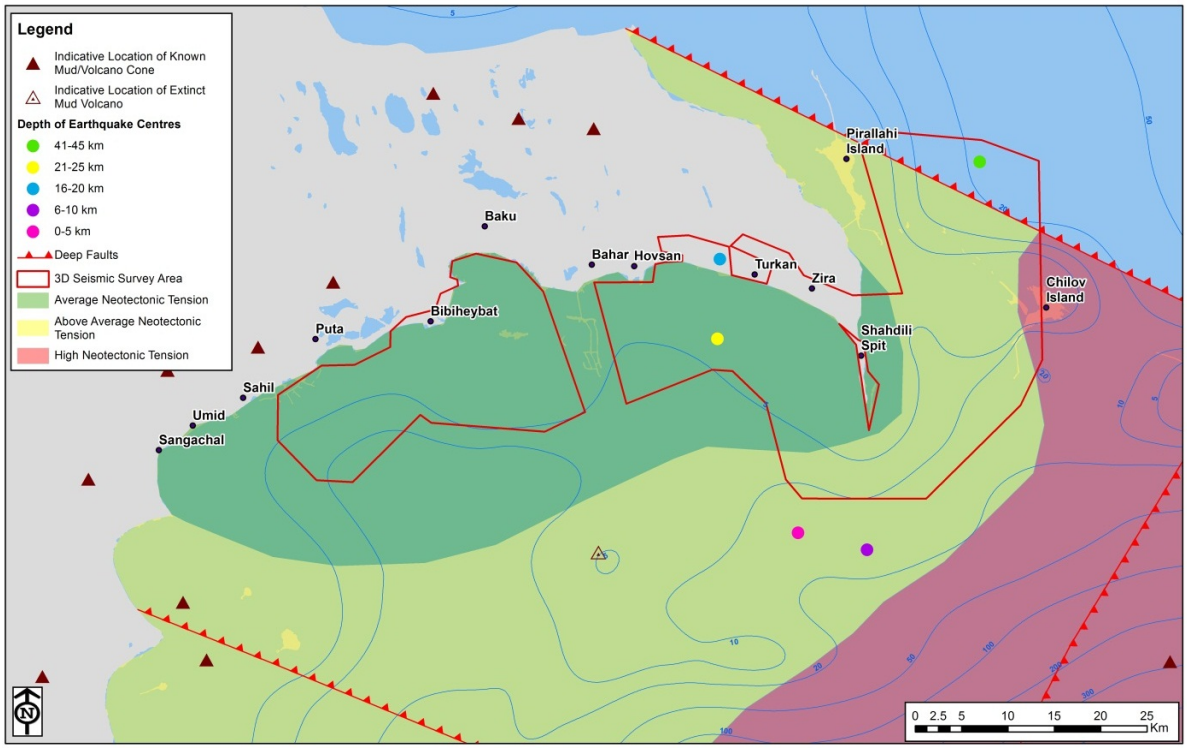
5.3.1.3 Seismicity

The Caspian region, which is part of the Eurasian continental plate, has a convergent plate boundary with the Arabian and Indian continental plates. This has led to the destruction of an ocean (Tethys), which lay, between Eurasia to the north with Africa and India forming its southern shores. The mountain chains of the Alps, Caucasus and the Karakorum/Himalayas are composed of upthrusted rocks formed in, and around, this ancient ocean. Convergent plate movements are associated with relatively high levels of seismic activity and typically accompanied by earthquakes and volcanism.

The Southern Caspian area (in which the 3D Seismic Survey Area is located - refer to Figure 5.2 below) is defined by the Scythian microplate (regional tectonic block), as part of the Russian plate, the Turanian, Iranian and small Caucasian plates, as well as the South Caspian microplate. Current neotectonic (more recent) processes are leading to convergent movements of these plates. Figure 5.2 shows the SWAP 3D Seismic Survey Area is located partially in areas classified as subject to average neotectonic tension. Figure 5.2 shows the SWAP 3D Seismic Survey Area is located partially in areas classified as subject to average neotectonic tension. Figure 5.2 also shows the location and depth of recorded earthquakes within the area[1,19]. Five earthquakes with a magnitude greater than 6.0 on the Richter scale have occurred in Azerbaijan since 1842 with the most recent, measuring 6.5, on 25th November 2000 with an epicentre 30km east-north east of Baku[2,8].

It is estimated that there are more than 170 mud volcanoes located across the Caspian Sea. The indicative locations of known mud volcanoes at the time of writing located within and in the vicinity of the 3D Seismic Survey Area are also shown in Figure 5.2 (including the Makarov Bank which is understood to be an extinct mud volcano). These phenomena are formed as a result of overpressurising of muds and are found most commonly in areas where there are thick, rapidly deposited young sediments. In addition to the basic mud medium, rock fragments, water, gas and oil often erupt from the volcanoes, depositing sediments highly distinguishable from the well sorted clays, silts and sand deposits of the surrounding seabed.

Figure 5.2: Seismic Characteristics in the Vicinity of the 3D Seismic Survey Area, including the Locations of Mud Volcanoes and Earthquake Centres [19,20,21]



[19] AETC, 2011, Shafag Asiman Offshore Block 3D Seismic Exploration Survey Environmental Impact Assessment
[20] Geology data from the State Committee of Land and Mapping. Available at: http://dtxk.azeriland.com/node/1586 Accessed November 2015
[21] Geomorphology data from the State Committee of Land and Mapping. Available at: http://dtxk.azeriland.com/node/1587 Accessed November 2015

5.3.2 Meteorology and Climate

5.3.2.1 Temperature

The climate along the coastline of the Absheron region is classified as being warm and semi-arid. Based on meteorological data collected at Baku and Puta the annual mean air temperature is approximately 14 degrees Celsius (°C). Summers are warm with typical maximum air temperatures in the order 35-40°C. January is the coldest month with an average of 0°C. Temperature extremes of –16°C and 41°C have been recorded historically in January and July, respectively.

Offshore air temperatures exhibit a wide degree of variation. The average air temperatures above the Caspian Sea typically peak at 25.5°C during the summer, and may drop to 0°C for some periods in the winter[22].

5.3.2.2 Precipitation

Based on the rainfall data collected from the meteorological station at Baku, mean annual rainfall from 1992 to 2006 was 263mm. The maximum monthly rainfall from 2002 to 2006 was 184mm in December 2002. October to February were wet months receiving an average of 41 to 79mm rain/month, with drier months occurring from July to August receiving an average of 1 to 5mm rain/month.

5.3.2.3 Wind

In regional terms, the wind conditions are influenced by the north-south orientation of the Caspian Sea as well as the physical and geographical conditions of the coastline. Based on data collected during 2007 at Baku Airport[23] the predominant wind direction in the vicinity of Baku is north, occurring approximately 15% of the year. North-north-westerly and north-north-easterly winds account for approximately 10-12% of other winds. Wind speeds typically range from 0.5m/s to 12m/s with approximately 30% of winds being greater than 8m/s. Strong winds and storms can arise at any time of the year but are more frequent during the winter months with the largest number of days with storm winds of more than 15 m/s occurring on the Absheron Peninsula.

5.3.2.4 Visibility

Moisture saturated air converges in the south-west Caspian giving rise to foggy conditions during the winter months. Such conditions are expected to occur for around 10% of the year, mainly between October and May[24].

5.4 Terrestrial Environment

5.4.1 Setting

The onshore 3D Seismic Survey Area comprises the onshore elements of Priority Areas 1, 2 and 3. The onshore element of Priority Area 1 is located to the south of Baku and includes a mix of predominantly open (mostly highly disturbed), residential land (to the west) and industrial land (the east). The land to the west adjacent to the coastline is situated on a low lying plain which gradually rises, in some areas steeply, moving inland. Badamdar Hill is located in the centre of Priority Area 1; a rocky elevation that rises abruptly from Caspian Sea level to an elevation approximately 218m. To the immediate west of Badamdar Hill is located the man-made South Dock industrial harbour, which is adjacent to industrial facilities including the ATA Construction Yard and the Bibiheybat oil field.

[22] Kosarev, A.N. and Yablonskaya, E.A., 1994, The Caspian Sea. SPB Academic Publishing, The Hague
[23] The anemometer is located 10m above ground level
[24] Wei Shi and Menghua Wang, 2010, 'Characterization of global ocean turbidity from Moderate Resolution Imaging Spectroradiometer Ocean Color Observations'

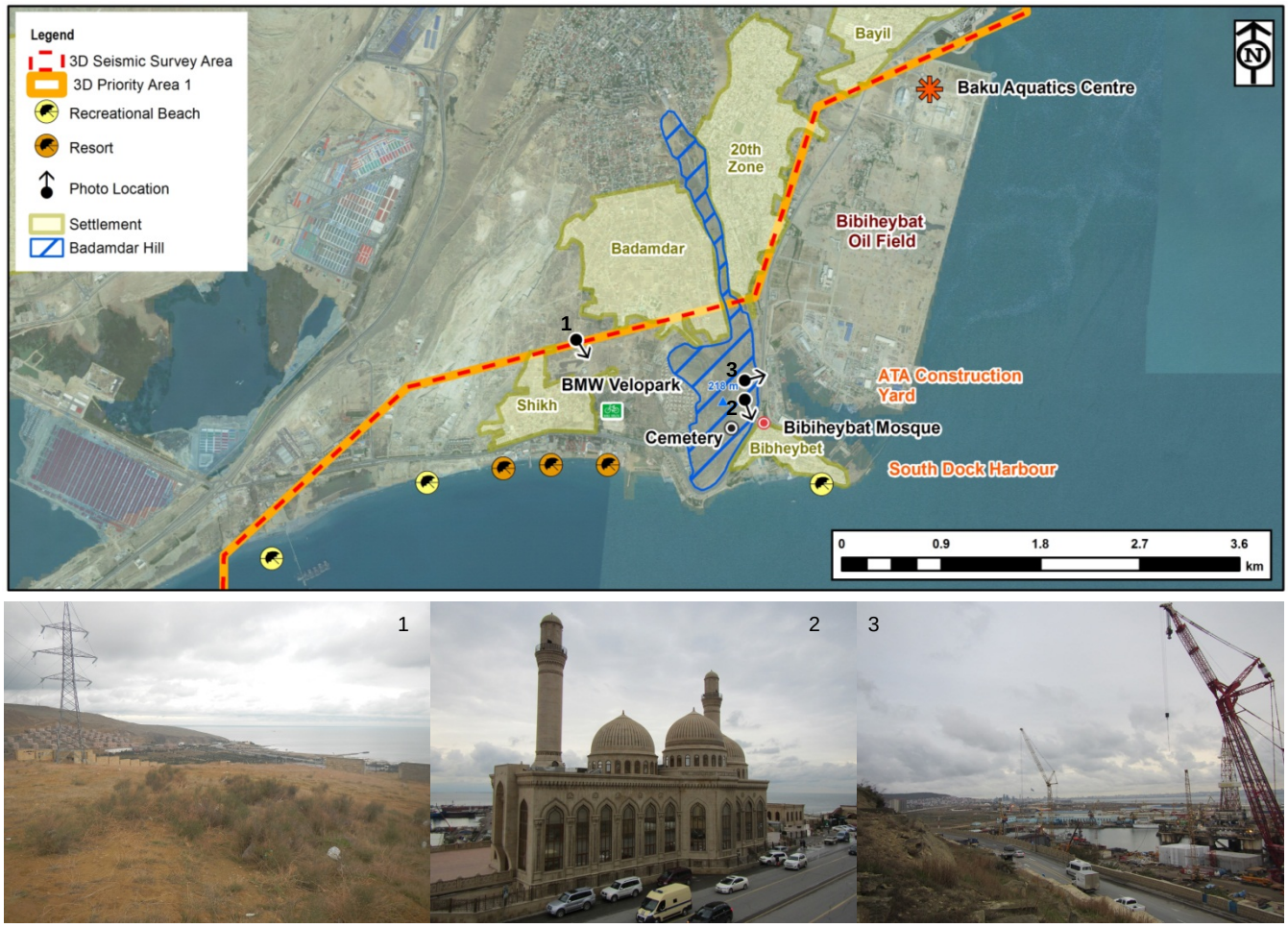
The two main settlements within the onshore element of Priority Area 1 are Bibiheybat (located on a ridge overlooking South Dock Harbour) and Shikh (located immediately adjacent to the coastline to the west). In addition a new residential development is under construction on the western slope of Badamdar Hill, set back from the coastline. Other features (shown in Figure 5.3) include:

- The Bibiheybat Mosque, which overlooks South Dock Harbour, and nearby cemetery;
- A small number of beach resorts and hotels located within and in the vicinity of Shikh;
- A BMX Velopark, located approximately to the west of Badamdar Hill; and
- The Baku Aquatics Centre and park built on remediated land to the far east of the Bibiheybat oil field.

The Baku-Salyan Highway, a major four lane hard surfaced road, runs along the coastline from the south of Azerbaijan, to the east of Badamdar Hill and into central Baku. Access to residential and commercial areas across the Priority Area is via a mix of surfaced and unsurfaced roads.

No major natural or man-made watercourses are located within Priority Area 1; however, ephemeral streams have been observed as well as ponds created by leaking water pipes (refer to Section 5.4.6.1.1 below). It is understood that the main gas and oil pipelines to Baku from the south travel along the coast to Shikh and then divert inland[25]. The potential for and location of other underground pipes is not known.

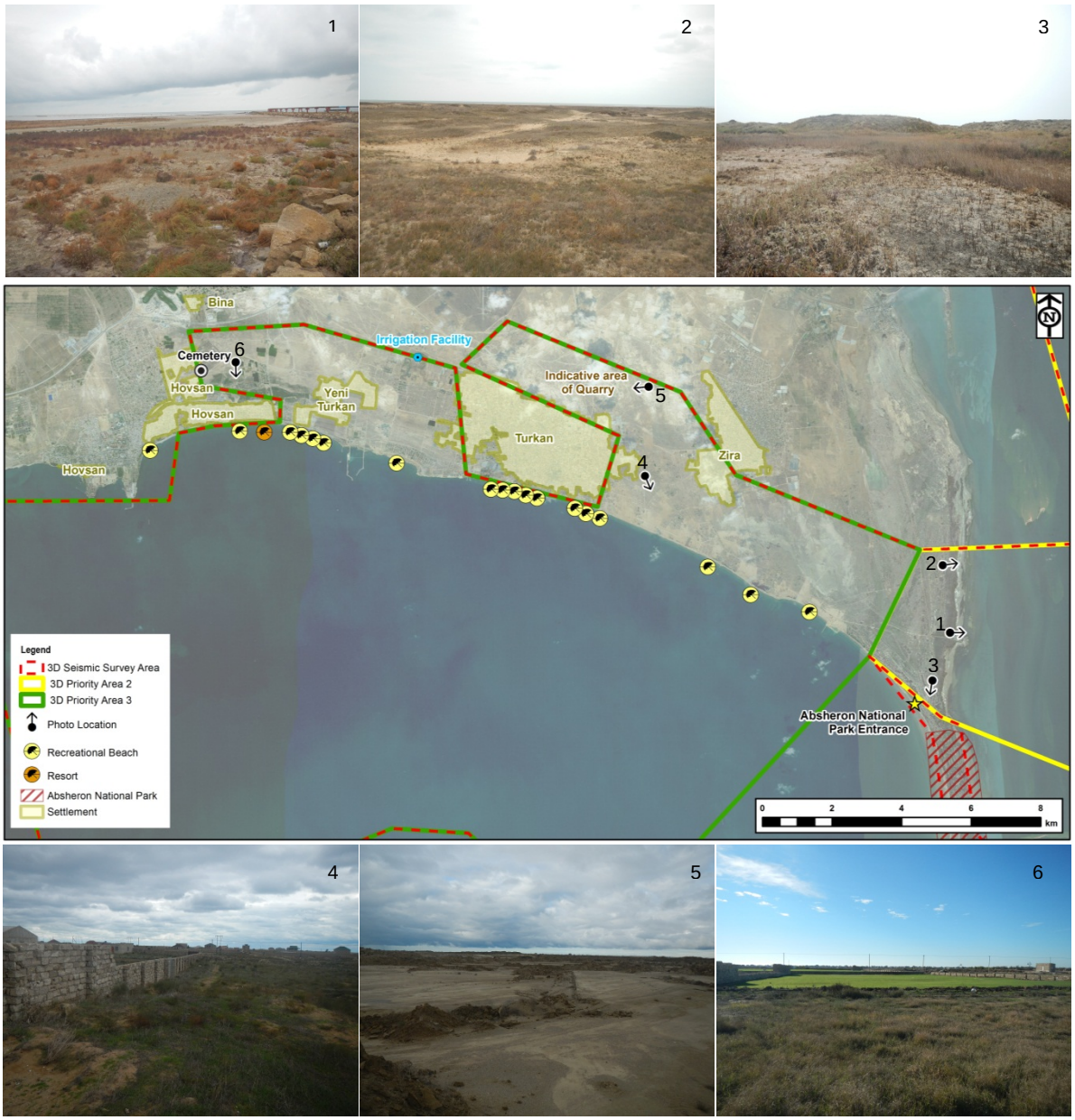
Figure 5.3: Setting and Geographic Features within Priority Area 1



[25] Data from the State Committee on Town Planning and Architecture of the Republic of Azerbaijan, 2015, Maps from the draft Greater Baku Regional Development Plan

The onshore elements of Priority Areas 2 and 3 are located to the west of Baku with Priority Area 2 at the furthest extent of the Absheron Peninsula immediately adjacent to the Absheron National Park (refer to Section 5.4.7.1). This Area is predominantly rural comprising areas of marsh nearest to the coast and sparsely vegetated land moving inland. The land itself is typically flat although a number of man-made pits and mounds are evident. Unsurfaced roads and tracks cross the land and a number of above ground pipelines and abandoned oil exploration infrastructure is visible. One surfaced road passes from Gala and Zira to the north, terminating at the controlled entrance to the Absheron National Park (refer to Figure 5.4). Along the southern coastline an area of land, which also overlaps into Priority Area 3, is fenced for military use.

Figure 5.4: Setting and Geographic Features within Priority Areas 2 and 3



Priority Area 3 comprises a mixture of rural, residential and developed land, which is low lying and flat. Towards the east, the land is characterised by bare or barely vegetated ground. Moving west and inland from the coast is the small town of Zira, which is partially located in Priority Area 3. Further west is the town of Turkan; the majority of which lies outside but surrounded by the boundary of the Priority Area. To the north of Turkan the landscape is generally sparse and there is a large area where rock is quarried. West of Turkan is the settlement of Yeni Turkan, which extends from the coastline inland. Structures within the Priority Area largely comprise small one and two storey brick built houses, agricultural warehouses and small walled agricultural plots. Other features within Priority Area 3 include a cemetery to the far east of the Priority Area, a military area to the west of Yeni Turkan, an irrigation facility and a small number of hotels and beaches along the coastline (refer to Figure 5.4). Existing and abandoned infrastructure (including abandoned oil industry, electricity and water infrastructure) and dumped rubbish is evident across Priority Area 3 with some large contaminated areas noticeable (refer to Section 5.4.2.2 below). Numerous roads, mostly unsurfaced, cross the area in addition to two man made irrigation channels (refer to Section 5.4.3 below).

5.4.2 Ground Conditions, Soils and Contamination

5.4.2.1 Ground Conditions and Soils

As described with Section 5.4.1 above, the onshore 3D Seismic Survey Area comprises large areas of land which is either developed or significantly disturbed by current and past activity. Uses include residential and industrial use, oil and gas exploration and production, quarrying and agriculture. The few areas of natural undisturbed ground are predominantly located within Priority Areas 2 and 3.

Within all Priority Areas, soil conditions towards the coastline (excluding man-made features e.g. riprap, groins, seawalls, hard landscaping) predominantly comprise sand, mixed sand and gravel and areas of rock. Moving inland, in each Priority Area, soil is predominantly formed from alluvium deposits, comprising loose, unconsolidated soils and sediments. Soils are predominantly light grey or grey-brown in colour. Soils have a typically low organic content due to the arid climate and associated limited vegetation growth. High salinity has been recorded in soils in some areas towards the centre of the Absheron Peninsula. The salinity of the soils within the onshore 3D seismic Survey Area is not known.

The landscape is subject to widespread erosion, predominantly associated with oilfield activities in the area. In addition, the lack of vegetation, semi-arid climatic environment and coastal processes have further exacerbated terrestrial soil erosion. Examples of erosion features in the area include the formation of ravines and hillocks due to soil loss and subsequent accumulation in other areas.

5.4.2.2 Contamination

5.4.2.2.1 Overview

Oil and gas exploration has been active in the Absheron region for more than 150 years, focused in and around the Absheron Peninsula. As a result of the historic exploration activities a significant area of the Absheron Peninsula, including the area surrounding Baku, is known to be contaminated. In 2008 it was estimated that approximately 20-22,000 hectares of land was polluted, with hydrocarbon and heavy metal concentrations recorded significantly above typical background levels (from 3 to 60 times higher) at depths of up to 3 metres or more below surface level. This problem has been recognised by the government of Baku who have put in place a programme to rehabilitate and remediate the most polluted areas. One of the areas where remediation has commenced is the Bibiheybat oil field (see below).

Locations where hydrocarbon contamination was encountered and was visible were recorded during the ecology walkover survey undertaken during October 2015. In all Priority Areas surveyed there were small localised areas of hydrocarbon contamination. These were primarily associated with observed pipeline leaks and in the vicinity of abandoned hydrocarbon infrastructure. Two significant area of hydrocarbon contamination were noted within Priority Area 3 in vegetated areas within 2km of Zira (refer to Figure 5.5). In both cases the source of contamination appeared to be associated with a number of abandoned oil wells and associated infrastructure.

Some areas of the Absheron Peninsula are also known include Naturally Occurring Radioactive Materials (NORM). As a result of the historic oil and gas exploration activities radium and associated radon gas is known to have accumulated in isolated areas, in places up to 200 times or more than typical background levels (typically 4 to 10 µR/h) [11,26]. The highest radiation levels have been recorded in the soil substrates at the bottom of ponds and within pipelines where produced water from exploration activities is or has been present[27]. Remediation in areas where high NORM has been recorded (predominantly industrial areas) has been ongoing and has included two former iodine sites on the outskirts of Baku[28].

Figure 5.5: Photos Showing Hydrocarbon Contamination Observed within Priority Area 3 During 2015 Walkover Survey

5.4.2.2.2 Bibiheybat Oil Field

The Bibiheybat oil field, extending across an area of approximately 8km^2, is located within Priority Area 1. Surface and subsurface soils have been heavily polluted for many years with the main cause of the pollution identified as abandoned or poorly decommissioned oil exploration facilities which are evident across the field. Surface hydrocarbons collected in ponds were clearly visible with monitoring confirming highly elevated concentrations of heavy metals (including zinc, lead, arsenic and chromium).

Remediation within the Bibiheybat oil field using mechanical methods and bioremediation commenced in 2009 as part of a wider remediation project across the Absheron Peninsula as a whole and is ongoing[29]. Mechanical methods, suitable for heavily contaminated areas, involved removing the polluted soils to a depth of 1-2 metres and backfilling with clean soils of a similar type and mechanical property. The polluted soils were sent to a specialist facility operated by SOCAR for treatment. To date approximately 5.7km^2 of the field area has been remediated in this way,[30] involving the removal and treatment of approximately 6.2 thousand tons of oil contaminated soils. During the ecology walkover the areas remediated were evident, with ground comprising thick muddy clay. A small number of isolated areas of contamination were noted mostly on the outskirts of the field towards the main highway.

[26] S. Aliyeva, 2004. Radionuclide Contamination Of Natural Environment Of Absheron Peninsula (Azerbaijan)
[27] V.A. Mammadov, 2004, *Radioactivity of lakes in the urbanised territories* in M.K. Zaidi and I. Mustafaev (eds.) Radiation Safety Problems in the Caspian Region, 97-102. Kluwer Academic Publishers, Netherlands
[28] MES, 2008. Absheron Rehabilitation Program Contaminated Sites Rehabilitation Project
[29] Zoi Environment Network, 2013, Waste and Chemicals in Azerbaijan: A Visual Synthesis
[30] Article by the Azerbaijan State Information Agency. Available at: http://azertag.az/xeber/az-801985?device=Desktop Accessed October 2015

5.4.3 Groundwater and Surface Water

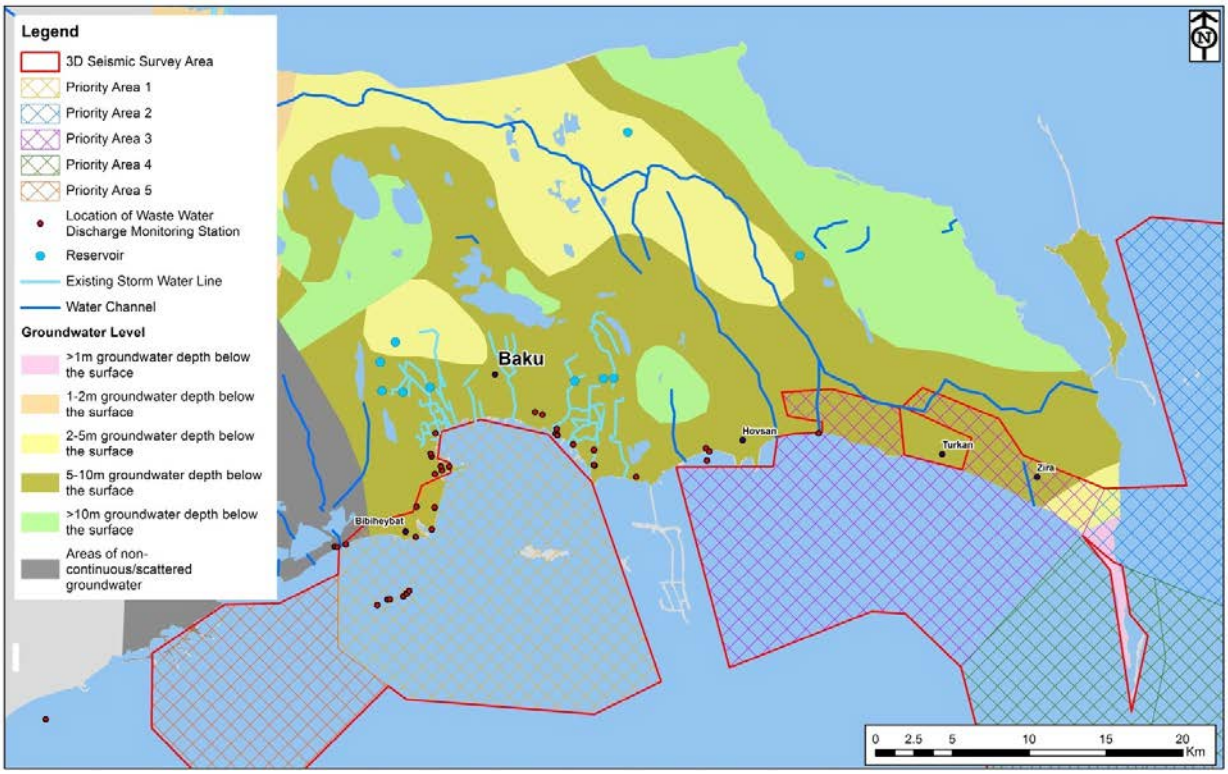
The onshore 3D Seismic Survey Area is located within the Absheron Region of the Greater Caucasian hydrogeological basin. Groundwater bearing strata include fine to coarse sandy and sandy clay units located at depths of approximately 10 – 20m below sea level on sloped near coastal land[9,31]. Along the coastal plain, groundwater depth is typically encountered at 1 – 2m depth and is highly saline. Due to semi-arid climate conditions and high evaporation rates within the region, the groundwater recharge in the area is low[32]. A further source of groundwater in the region is the accumulation of water from leaking sewer pipes, water canals and poorly maintained pressurised distribution networks, into water bearing strata High soil moisture and precipitation evaporation rates, along with mixing of sea water and terrestrial groundwater have resulted in the groundwater being highly mineralised[9,33]. Groundwater therefore does not provide a sustainable source of potable water supply for highly populated areas.

There are no known natural surface water features within the onshore 3D Seismic Survey Area. In addition the irrigation facility noted during the ecology survey (refer to Section 5.4.1) man-made surface water features include two water channels which cross Priority Areas 2 and 3 (Figure 5.6):

- Hovsan Canal: this canal crosses Priority Area 2, originating from the canal system located further inland on the Absheron Peninsula, and flows south to the coast; and
- Samur-Divichi-Absheron Canal: this canal crosses Priority Area 3, originating from near the settlement of Zira; and flowing south to the coast.

It is understood that these are primarily used for irrigation and to collect surface water runoff. Both canals are engineered, hard landscaped channels. Both are regularly monitored at the point of discharge as are a number of industrial and storm water discharges along the coastline of the onshore 3D Seismic Survey Area (refer to Figure 5.6).

Figure 5.6: Ground Water and Surface Water Features Within the Onshore 3D Seismic Survey Area [25,34,31]



[31] MENR Letter, 3 July 2015. Response to a Request for Information from BP. Ref. 4/1009-6.
[32] Fugro Interpretive Report (Draft), Geotechnical Investigation SD2 Project Sangachal terminal, Azerbaijan, October 2011
[33] Howard et al, 2007, Use Of Groundwater Models For Managing Serious Urban Water Issues In Baku, The Capital City Of Azerbaijan
[34] Groundwater data from State Committee of Land and Mapping. Available at: http://dtxk.azeriland.com/node/1573#page/2 Accessed November 2015

5.4.4 Air Quality

Air quality varies across Azerbaijan with higher pollutant concentrations recorded in cities (such as Baku and Sumgayit) due to increased industry and transport emissions than in rural areas. At national level air quality monitoring has been undertaken and reported on an annual basis since 2005 at 26 stations in cities across the country, including nine locations within Baku city including two locations in the in the vicinity of Bibiheybat[35]. Outside of Baku it is understood that air quality in coastal areas of the Absheron region is not routinely monitored except in the vicinity of the Sangachal Terminal located approximately 40 km south west of Baku and 10km south of the 3D Seismic Survey Area.

From the survey data available, air quality along the coastline of the Absheron region is known to be variable with the background NO_2 concentrations in the vicinity of Sangachal Terminal remaining relatively consistent from 2012 to 2014 based on 18 monitoring locations around the Terminal[36](varying between average NO_2 concentrations of 10.4 µg/m^3 and 11.4 µg/m^3, well below the annual average EU standard for NO_2 of 40µg/m^3). In the vicinity of Bibiheybat, concentrations of NO_2 recorded between 2005 and 2013 have varied between approximately 25µg/m^3 and 50µg/m^3 with a concentration of approximately 38µg/m^3 recorded in 2013. Significantly higher NO_2 concentrations (up to 120 µg/m^3)[37] have been recorded within Baku itself. The lower concentrations recorded around Sangachal are due to the relatively rural setting of the Terminal.

As stated within Section 5.3.2.3 above, the predominant wind direction is north. As such, air quality within the Priority Areas 2 and 3 of the onshore 3D Seismic Survey Area located on the Absheron Peninsular are not expected to be affected by the poor air quality within Baku and the relatively rural coastal areas are expected to have relatively good air quality.

The Absheron Peninsular is classed semi arid and land, within Priority Areas 2 and 3 in particular, is generally flat. As described in Section 5.4.6 below, there are bare and sparsely vegetated areas across these Priority Areas where, given their exposed nature, there is significant potential for wind-blown dust. This is particularly the case during summer months when rainfall is infrequent. Dust and particulate levels are not measured on the Absheron Peninsula; however, monitoring data for around the Sangachal Terminal and within Baku indicate average particulate concentrations (as PM_{10}[38]) of 91.8 and 240 µg/m^3 [36,36] 2.5 to 6 times more than the annual average EU standard of 40µg/m^3. Wind blown dust is a known nuisance issue across the region and within Baku and considered typical of such an environment.

5.4.5 Terrestrial Noise

An ambient noise monitoring survey was undertaken between 11th and 14th November 2015 to identify the existing levels of ambient noise across the onshore 3D Seismic Survey Area including at community receptors[39] located within or in close proximity of the onshore 3D Seismic Survey Area.

Survey locations were selected across the onshore 3D Seismic Survey Area at locations considered to be representative of the typical noise environment for the land use type (i.e. urban, rural, coastal or commercial/industrial) and in the vicinity of the proposed main base and sub bases to be used during the 3D Seismic Survey activities. The survey locations are shown in Figure 5.7 below.

[35] MWH, 2014, Air Quality Governance in the ENPI East Countries National Pilot Project – Azerbaijan "Improvement of Legislation on Assessment and Management of Ambient Air" - Draft National Strategy on AQAM, report funded by the European Union

[36] Azecolab and National Physical Laboratory, 2014, Ambient Air Quality Monitoring in the Vicinity of the Sangachal Terminal Annual Report for 2014

[37] Azerbaijan Branch office of Regional Environmental Center for Caucasus, 2014, Air Quality Governance in the ENPI East Countries National Pilot Project – Azerbaijan "Improvement of Legislation on Assessment and Management of Ambient Air" Draft National Strategy on AQAM

[38] Atmospheric air containing dust having particulates with <10 um diameter aerodynamic size distribution

[39] Receptors where a low noise environment is desirable for the use and amenity of these receptors and which may be adversely affected by noise (such as residential dwellings, hospitals, schools, religious sites and community buildings)

Figure 5.7: Noise Monitoring Locations

Table 5.1 presents the noise levels recorded (as $L_{Aeq,T}$[40]) during daytime periods at the monitoring locations. During each survey, weather conditions were fair with no precipitation and wind speeds generally less than 5 m/s[41]. Observations were made throughout the surveys to record the noise sources and identify dominant sources in each location.

Table 5.1: Summary of Noise Levels Recorded During November 2015 Noise Survey

Monitoring Location	Date of Surveys	Nearest Town	Land Use Type	Range of Measured Levels dB $L_{Aeq,5min}$
PRIORITY AREA 1				
1*	11/11/2015	Lokbatan	Urban	72-72
2	11/11/2015	Lokbatan	Commercial/Industrial	65-65
3	11/11/2015	Lokbatan	Coastal	69-69
4	11/11/2015	Bibiheybat	Commercial/Industrial	60-64
5*	11/11/2015	Bibiheybat	Urban	55-55
6*	11/11/2015	Bibiheybat	Commercial/Industrial	56-58
7*	11/11/2015	Bibiheybat	Urban	63-65
			Range of Average Noise Level:	55-72
PRIORITY AREA 3				
8*	13/11/2015	Yeni Turkan	Urban	45-48
10*	13/11/2015	Yeni Turkan	Coastal	54-55
11*	13/11/2015	Yeni Turkan	Rural	61-65
12*	14/11/2015	Zira	Rural	54-58
13	14/11/2015	Zira	Urban	46-48
15*	14/11/2015	Zira	Commercial/Industrial	66-71
21	14/11/2015	Zira	Rural	51-52
17	11/11/2015	Hovsan	Coastal	54-57
18*	11/11/2015	Hovsan	Urban	61-63
22	11/11/2015	Hovsan	Commercial/Industrial	41-43
			Range of Average Noise Level:	41-71
MAIN BASE (HOVSAN)				
16*	12/11/2015	Hovsan	Commercial/Industrial	46-66
SUB BASE (Bibiheybat)				
19	11/11/2015	Bibiheybat	Commercial/Industrial	43-68
SUB BASE (Zira)				
14	14/11/2015	Zira	Commercial/Industrial	56-57
SUB BASE/ Alternative Sub Base (Pirallahi)				
23*	14/11/2015	Pirallahi	Commercial/Industrial	65-70
24*	14/11/2015	Pirallahi	Commercial/Industrial	57-59
Notes: * Locations where traffic counts were undertaken (over 5 minute period) during noise survey.				

The survey results show that average noise levels were generally higher within Priority Area 1 and lower within Priority Area 3. This is to be expected given that there is less urban and industrial development and fewer highway roads in Priority Area 3 in comparison to Priority Area 1. In a number of areas the IFC daytime noise guidance level for residential receptors of 55 dB (L_{Aeq}) were exceeded, primarily due to road traffic.

In urban and commercial/industrial areas, road traffic noise from the use of local roads was identified to be the dominant noise source. Road traffic comprised of mix of cars, LGVs and HGVs. Occasional noise events from airplanes and helicopters was also observed during surveys in the vicinity of Hovsan. The range of average noise levels in commercial/industrial areas across the surveyed locations varied between 41-71 dB (L_{Aeq}). Whereas, in urban areas noise levels varied between 45-72 dB (L_{Aeq}). The highest average levels were recorded in Priority Area 1 where background noise

[40] The equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation that is usually composed of sound from many sources near and far (e.g. road traffic, construction works, animals), within a specified time interval T

[41] Where wind speeds more than 5m/s occurred, the results were disregarded

was dominated by the Baku-Salyan highway. In rural areas, noise sources included traffic from roads in the distance, occasional vehicles passing by on local roads and tracks, and animals. In these areas the range of average noise levels varied between 51-65 dB (L_{Aeq}), with higher average levels recorded in the vicinity of Hovsan during airplane and helicopter flyovers.

The noise environment in coastal areas was dominated by wave noise, with average noise levels at coastal monitoring locations within Priority Areas 2 and 3 varying between 54-57 dB (L_{Aeq}). Higher average noise levels (69 dB (L_{Aeq})) were recorded in coastal areas within Priority Area 1, particularly around Lokbatan, Bibiheybat and adjacent to the proposed sub base location near to Pirallahi. No significant sources of commercial or industrial noise were noted at any location during the noise survey.

With regard to the proposed main base and sub bases the noise levels and main land use type in the vicinity of the locations were:

- Main Base (Hovsan) - Commercial/industrial. Average daytime noise levels of 46-66 dB (L_{Aeq}) were recorded;
- Sub base (Bibiheybat) - Commercial/industrial with adjacent urban and residential development Average daytime noise levels of 43-68 dB (L_{Aeq}) were recorded;
- Sub base (South of Zira) - Coastal/rural. Average daytime noise levels of 56-57 dB (L_{Aeq}) were recorded; and
- Sub Base (Near to Pirallahi) – Coastal/rural. Average daytime noise levels of 57-70 dB (L_{Aeq}) were recorded.

Traffic counts were undertaken at the locations indicated in Table 5.1. The highest traffic numbers (LGVs and HGVs) were recorded at location 18 in an urban area near to Hovsan, where approximately 77 LGVs and 2 HGVs were counted during a five minute period (10:46 – 10:51) during off peak traffic flow.

5.4.6 Terrestrial Ecology

To obtain an overview of the habitats within the onshore 3D Seismic Survey Area (within Priority Areas 1, 2 and 3) and the potential for the presence of protected flora and fauna an ecological walkover survey was undertaken. The survey was undertaken between 28th October and 3rd November 2015 and involved local botany, reptiles and amphibians and mammal specialists from the Azerbaijan National Academy of Sciences. The survey involved travelling along a number of transects within each Priority Area along which habitat types were recorded in addition to the availability and suitability (condition, level and nature of disturbance *etc*.) of areas to support protected flora and fauna. The transects surveyed and the survey results are provided in full within Appendix 5C**.** The sections below summarise the key findings of the survey.

5.4.6.1.1 Habitats

Priority Area 1

As stated within Section 5.4.1 above, Priority Area 1 is situated within an urban setting, principally comprising residential dwellings to the west and industrial units to the east. Much of the land has either been developed or is in the early stages of development.

The coastline, located to the south and east of the main highway, is almost entirely developed and very little natural habitat remains. An above-ground water pipe was identified to the north of (and running parallel with) the highway. Water was observed to be seeping from the pipe and has resulted in the formation of a small ephemeral pond beneath it.

Further inland, situated between residential dwellings and industrial units, a relatively small fragment of as yet undeveloped land was identified on a relatively steep embankment to the east of Shikh. Despite not being developed, large tracts appear to have been extensively disturbed and much of the topsoil has been stripped away. A small but fast flowing ditch was located on the embankment and is likely to be fed by irrigation practices undertaken at higher elevations. This ditch, although likely to be ephemeral, contained marginal vegetation including water reed (*Phragmites australis*). Scattered

patches of semi-natural vegetation were present, particularly on the steep slopes along with recently planted olive plantations. This mosaic of semi-natural habitat, plantation and surface water was assessed by the local specialists to be the only area within Priority Area 1 that could support species listed on the Azerbaijan Red Data Book (AzRDB)[42] and the IUCN Red List of Threatened Species[43], although it was considered unlikely give the surrounding level of disturbance.

To the west, in the Bibiheybat area, recently planted parkland was identified and comprised semi-mature standards of trees set within largely bare ground and enclosed by development.

Within the industrial area between the Bibiheybat oil field and South Dock the remediation works and subsequent planting completed in the last two years (refer to Section 5.4.2.2 above) was evident with large areas of previously developed land having been levelled and planted with sapling trees. At the time of the walkover, the heavily clay-rich soil was largely devoid of ground flora and in parts water-logged. Further east, an existing network of ditches was identified complete with dense stands of marginal vegetation. While it is understood much of the Bibiheybat oil field has been remediated, small accumulations of hydrocarbons in localised areas were observed. The isolated nature of the newly planted areas and ditches are likely to limit the opportunities for future site colonisation.

It was concluded that, given its highly disturbed nature, Priority Area 1 was unlikely to support any threatened or nationally important habitats.

Priority Area 2

Priority Area 2, in contrast to Priority Area 1, comprised large stretches of semi-natural habitat. Although generally more diverse, the area could be divided into two broad categories of relatively homogeneous habitat, namely marshland and semi-arid.

Close to the coast (within 150m), marsh vegetation dominated the landscape including dense stands of water reed and soft rush (*Juncus effusus*). A number of discrete sections of water reed, situated adjacent to an above-ground pipeline, have been flattened or cleared by heavy machinery presumably to enable vehicular access to more remote areas.

Further inland (greater than 150m from the coast), the habitats are more typical of semi-arid landscapes. Sparse, low growing vegetation comprising a range of grass species and woody shrubs dominated the sandy soils. The area is repeatedly bisected by access tracks creating areas of bare ground. A frequently encountered feature of the semi-arid areas were extraction pits and partially vegetated overburden mounds. The pits, excavated to around 5m in depth, supported stands of water reed and/or soft rush, indicative of either surface or sub-surface water. None of the extraction pits contained water during the walked transects despite frequent rains.

Shepherds with large flocks of sheep were observed throughout much of Priority Area 2. Sheep are typically selective grazers, targeting soft vegetation such as flowering plants, which could limit the overall botanical diversity of the area.

Priority Area 3

As discussed within Section 5.4.1, Priority Area 3 comprised residential housing and gardens, industrial units and sparsely vegetated areas of semi-arid habitat.

Much of the western half of Priority Area 3 was situated within an urban setting. A significant proportion of the available land has been, or is in the process of being, developed. Much of that land not currently built on has been stripped of topsoil and divided into plots using small stone walls. On the outskirts of the settlements, and to a lesser extent within, land was being used for agricultural purposes, which included the growing of both edible and non-edible (grass turf) crops. Very little

[42] MENR, Azerbaijan Red Data Book (2015). Available at: http://www.redbook.az/Accessed December 2015
[43] IUCN, 2015, IUCN Red List of Threatened Species. Available at: http://www.iucnredlist.org/ Accessed August 2015

natural habitat was observed within or around the settlements; none of which was considered to be of ecological importance.

Further to the north and east, more natural semi-arid habitats were recorded. Although these areas of sparse vegetation were extensive, they were repeatedly bisected by a network of linear features such as roads, above-ground pipes and overhead power cables. On the boundary of the Priority Area a state-owned irrigation facility that contained large tracts of open water was situated. An area of water approximately 100m by 50m belonging to this facility is located just within Priority Area 3. Further east, historical oil spills in several locations (refer to Section 5.4.2.2 above) appear to have destroyed a large tract of habitat, albeit on a highly localised scale. Despite this, the semi-arid areas observed were assessed as likely to support protected or notable habitats and species.

As with Priority Area 1, much of the habitat situated adjacent to the coastline has been, or is in the process of being, developed. The area supports a high level of industry and very little, if any, natural habitat remains.

5.4.6.2 Flora

During the survey within each Priority Area, floral species either observed during the walked transects or assessed as 'potentially present' by the Azerbaijani botanist (based on geographical region, habitat type and levels of anthropogenic disturbance) were recorded. Table 5.2 presents a summary of survey findings.

Table 5.2: Flora Species Recorded During the Ecological Survey[1]

Location	Total Number of Species Recorded	Number of Species Recorded with Conservation Status	Name of Species with Conservative Species Recorded	Conservation Status
Priority Area 1	56	5	Eldar pine (*Pinus eldarica*)	AzRDB
			Hairy Bird's-foot-trefoil *(Lotus angustissimus)*	IUCN RDB Least Concern
			Oleander *(Nerium oleander)*	IUCN RDB Least Concern
			Common reed *(Phragmites australis)*	IUCN RDB Least Concern
			Saltcedar *(Tamarix ramosissima)*	IUCN RDB Least Concern
Priority Area 2	40[3]	5	Sea Grape (*Ephedra distachya*)	IUCN RDB Least Concern
			Spiny rush (*Juncus acutus*)	IUCN RDB Least Concern
			Common reed *(Phragmites australis)*	IUCN RDB Least Concern
			Annual beard-grass (*Polypogon monspeliensis*)	IUCN RDB Least Concern
			Saltcedar *(Tamarix ramosissima)*	IUCN RDB Least Concern
Priority Area 3	59	10	Iris (*Iris acutiloba*)	AzRDB
			Pomegranate (*Punica granatum*)	AzRDB
				IUCN RDB Least Concern
			Sea clubrush (*Bolboschoenus maritimus*)	IUCN RDB Least Concern
			Sea Grape (*Ephedra distachya*)	IUCN RDB Least Concern
			Common Fig (*Ficus carica)*	IUCN RDB Least Concern
			Spiny rush (*Juncus acutus*)	IUCN RDB Least Concern
			Common reed *(Phragmites australis)*	IUCN RDB Least Concern
			Saltcedar *(Tamarix ramosissima*	IUCN RDB Least Concern
			Common grape vine (*Vitis vinifera*)	IUCN RDB Least Concern

1- Note that these species were either 'Recorded' or 'Likely to be Present' within the Priority Areas.

Of the 155 species recorded, 20 are listed as being of conservation concern as either IUCN "Least Concern" or within the AzRDB. The Eldar pine (*Pinus eldarica*), observed within Priority Area 1, was only recorded within the newly created parkland and is unlikely to occur elsewhere across the onshore 3D Seismic Survey Area.

Within Priority Area 3, a total of 59 species were either recorded or assessed as 'likely to be present'. Of these, two species of plants listed on the AzRDB were recorded, namely an iris (*Iris acutiloba*) and the pomegranate (*Punica granatum*). The iris is typically associated with sparsely vegetated, water-poor ground and occurs throughout the Transcaucasia between 1,500 and 3,000 m. The potential for the species was identified both within and in the vicinity of the quarry area (refer to Section 5.4.1 above). As the survey was undertaken during late autumn, the plant (which is a perennial) would not have been in leaf; however, the AzRDB suggests that it is typically within the particular botanical assemblage identified within the quarry. The pomegranate is a spiny shrub best known for its edible fruit. The species is drought tolerant and has been cultivated throughout in many of the drier regions of Europe and Asia. The occurrence of the pomegranate was strongly associated with the developed towns where it is likely to be planted. In total 9 species recorded were either listed within the AzRDB or as IUCN "Least Concern".

5.4.6.3 Fauna

Reptiles and Amphibians

Reptiles and Amphibians either observed during the survey or assessed as 'potentially present' by the Azerbaijani specialist are summarised within Table 5.3.

Table 5.3: Reptile and Amphibian Species Identified or Potentially Present within the Ecological Survey Area

Species		AzRDB Listed	IUCN Red List Status	Priority Area		
Species name	**Common name**			**1**	**2**	**3**
Priority Area 1						
Bufo viridis	Green toad	No	Least concern	✓	✓	✓
Cyrtopodion caspium	Caspian bent-toed gecko	No	Least concern	✓		✓
Eirenis collaris	Dwarf collared snake	No	Least concern	✓	✓	✓
Emys orbicularis	European pond turtle	**Yes**	**Near threatened**	✓[1]		✓[1]
Eremias arguta	Steppe runner	No	Not assessed	✓	✓	✓
Eumeces schneideri	Berber skink	No	Not assessed	✓		
Macrovipera lebetina	Levant viper	No	Not assessed	✓	✓	✓
Malpolon monspessulanus	Montpellier snake	No	Least concern	✓	✓	
Natrix tessellata	Dice snake	No	Least concern	✓	✓	✓
Ophiscops elegans	Snake-eyed lizard	No	Not assessed	✓	✓	✓
Platyceps najadum	Dahl's whip snake	No	Least concern	✓		✓
Rana ridibunda	Marsh frog	No	Least concern	✓		✓
Telescopus fallax	European cat snake	No	Least concern	✓		✓
Testudo graeca	Spur-thighed tortoise	**Yes**	**Vulnerable**	✓[2]	✓[1]	✓[1]
Eryx jaculus	Javelin sand boa	No	Not assessed		✓	✓
Lacerta strigata	Caspian green lizard	No	Least concern			✓

Notes:
1. Presence suspected/Field sign
2. Confirmed sighting

The majority of species recorded were either listed as IUCN "Least Concern" or "Not Assessed" and not listed in the AzRDB. However, two species of notable reptiles were observed or their presence suspected:

- European Pond Turtle – This species is known to be present across a wide geographic area from Europe to North Africa, however populations are often isolated and numbers appear to be declining rapidly. This species, classified as near threatened, is particularly sensitive to water pollution as well as habitat loss. While largely living in still or slow moving fresh water, the turtle also basks adjacent to water. Mating takes place between March and May and

nesting, on land, between May and July. The young emerge between August and October but can remain where they are buried underground until the spring. Once emerged, the juveniles are highly vulnerable to predation from birds, rodents, snakes and domestic pets. Based on its preferred habitat this species is likely be restricted to ephemeral ponds, man-made canals and reservoirs and small streams located within the onshore 3D Seismic Survey Area.

- Spur-thighed Tortoise[44] – this species, classified as IUCN "Vulnerable", is also found across wide area and is commonly found in dry grassland, scrub, sand dunes and open woods where it feeds upon a range of vegetative matter. The species typically mates during April and May with nesting occurring soon afterwards. The onset of hibernation is dictated by the onset of cooler temperatures and the species burrows beneath bushes or trees[45]. One individual was recorded during the survey however it could within any of the sparsely vegetated, semi-natural fields/areas away from the coastline.

Mammals

Signs of eight mammal species were recorded during the Ecology Survey in Priority Areas 1, 2 and 3 (refer to Table 5.4), of which only the brown hare was observed directly. No mammalian species listed on the AzRDB or listed as threatened by the IUCN Red List were observed or considered likely to be present in the onshore 3D Seismic Survey Area.

Table 5.4: Mammal Species Potentially Present within the Ecological Survey Area

Species		AzRDB Listed	IUCN Red List Status	Priority Area		
Species name	Common name			1	2	3
Allactaga elater	Five-toed jerboa	No	Least concern	✓[1]		✓[1]
Canis aureus	Golden jackal	No	Least concern	✓[1]	✓[1]	✓[1]
Erinaceus concolor	White-bellied hedgehog	No	Least concern	✓[1]	✓[1]	✓[1]
Hemiechinus auritus	Long-eared hedgehog			✓[1]	✓[1]	✓[1]
Lepus europaeus	Brown hare	No	Least concern	✓[2]	✓[1]	✓[2]
Mus musculus	House mouse	No	Least concern	✓[1]	✓[1]	✓[1]
Vulpes vulpes	Red fox	No	Least concern	✓[1]	✓[1]	✓[1]
Meriones libycus	Libyan jirb	No	Least concern		✓[1]	✓[1]
Microtus socialis	Social vole	No	Least concern			✓[1]
Notes: 1. Presence suspected/Field sign 2. Confirmed sighting of one brown hare						

5.4.6.4 Birds

The Caspian region has a high diversity of bird species, with a large number of endemic species present. Migrating and overwintering birds tend to move widely along the Caspian coast. Consequently, at a regional level, the coastal zone of the Caspian Sea has been identified as an area of ornithological importance, supporting both internationally and nationally significant numbers of migrating and overwintering birds. Given Azerbaijan's location within the bird migrating circuit of Europe, Asia and the Middle East a large number of bird species have been recorded, with onshore and offshore areas providing habitats for 347 avifauna species, including 31 species of seabirds[46].

[44] Recent changes to the phylogeny of the *Testudo* genus has resulted in a number of authors referring to the spur-thighed tortoise that inhabits Azerbaijan as *Testudo* (*graeca*) *armeniaca (*Bonin et al., 2006, Turtles of the World). However, the IUCN Red List cites *T. g. armeniaca* as a synonym of *T. graeca*. For clarity, *T. graeca* will be used in this document in line with the IUCN.
[45] Arnold and Overden, 2004, Reptiles and Amphibians of Europe
[46] BirdLife International, 2014, Country profile: Azerbaijan. Available from: http://www.birdlife.org/datazone/country/azerbaijan Accessed August 2015.

The Absheron to Gobustan coastline of the Caspian Sea is an area of international and regional importance providing habitat for breeding, nesting, migratory and overwintering birds. An estimated 128 species of waterfowl and coastal birds have been recorded in this region. Many species of conservation importance, including globally threatened species, species included in Annex I of the EU Birds Directive (2009/147/EC) and birds listed in the AzRDB can be found in this coastal area at some point. Approximately 21 of these species are included in the AzRDB and the IUCN Red List of Threatened Species.

The waters and coastline within the vicinity of the SWAP 3D Seismic Survey Area provide an abundant food source, including small fish (preyed on by grebes, herons, cormorants, gulls, terns and egrets), plants and invertebrates (fed on by grebes, swans, geese, ducks, coot and stints) and large fish and other birds (preyed on by harriers and white-tailed eagles). A total of around 130,000 waterfowl are found in the coastal waters of the Absheron to Gobustan region (refer to Appendix 5B).

The distribution and abundance of birds in the vicinity of the SWAP 3D Seismic Survey Area is subject to significant seasonal changes particularly during the spring and autumn migration periods as birds move between feeding, breeding and overwintering grounds.

The species composition changes sharply during migration periods, leading to the area being highly sensitive during periods of overwintering and migration, (although Shahdili Spit is considered to be sensitive all year around). Birds use these routes primarily for migrating to the southern coast of the Caspian Sea, the Kur-Araz lowland, Turkmenistan, south west Asia and Africa for the winter and then fly north along the same route during spring.

In the autumn, birds nesting in western Russia, Siberia and northwest Kazakhstan migrate south to overwinter in the southern Caspian, south west Asia and Africa. The most active migration period occurs from mid-August until mid-December though this may extend into January depending on the weather. The most active period of migration, when most migrating birds are likely to be travelling through the 3D Seismic Survey Area, is November. The number of birds is directly influenced by the weather conditions, with colder winters bringing greater numbers and species to the region. Following the autumn migration, birds are widespread along the coastline, both on land and at sea.

The spring migration starts in the second half of February and finishes in April with March being the most active period[47,48]. During the autumn migration, data suggests that 51.43% of birds fly along the Caspian Sea coast to the south, 36.64% fly to the south west, while 11.93% of the birds fly from the Pirallahi-Shahdili coastline to the south east. In spring, data suggests that 39.76% of the birds fly to the north, 26.32% to the northwest and 25.50% to the north east[49]. The migration routes in the surroundings of the SWAP 3D Seismic Survey Area are shown in Figure 5.8.

Limited information is available regarding the offshore distribution and abundance of birds in the Southern Caspian Sea. However, a literature review undertaken in January 2010 focused on the number and species of birds observed in surveys between 2002 and 2006 along the coastlines of the Shahdili Spit and Pirallahi Island. This review highlighted that the breeding season of birds in the area begins at the end of April/beginning May and continues until mid-July. At the end of July and beginning of August, the birds leave their nesting places and disperse. During the breeding season, 18 species were recorded along the Pirallahi coastline and 16 species along the Shahdili coastline.

Within and in the vicinity of the 3D Seismic Survey Area are three main areas of particular value to nesting/breeding birds:

- The series of small islands in Puta bay and associated lagoons at the Deep Water Jackets factory supports nearly 1,000 nests, primarily consisting of sandwich tern, common tern and Caspian gull which represent 0.3% of the breeding population of the Caspian coast. This are is located within the Sahil Settlement IBA (refer to Section 5.4.7 below);

[47] Mustafayev G. T., Sadigova N. A., 2005, Azerbaijan Birds (defining monograph) Baku, “Çaşoğlu” publishing house.
[48] Tugayev D. G., 2000, Catalogue of Azerbaijan birds. Elm, Baku.
[49] Karabanova N. I., 1991, Migrations of birds in the northeast part of Azerbaijan. Abstract of a thesis for a degree of Cand. S. {Biology} Kishinyov.

- Gum Zira, Dash Zira, Tava and other small islands in this immediate location (located between Priority Areas 1 and 3) support a regular population of up to 110 pairs of birds. The population mainly comprises common tern (110 pairs) but also includes small numbers of sandwich tern, Caspian gull and slender billed gull; and
- Shahdili Spit and the nearby small islands and platforms offshore support a large population of up to 3,700 recorded breeding pairs which represents 1.5% of the breeding bird population of the Caspian coast. Birds are split by habitat type but include over 1,000 pairs of Caspian gull and large numbers of common and sandwich tern. Also present are little grebe (inland), Eurasian coot, grey heron and little ringed plover. Shahdili Spit is a recognised IBA (refer to Section 5.4.7 below).

Overwintering Birds

Around 50 species of bird are reported to overwinter along the Absheron to Gobustan coastline. The majority are ducks (of the genera *Anas, Netta* and *Aythya*) and coot (*Fulica atra*) but migrating herring, common, black-headed and great black-headed gulls (all of the genus *Larus*) also overwinter in this area. The most sensitive areas for overwintering birds are largely defined by the designated IBAs[50] although the coastline near Turkan and Puta (Figure 5.8) is also reported to be important (refer to Appendix 5B).

The Absheron Peninsula coastlines support particularly high numbers of overwintering birds. During the winter bird surveys between 2002 and 2006, an average of 24873 waterfowl and 181 coastal birds, and 20004 waterfowl and 198 coastal birds were recorded along the Pirallahi coastline and Shahdili coastline, respectively. Table 5.5 presents overwintering birds of importance recorded between 2002 and 2006 along the Pirallahi and Shahdili coastlines. Four species recorded along both coastlines exceeded the 1% limit[51] for the provision of Ramsar status though none of these is considered to be endangered. Four rare and endangered bird species listed in the AzRDB and the IUCN Red List of Threatened Species were also recorded.

Table 5.5: Overwintering Birds of Importance Recorded between 2002 and 2006 in Pirallahi and Shahdili Coastlines

Bird Species		Pirallahi Coastline	Shahdili coastline	Exceeds limit for the provision of Ramsar Status	Red Book of Azerbaijan	IUCN Red List Status
Species name	Common name					
Aythya ferina	Common Pochard	✓	✓	✓		
Aythya fuligula	Tufted duck	✓	✓	✓		
Cygnus cygnus	Whooper Swan	✓	✓			
Cygnus olor	Mute Swan	✓	✓		✓	
Falica atra	Coot	✓	✓	✓		
Numenius arquata	Eurasian Curlew	✓				✓ (NT)
Pelecanus crispus	Dalmatian Pelican		✓		✓	✓ (VU)
Podiceps cristatus	Great Crested Grebe	✓	✓	✓		
Porphyrio porphyrio	Purple Swamphen		✓		✓	

[50] BirdLife International, 2015, Important Bird and Biodiversity Areas (IBAs). Available at: http://www.birdlife.org/worldwide/programmes/important-bird-and-biodiversity-areas-ibas Accessed August 2015

[51] Criterion 6 of the Ramsar Convention states that a wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbirds.

A number of overwintering species, particularly ducks, will dive in shallow waters to feed on small fish and benthic invertebrates on or near the seabed. Wading birds also feed in coastal waters but, with the exception of the beak, remain above the water during feeding.

There are no duck or gull species of conservation concern thought to be overwintering in or in the vicinity of the 3D Seismic Survey Area although the ferruginous duck (*Aythya nyroca)*, is listed as Near Threatened (NT) on the IUCN Red List of Threatened Species.

During the ecology walkover completed between 28th October and 3rd November 2015 within the onshore 3D Seismic Survey Area, incidental sighting of birds were recorded. None of the bird notable species described within Table 5.5 were observed.

Migrating Birds

Survey work completed between 2002 and 2006 during the spring migration identified 19 and 29 bird species in the coastal waters of Pirallahi Island and the Shahdili coastline, respectively. In total, seven species recorded between 2002 and 2006 exceeded the 1% limit established for the provision of Ramsar status. During the same period, five endangered species were also recorded (Table 5.6).

Table 5.6: Migrating Birds of Importance Recorded between 2002 and 2006 in Pirallahi and Shahdili Coastlines

Bird Species		Pirallahi Coastline	Shahdili coastline	Exceeds limit for the provision of Ramsar Status	Red Book of Azerbaijan	IUCN Red List Status
Species name	Common name					
Aythya ferina	Common Pochard	✓	✓	✓		
Aythya fuligula	Tufted duck		✓	✓		
Aythya nyroca	Ferruginous Duck		✓			✓ (NT)
Cygnus Cygnus	Whooper Swan		✓	✓		
Cygnus columbianus	Tundra Swan		✓	✓	✓	
Cygnus olor	Mute Swan	✓	✓	✓	✓	
Netta rufina	Red-crested pochard		✓	✓		
Pelecanus crispus	Dalmatian Pelican	✓	✓		✓	✓ (VU)
Podiceps cristatus	Great Crested Grebe	✓	✓	✓		
Phoenicopterus roseus	Greater Flamingo		✓		✓	

None of the notable bird species listed in Table 5.6 were observed during the ecology walkover survey within the onshore 3D Seismic Survey Area.

Specific areas of importance for overwintering birds in the vicinity of the3D Seismic Survey Area include the Sahil Settlement, Shahdili Spit and Absheron archipelago (north) and Pirallahi Bay IBAs in addition to offshore areas near to the coastline of approximately 2-3km^2 in the vicinity of Hovsan and Turkan. These are the specific locations where the number of birds have been recorded in exceedance of the 1% threshold for Ramsar status.

Nesting Birds

The coastal area of the Absheron region is also important for nesting migratory seabirds, in particular the Mediterranean gull (*Larus melanocephalus)* (listed in the AzRDB) and the slender-billed gull *(Larus genei)* and a number of tern species (of the genera *Sterna*, *Chlidonius* and *Hydroprogne*). There are key areas for nesting birds include:

- **Pirallahi Island and other nearby islands (Tava, Koltis, Urinos, Yal and Garabatdag)** – These islands fall within the Absheron archipelago (north) and Pirallahi Bay IBA and comprise a mixture

of habitats for nesting birds including areas of open dry land, wet sandy areas, pilled shells and rocks and disused oil rigs. The specific areas used include:

- Pirallahi Island: the majority of this island does not provide suitable habitat for nesting birds due to the presence of built up areas and oil fields. Nesting birds focus on the reed beds, open swaps and disused oil rigs primarily along the south western edge of the island.
- Tava and Koltis Islands: birds nest on existing platforms and include the (*Larus cachinnans* and *Sterna hirundo*).
- Garabatdag Island: this island provides both natural sandy areas for nesting and disused oil rigs located in the water. *Sterna hirundo* nest within the sandy area and *Phalacrocorax carbo* and *Larus cachinnans* nest on the disused rigs.
- Yal Island: the island itself along with disused oil rigs in the surrounding water provides suitable habitats for nesting birds. 4 species are known to nest on the island: *Phalacrocorax carbo*, *Larus cachinnans*, *Sterna hirundo* and *Sterna albifrons*.

Key periods for all the areas/islands range from April to July. 0.1% (985 individuals) of the total number of birds nesting on the Caspian coastline nest on these islands. Other islands in this vicinity (including Chilov Island) are not important for nesting birds as suitable habitat is not available.

- **Puta Bay (including lagoons near the Deepwater Jacket Factory)** – located within the Sahil Settlement IBA and comprises lagoons, open dry lands, wet sandy area, and areas of piled shells. Birds know to use this area include *Larus cachinnans*, *Larus genei, Sterna hirundo* and *S.sandvicensis*).
- **Gum Zira, Dash Zira, Boyuk Zira, Tava and Khanlar islands** – located to the immediate south of Baku and comprising open dry lands, rocky, gravelly places, piled shells and wet sandy areas. Also includes an area of long reeds approximately 1 to 2m wide and between and 60 to 70m.
- **Shahdili Spit -** The Shahdili Spit, a designated IBA, comprise a mixture of habitats for nesting birds including areas of open dry land, wet sandy areas, rocky areas, reeds and marshes. A wide variety of nesting species are known to use the area (primarily terns and gulls but also wading birds including plover and avocet, herons, grebes and coots). One nesting species of conservation importance (pied avocet) has been recorded in this area.

Some species, particularly terns (of the genus *Sterna*), are specialist plunge divers taking fast moving prey by diving into the water from height. Non-specialist feeders like the gulls may also dive to feed but do so with less skill and from lower height. Most gulls are more reliant on surface feeding catching krill or small fish that have been concentrated by marine currents. Thus, there may be diving birds feeding in waters within or close to the SWAP 3D Seismic Survey Area during the nesting season.

Marsh harrier (*Circus aeruginosus*), skylark (*Alauda arvensis*), crested lark (*Galerida cristata*) and meadow pipits (*Anthus pratensis*), all species of no conservation concern, were recorded in coastal areas during the ecology walkover survey within the onshore 3D Seismic Survey Area. Further inland and typical of bird assemblages associated with urban spaces, species recorded in Priority Areas 1 and 3 included hooded crows (*Corvus cornix*), rooks (*Corvus frugilegus*), feral pigeon (*Columba livia*) and house sparrows (*Passer domesticus*). Small flocks of linnets (*Carduelis cannabina*) were recorded on the outskirts of the towns, principally where crops were being grown. None of these species are of conservation concern.

Species of Conservation Importance

Table 5.7 list the 21 species of bird of conservation importance (included on the IUCN Red List or listed in the AzRDB) known to be present along the Absheron to Gobustan coastline (predominantly migratory and overwintering birds). It is unlikely all 21 species of notable birds would be present at any one time.

Table 5.7: Bird Species of Conservation Concern Observed on the Absheron to Gobustan Coastline

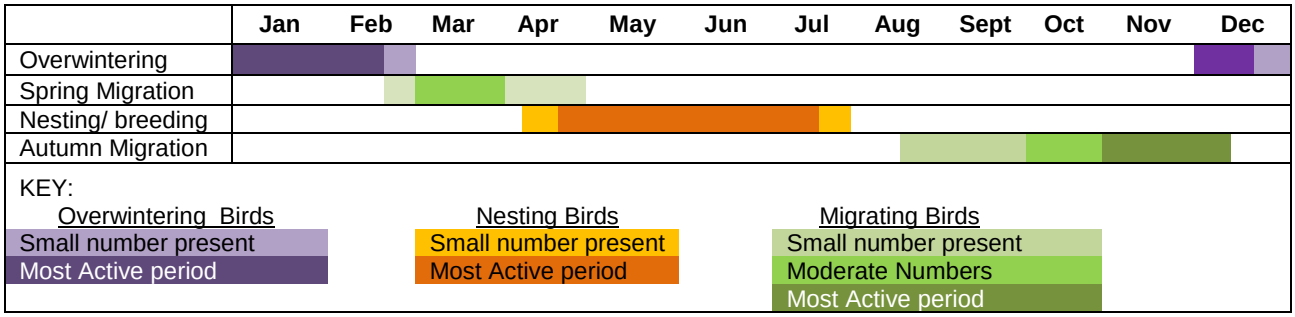
Species*	Common name	Red Book of Azerbaijan	IUCN Red List of Threatened Species
Anser erythropus	Lesser White-fronted Goose	✓	✓ (VU)
Aythya nyroca	Ferruginous Duck	✓	✓ (NT)
Branta ruficollis	Red-breasted Goose	✓	✓ (EN)
Chetusia gregaria (or Vanellus gregarious)	Sociable Lapwing	✓	✓(CE)
Crex crex	Corncrake	✓	
Cygnus olor	Mute Swan	✓	
Gallinago media	Great Snipe	✓	✓ (NT)
Glareola nordmanni	Black-winged Pratincole	✓	✓ (NT)
Leucogeranus leucogeranus (or Grus leucogeranus	Siberian Crane		✓(CE)
Limosa limosa	Black-tailed Godwit		✓ (NT)
Marmaronetta angustirostris	Marbled Teal	✓	✓ (VU)
Melanitta fusca	Velvet Scoter	✓	✓(EN)
Numenius arquata	Eurasian Curlew		✓ (NT)
Numenius tenuirostris	Slender-billed Curlew		✓ (CE)
Oxyura leucocephala	White-headed Duck	✓	✓ (EN)
Pelecanus crispus	Dalmatian Pelican	✓	✓ (VU)
Pelecanus onocrotalus	Great White Pelican	✓	
Phoenicopterus ruber	Greater Flamingo	✓	
Porphyrio porphyrio	Purple Gallinule or Purple Swamphen	✓	
Vanellochetusia leucura (or Vanellus leucurus)	White-tailed Lapwing	✓	
Larus melanocephalu	Mediterranean gull	✓	

IUCN: CE - critically endangered; E – endangered; VU – vulnerable; NT – near threatened.
*With the exception of the nesting *Larus melanocephalu* all birds are migratory or overwintering.

Summary of Bird Sensitivity

A summary of seasonal sensitivity relating to birds known to be present within and in the vicinity of the 3D Seismic Survey Area is presented within Figure 5.8.

Figure 5.8: Summary of Bird Sensitivity



5.4.7 Protected Areas and Sites of Ornithological Importance

In total there are eight National Parks, 11 State Nature Reserves and 24 Sanctuaries designated within Azerbaijan primarily for the protection of wildlife. Those protected sites which are closest to the SWAP 3D Seismic Survey Area are listed within Table 5.8 and shown within Figure 5.9.

In addition, Table 5.8 also summarises the Important Bird and Biodiversity Areas (IBAs) which are located in vicinity of the SWAP 3D Seismic Survey Area. In a number of cases, some areas are

designated as both protected areas and Sites of Ornithological Importance, although the area under each designation may slightly differ.

Table 5.8: Azerbaijani Protected Areas and Sites of Ornithological Importance In the Vicinity of the SWAP 3D Seismic Survey Area

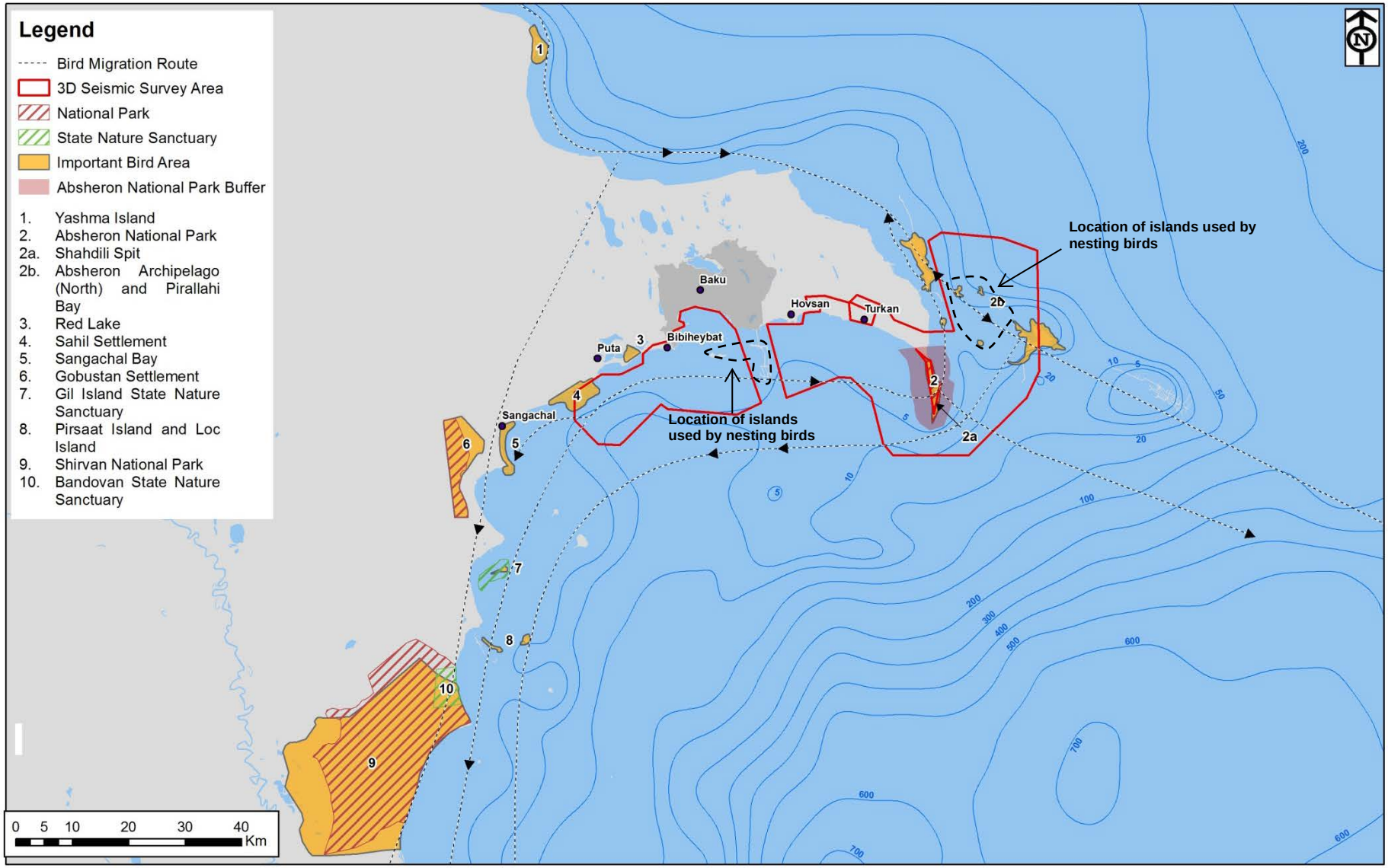
Protected Areas/ Sites of Ornithological Importance		Nearest Distance to the SWAP 3D Seismic Survey Area	Protected Area	Site of Ornithological Importance	Designation	Reasons for Designation
1	Yashma Iland	75 km		✓	KBA[1]/IBA[2]	Important area north of Absheron Peninsula used as stop over and wintering area for several species of waterbirds. It is one of the few locations where the critically endangered Slender-billed curlew (*Numenius tenuirostris*) has been observed[52].
2	Absheron National Park (including Shahdili spit and Pirallahi Island)[6]	Adjacent	✓	✓	KBA/IBA IUCN Category II[3]	IUCN II - In 1969 the area was established as a Nature Reserve to protect, amongst others, the endangered Caspian seals and water birds of international importance. It was later designated as a National Park in 2005. Approximately 46 RDB species occur within and in the surroundings of the national park. KBA/IBA - The area is important for overwintering and migrating bird species.
3	Red Lake	0.5 km		✓	KBA/IBA	Significant populations of globally threatened bird species are known to occur here. The area is important for breeding bird species.
4	Sahil Settlement	Adjacent		✓	KBA/IBA	Significant populations of globally threatened bird species are known to occur here. The area is important for overwintering and migrating bird species.
5	Sangachal Bay	11 km		✓	KBA/IBA	The area is important for overwintering and migrating bird species.
6	Gobustan Area	17 km		✓	KBA/IBA IUCN not reported[4]	KBA/IBA - Populations of globally threatened bird species are known to occur here. The area is important for breeding bird species.
7	Gil Island (or Glynanyi Island) State Nature Sanctuary	27 km	✓	✓	KBA/IBA IUCN Category IV[5]	IUCN IV - The Sanctuary was designated in 1964 due to its importance for migratory and wintering waterfowl birds, sea-gull colonies and Caspian seals[53]. Two RDB species occur in the area. KBA/IBA - The area is important for breeding bird species.
8	Pirsagat Island and Loc Island	36 km		✓	KBA/IBA	Populations of globally threatened bird species are known to occur here. The area is important for breeding bird species.
9	Shirvan National Park	47 km	✓	✓	KBA/IBA IUCN Category II	IUCN II - In 1969 the area was established as Shirvan State Reserve, focused to protect one of the world's largest population of Persian gazelle (*Gazella subgutturosa*) and its rich water-wading ecosystem. The wetlands are considered as an important site for many valuable bird species, used for nesting, migration routes and wintering area. It was later designated as a National Park in 2003. Approximately 56 threatened species occur in this area. The Park also comprises underwater archaeological sites associated with the ancient town of Bandovan[54]. KBA/IBA - Significant populations of globally threatened bird species are known to occur here. The area is important for overwintering and breeding bird species.
10	Bandovan (or Byandovan) State Nature Sanctuary	47 km	✓		IUCN Category IV	In 1961 the area was designated as a Sanctuary for the protection of the Persian gazelle, the little bustard (*Otis tetrax*) and waterfowl birds[55]. The area is also a potentially important site for Caspian seals.[43,56]

[52] BirdLife International, 2015, Important Bird and Biodiversity Area factsheet: Yashma Island. Available at http://www.birdlife.org Accessed November 2015
[53] MENR, State Nature Sanctuaries. Available at http://www.eco.gov.az/en/b-yasaqliq.php Accessed November 2015
[54] MENR, Specially Protected Nature Areas of Azerbaijan. Available at https://www.cbd.int/doc/nbsap/nbsapcbw-eur-01/nbsapcbw-eur-01-az-01-en.pdf Accessed November 2015.
[55] MENR, State Nature Sanctuaries. Available at http://www.eco.gov.az/en/b-yasaqliq.php Accessed November 2015
[56] SSPA, 2011, Seal Special Protected Network Final Report. CaspEco Project. University of Leeds

Protected Areas/ Sites of Ornithological Importance	Nearest Distance to the SWAP 3D Seismic Survey Area	Protected Area	Site of Ornithological Importance	Designation	Reasons for Designation

Notes:
[1] Nationally identified sites of global significance that address biodiversity conservation at a local scale (individual protected areas, concessions and land management units). Key Biodiversity Areas (KBAs) comprise an 'umbrella' which includes globally important sites (e.g. Important Bird Areas (IBAs), Important Plant Areas (IPA), Important Sites for Freshwater Biodiversity, Ecologically & Biologically Significant Areas (EBSAs) in the High Seas, Alliance for Zero Extinction (AZE) sites).
[2] IBA are key sites for the conservation of bird species, identified by BirdLife International. These sites are small enough to be conserved in their entirety, and are different in character or habitat or ornithological importance from the surrounding area.
[3] The main objective of a national park (IUCN Category II) is to protect functioning ecosystems, rather than focussing on protecting a particular species or habitats through management of the reserves thus prioritising these species or habitats which would come under IUCN category IV
[4] A nationally protected area as listed by the World database on protected areas, but with an unknown IUCN category.
[5] Category IV refer to Habitat/Species Management Area. It aims protecting a particular species or habitats and its management prioritise these species or habitats.
[6] Comprises two adjacent IBAs: Shahdili Spit and Absheron archipelago (north) and Pirallahi Bay shown as 2a and 2b within Figure 5.8

Figure.5.9: Protected Areas and Important Ornithological Sites Located on the Southwest Caspian Coast and Bird Migration Routes



5.4.7.1 Absheron National Park

The Absheron National Park (ANP) (an IUCN Category II protected area) is located within the Shahdili territory on the south-east part of the Absheron Peninsula; it's Buffer Zone extends 3km offshore and 2km onshore.

The ANP was established by Order 622 of the President of Azerbaijan on 8th February 2005 for the protection of the environment, the preservation of endangered rare fauna and flora species and the development of ecotourism[31,57]. According to its regulations, the Park land use is limited for scientific research and environmental protection purposes[58], although educational and cultural practices (ecotourism, site visits) are also permitted. The park is surrounded (both onshore and offshore) by a buffer zone, which aims to protect its habitats (refer to Figure 5.9). Land use or resource use within this buffer zone is controlled and any activity liable to create impacts on the ANP area is strictly prohibited.

Over 50 animal species and approximately 25 plant species have been registered in the Park, many of them rare and endangered. Fauna reported to be present includes reptiles and amphibians such as Green toad and Common toad, Marsh frog and Lake frog, Spur-thighed tortoise and Caspian tortoise, Gecko, Lizard, Blant-nosed viper and Water snake. Mammals reported to be present include Bobcat, Common hare, Wild rabbit, Wolf, Jackal, Fox, Racoon, Badger and a variety of rodents including Crested porcupines. Within the last two years it is understood that the Goitered gazelle have been reintroduced to the Park and the population has been observed to be increasing.

As stated on Absheron National Park website (maintained by the MENR), flora species under conservation status known to be present in the ANP include the Sand plantain (*Plantago indica L.),* Saltcedar (*Tamarix ramosissima),* Common reed *(Phragmites australis)*, Spiny rush (*Juncus acutus*) and Sea Grape (*Ephedra distachya*). Fauna species known to be present and listed under the IUCN Red List include the Vulnerable Goitered gazelle (*Gazella subgutturosa*) and the Spur-thighed tortoise (*Testudo graeca*), the Endangered Caspian seal (*Phoca caspica*), the Least Concern the Caspian bent-toed gecko (Cyrtopodion caspium) and the Golden jackal (*Canis aureus*).

Among the birds species known to be present in the ANP, the greater flamingo (*Phoenicopterus roseus*), the mute swan (*Cygnus olor*) and the tundra swam (*C.bewickii*) are listed in the AzRDB. The ferruginous duck (*Aythya nyroca*) and the Dalmatian pelican (*Pelecanus crispus*) are listed in the IUCN Red List of Threatened Species.

5.5 Marine Environment

5.5.1 Bathymetry and Oceanography

The Caspian Sea is the largest landlocked water body on earth with a surface area of approximately 371,000km^2. It is fed by numerous rivers; the largest of which is the Volga to the north. The Sea is made up of three basins: the Northern, Central and Southern Basins (refer to Figure 5.10). The Northern Basin is the smallest (about 25% of the total surface area), but is very shallow. The Central and Southern Basins have similar surface areas, but the Southern Basin is deeper and contains almost twice the volume of water as the Central Basin. The deepest recorded depth is in the Southern Basin at just over 1,000m.

The Absheron Ridge, which separates the Central and Southern Basins, is a narrow section of relatively shallow water (between 50 to 300m deep) which extends from Absheron Peninsula to the Khazar Peninsula on the east coast of Turkmenistan. The SWAP 3D Seismic Survey Area is located within the Southern Basin, within a shallow subsea plateau that gently slopes offshore from the coast

[57] MENR, Absheron National Park. Available at http://www.eco.gov.az/en/ab-milli%20parki/ Accessed October 2015
[58] Decree N. 227, 27 April 2004, Absheron National Park. Available at http://www.eco.gov.az/biomuxteliflik/esasname-mp/absheron-mp.doc (in Azeri) Accessed November 2015

to a distance of approximately 20 to 35 km offshore. The SWAP 3D Seismic Survey Area includes a small section of the Absheron Ridge.

Figure.5.10: Location of the Northern, Central and Southern Basins of the Caspian Sea[59]

The Caspian Sea experiences significant short term and long term water level fluctuations and is one of the few water bodies in the world where the water level is lower than that of the world's oceans. While sea levels were observed to fall between the 1930s and 1970s, in 1978 they had increased before falling again up to 1996. More recent measurements between 2002 and 2006[60] showed that the Caspian Sea level is again rising at a mean rate of +7.5 cm/year. The continued rise in sea levels has resulted in the inundation of low-lying areas, the formation of lagoons, and the development of islands. The current water level is approximately 27-28m below sea level.

5.5.1.2 Wave and Current Regime

Wind induced waves are a predominant feature of the Southern Caspian. Storms in the Caspian region blow along a north-westerly/northerly axis, although the Absheron Peninsula shelters most of the 3D Seismic Survey Area from the most severe of these storms. A large gradient in extremes of

[59] Aladin, N. and Plotnikov I., 2004, The Caspian Sea. Lake Basin Management Initiative, Thematic Paper
[60] Lebedev S. and Kostianoy A., 2006, Satellite Altimetry of the Caspian Sea

waves also exists across the region. A maximum wave height of 14m in the Southern Caspian Basin has been recorded[61]. During normal wind conditions wave heights are generally less than 1m.

The Caspian is effectively a non-tidal water body, and any currents are primarily wind generated. Currents of the region are complicated and are affected by season with lower current speeds measured during summer as compared to winter. The severity of winter also affects current speeds and currents may be strong at both the surface and near the sea bed.

The predominant direction of the strong currents is from the north east. The currents may act from surface to seabed, or surface flows may differ from the deep water flows whereby strong currents may act in either layer. The currents may be driven directly by local weather events or by distant forcing mechanisms. In the latter case the currents may occur during periods of unremarkable local weather.

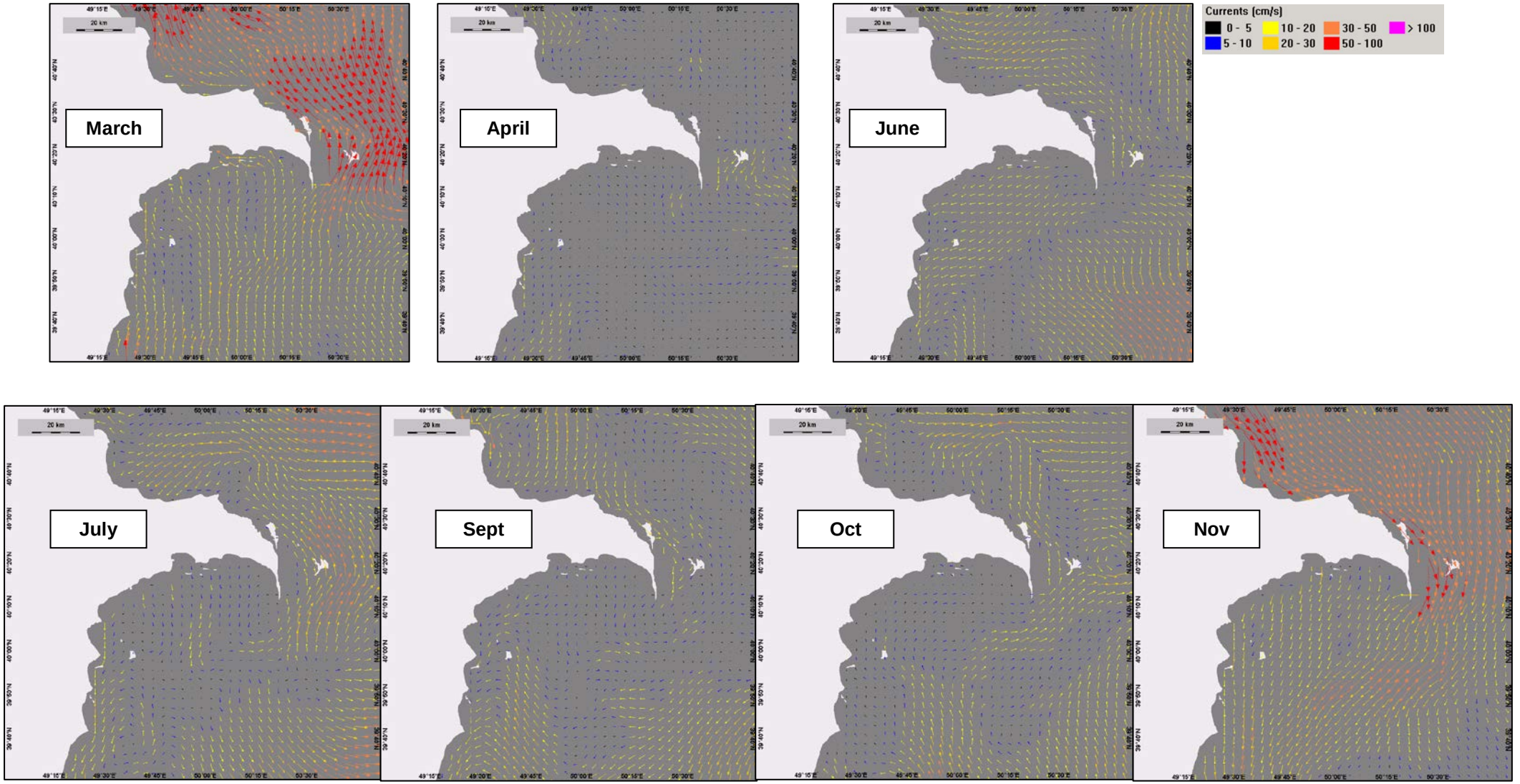
The mechanism that drives the current can be traced back to the Northern Caspian Basin. Here, very cold winter air temperatures, shallow waters and large fluvial inputs from rivers, lead to rapid ice development and the formation of a reservoir of cold, dense water on the boundary with the Central Caspian Basin. The cold water is transported along the western Central Caspian Basin under the influence of cyclonic winds associated with the winter low pressure trough. A component sinks and flushes the bottom waters of the Central Caspian Basin, but in normal years a large volume finds its way over the western section of the Absheron sill and into the Southern Caspian Basin where it appears to mix and sink. A counter flow of relatively warm Southern Caspian Basin water along the eastern section of the Absheron sill balances the cold water inflow.

The irregular depth of the Absheron shelf complicates the winter seasonal flow further. The shelf is deeper on the western side (with a maximum depth of over 200m), than on the eastern side (where depths are usually less than 150m). Therefore, the cold water inflow penetrates beneath the level of the warm water outflow. This is thought to cause currents along the continental slope of the eastern shelf to flow towards the west.

In the SWAP 3D Survey Area, surface currents vary throughout the year in direction and speed. Figure 5.11 shows the expected circulation variation during the months seismic activity will take place (i.e., March, April, June, July, September, October and November)[62]. Strong northward currents can be observed at the beginning of March, later replaced in the summer by smaller anti-clockwise circulation areas near the shore. Stronger southwards currents resume in November at the beginning of winter.

[61] Marine Annual Reference Books, cited in Woodward-Clyde International, 1996
[62] Data from the Imperial College London, ReEMS dataset from 2007

Figure.5.11: Surface Currents Recorded in the SWAP 3D Survey Area in March, April, June, July, September, October and November



5.5.1.3 Storm Surges and Waves

Storm surges occur in the Caspian Sea causing temporary rises or falls in sea level. Significant sea level changes occur in the Central Caspian Basin. These events are associated with persistent strong winds, particularly the strong prevailing regional winds that blow along the axis of the Caspian Sea, from north and north west or from the south and south east. Strong winds from the north are more frequent and more severe than strong winds from the south. Waves in the Caspian Sea are wind driven and subsequently the windiest months also exhibit the greatest wave action.

Wave height data recorded at Oily Rocks indicates that the months of July, August and September have the strongest winds and storms, with a greater frequency of wave heights in excess of 2m recorded. The period of October to February, however, shows the greatest number of wave heights between 1 and 2m, reflecting the steady occurrence of strong winds during this period.

South of the Absheron Peninsula, northerly winds create a fall in sea level while southerly winds result in a rise. In Baku Bay this change can be ±70-80cm. The typical time period for a storm surge is estimated to be 6-24 hours.

The area of greatest wave development extends from the western portion of the Central Caspian Basin, down and across the central section of the Absheron Ridge.

5.5.2 Marine Environment Survey Data

To establish the anticipated physical, chemical and biological characteristics of the seabed environment and the water column within the SWAP 3D Seismic Survey Area, the data sources as listed within Section 5.2 were reviewed. This included survey data collected between 2004 and 2014 from surveys conducted in and adjacent to Sangachal Bay, along the ACG offshore pipeline corridor and as part of the ACG Regional water column survey, to the east of Baku Bay at a Dredge Spoil Site, along the route of a proposed outfall from the Hovsan WTP, within the Bahar Gum Deniz Contract Area and associated with the SOCAR Baku Bay, Gurgan-Deniz and 8 Mart surveys. In addition, the survey results from the 2015 SWAP Survey were also reviewed.

Figure 5.12 shows the locations of the sampling stations associated with these surveys that are considered to be particularly relevant to the SWAP 3D Seismic Survey Area. A summary of the relevant stations per type of sample is presented within Table 5.10.

Table 5.9: Type and Number of Monitoring Stations Relevant to the SWAP 3D Seismic Survey Area

Survey Area	Date	Relevant Monitoring Locations[8]	Approximate Water Depth at Stations (m)	Number of Stations Relevant to the 3D Seismic Survey Area per Sample Type	
				Seabed	Water Column
Sangachal Offshore	2004	All	9-15	12	12
Dredge Spoil Site	2004	All	5	10	n/a
Hovsan WTP	2009	All	0-8	12[1]	12[1]
Bahar Gum Deniz[2]	2011	QD-01 to QD-25 and BH1-1 to BH1-1-16	5-10	41	41
ACG pipeline Corridor (sediment)	2012	6-9 (East) and 13-15 (West)	23-18 and 13-16	5	n/a
ACG Regional (Water Column)	2012	PL9, PL6, ACGR-63, ACGR-64	05-15	n/a	4[3]
Baku Bay EBS	2012	All	0-4	100[4]	71
SOCAR offshore Biological survey	2012	Baku Bay	5-9	15[5]	15[5]
Sangachal Bay	2013	All	3-10	62[6]	5
SOCAR offshore field surveys	2014	Gurgan-Deniz (east) and 8 Mart (west)	3-5	6[5]	3[5]
SWAP Survey	2015	All	3-11	24	8[7]

Notes:
1. Physical sediment characteristics not reported. Samples collected for biological analysis at 3 of the 12 stations
2. Comprising two survey areas – Gum Deniz and Bahar 1, as shown in Figure 5.12
3. Plankton samples associated only to stations PL09 and PL6
4. Physical sediment characteristics not reported. Benthic samples associated only to 3 stations.
5. Sediment characteristics and water quality parameters not reported. Samples collected for benthic and plankton analysis only
6. Reported results are provided for 57 of the 62 sample locations
7. Water microbiology analysis undertaken at each station
8. The quality of the results obtained from surveys undertaken by 3rd parties cannot be confirmed and should be considered a potential limitation

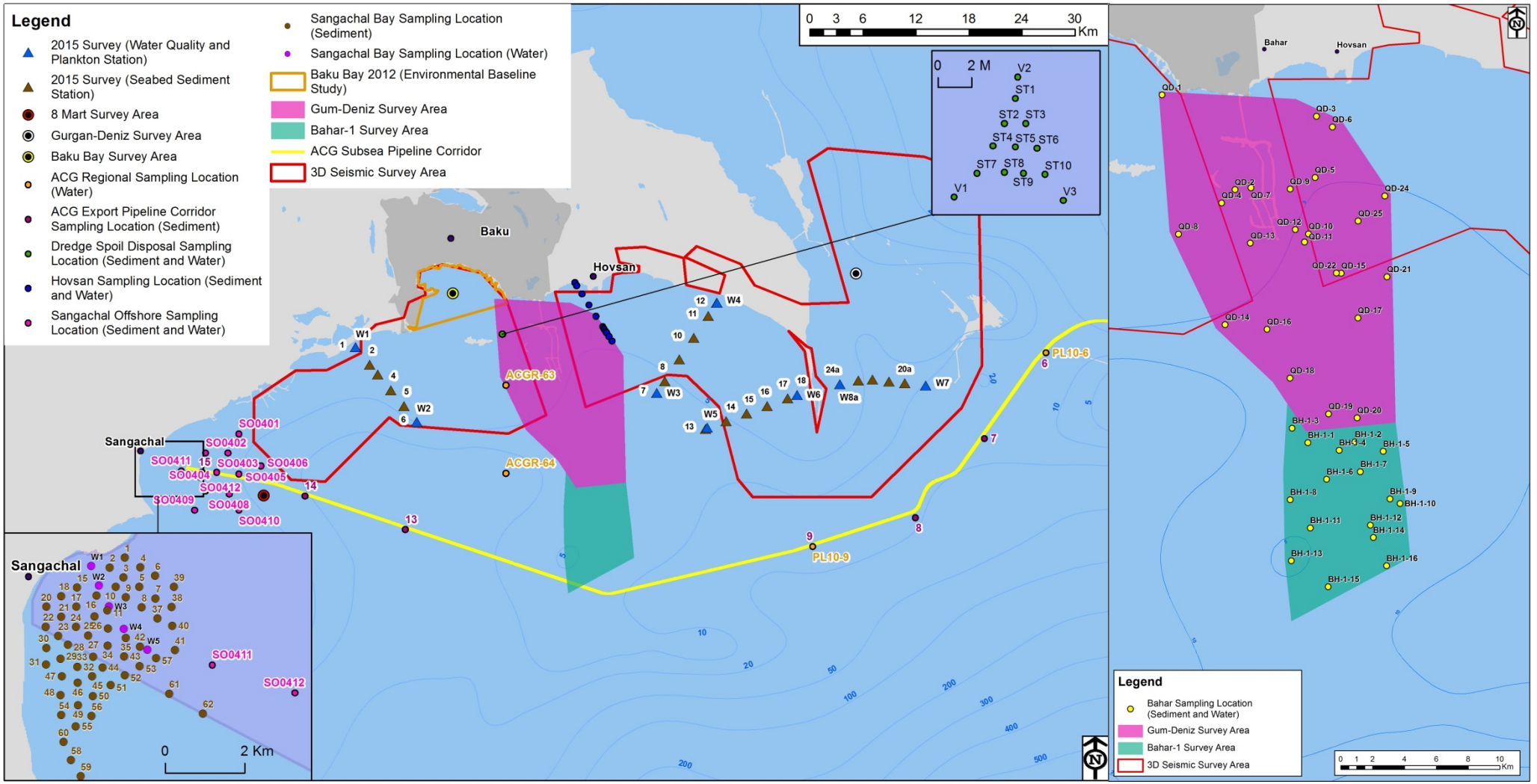
The limitations around the data obtained from these surveys are as follows:

- Baku Bay – both sediments and the water column within Baku Bay are known to be highly contaminated with hydrocarbons and heavy metals, and have an exceptionally high organic content (likely to reflect a combination of sewage and industrial discharges from onshore sources into an area with very limited circulation and flushing). As such, the data collected in the vicinity of Baku Bay is not necessarily representative of the general sediment properties across the entire SWAP 3D Seismic Survey area;
- Hovsan – Hovsan WTP is an operational facility and prior to the survey was routinely discharging waste water into the coastal environment at Hovsan from an existing outfall. It would therefore be expected that nutrient levels would be high in the vicinity of the coastal outfall. However, this would not be representative of the conditions across the entire SWAP 3D Seismic Survey area; and
- Sangachal Bay – a rocky sill at the outer margins of Sangachal Bay is thought to partially isolate the bay from coastal contamination, with the result that sediments within the bay are much less contaminated than areas to the north and support a greater biological diversity, than sediments immediately outside the bay.

There is limited flora benthic data available for the SWAP 3D Seismic Survey Area with the exception of the presence of seagrass in Sangachal Bay and an indication of algae presence in the Absheron Peninsula region[63]

[63] Data from the Institute of Botany, 2015

Figure 5.12: Location of Sampling Stations Relevant to the 3D Seismic Survey Area



5.5.3 Seabed Physical and Chemical Environment

5.5.3.1 Physical Properties of Sediment

Table 5.10 presents the physical sediment characteristics reported within the sediment surveys listed within Table 5.9 (with the exception of the Bahar Gum Deniz Survey for which no numerical data was reported).

The results indicate that towards the centre and east of the SWAP 3D Seismic Survey Area, sediments were found to comprise silt, clay and sand with gravel present in locations across the Bahar Gum Deniz Contract Area (comprising shell fragments and sand) and across most of the Hovsan WTP Survey locations. Sediments across the Bahar Gum Deniz Contract Area were found to be homogeneous, and no significant variations in sediment type of size were observed across different monitoring locations and water depths sampled.

In the eastern part of the SWAP 3D Seismic Survey Area, results from the 2015 SWAP Survey indicate that sediments vary between fine silt (station 22a) to medium sand (station 12). Coarser sediments are observed closer to the coast, decreasing in size towards deeper waters. Carbonate and organic content was found to be generally consistent across the survey locations with higher levels of carbonate and lower organic content recorded in areas of coarser sediments.

To the south east of the SWAP 3D Seismic Survey Area, results from the ACG Pipeline Corridor survey indicated that sediment range between silt (station 09) to very coarse sand (station 06). Similar to 2015 SWAP Survey results recorded for locations in shallower waters, higher levels of carbonate and lower organic content were recorded in areas of coarser sediments.

Across the Dredge Spoil Site, sediments generally ranged from medium silt (20µm mean particle diameter) to very coarse sand (1019µm mean particle diameter). Organic content ranged from 1.16% to 13.54%; the highest organic content recorded across all the surveys analysed. Significantly lower organic content was measured within the samples associated with Hovsan WTP Survey, which varied between 0.8 and 6.9%.

Towards the west of Baku Bay, results from the 2015 SWAP Survey show an increase in sediment size from shallower to deeper waters. Very fine sand was observed at station 01 while sediment at station 06 was found to be composed of fine silt. Similar results were observed on the western edge of the SWAP 3D Seismic Survey Area, within the ACG Pipeline Corridor where, sediments were found to become coarser moving towards Sangachal Bay, as water depth becomes shallower. In both areas carbonate and organic content was found to be generally consistent across the survey locations with higher levels of carbonate and lower organic content recorded in areas of coarser sediments.

Sangachal Bay Offshore Survey indicated that mean particle diameter varied between 15.58µm and 167.39µm with the coarsest particle size measured at location SO0401 at the shallowest water depth included in the survey (9m). Carbonate and organic content were found to be similar to those recorded within the other surveys mentioned above. Within Sangachal Bay itself sediments were found to be poorly sorted mixtures of fine and coarse particles with mean particle size varying between 4µm and 1281µm. An area in the centre of the Bay, as in previous Sangachal Bay surveys, was characterised by very coarse sediments high in carbonate but very low in silt/clay and organic matter.

Table 5.10: Physical Sediment Properties Recorded in Sediment Surveys within and in the Vicinity of the SWAP 3D Seismic Survey Area

	West Survey Area															East Survey Area								
	Sangachal Offshore Survey, 2004			Sangachal Bay Survey, 2013			ACG pipeline corridor (13-15), 2012			Dredge Spoil Disposal Site Survey, 2004			SWAP Survey (01-06), 2015			HWTP, 2009			ACG pipeline corridor (6-9), 2012			SWAP Survey (07-24a), 2015		
Parameter	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
Mean diameter (µm)	15.58	167.39	50.2	4	1281	263	9	49	253	20	1019	-	10	108	33	80	>10000	-	7	1414	253	15	251	56
Sampling Station	SO0405	SO0401	-	24	34	-	13	15	-	-	-	-	06	01	-	-	-	-	09	06	-	22a	12	-
Carbonate (% w/w)	41	64	54	17	92	57	20	53	40	-	-	-	33	60	48	10	45	-	15	90	40	32	70	51
Sampling Station	SO0405	SO0402	-	17	51	-	13	15	-	4	8	-	06	01	-	7800m	-	-	08, 06	06	-	22a	12	-
Organic (% w/w)	3.0	5.1	4.2	0.93	6.94	3.21	4.79	5.45	4.37	1.16	13.54	-	2.27	5.22	4.27	0.80	6.9	-	1.24	6.21	4.37	0.65	5.36	3.43
Sampling Station	SO0401	SO0408	-	55	24	-	15	13	-	-	-	-	01	06	-	7800m	-	-	06	08	-	24a	11	-
Silt/Clay (% w/w)	34	81	65	3	100	48	60.7	97.4	67	-	-	-	37.4	89.8	58.7	-	-	-	0.23	99.0	67	4.0	78.0	58.4
Sampling Station	SO0401	SO0404	-	45	17	-	15	13	-	-	-	-	01	06	-	-	-	-	06	09	-	18	20a	.
Silt (% w/w)	14.1	35.0	26.1	0	70	19	20.3	58.4	33.4	-	-	-	17.1	36.2	25.6	-	-	-	0.02	52.4	33.4	45.2	1.0	27.3
Sampling Station	SO0401	SO0405	-	45	23	-	15	13	-	-	-	-	01	06	-	-	-	-	06	07,08	-	22a	18	-
Clay (% w/w)	19.9	46.9	38.6	2	78	29	38.7	45.4	33.9	-	-	-	20.3	53.6	28.8	-	-	-	021	47.8	33.9	38.8	3.0	25.3
Sampling Station	SO0401	SO0404	-	45	24	-	13	14	-	-	-	-	01	06	-	-	-	-	06	09	-	07	18	-

5.5.3.2 Chemical Properties of Sediment

Hydrocarbon Concentrations

All the sediment samples listed within Table 5.9 and shown in Figure 5.12 were analysed to determine hydrocarbon concentrations (with the exception of the Baku Bay 2012 EBS, for which no numerical data was reported) with all surveys reporting Total Hydrocarbon Concentrations (THC) except for the Bahar Gum Deniz Survey which reported "hydrocarbon concentrations". A summary of the results obtained are presented in Table 5.11.

Table 5.11: Minimum, Maximum and Mean Total Hydrocarbon Concentrations in the Vicinity of the SWAP 3D Seismic Survey Area

Station		Total Hydrocarbon Concentration mg/g		
		Min	Mean	Max
West Survey Area	Sangachal Offshore Survey, 2004	387	705	839
	Sampling Station	SO0401	-	SO0405
	Sangachal Bay Survey, 2013	7	64	517
	Sampling Station	51	-	62
	ACG pipeline corridor (13-15), 2012	441	223	563
	Sampling Station	02	-	15
	Dredge Spoil Disposal Site Survey, 2004	1208	4309	14257
	Sampling Station	4	-	8
	SWAP Survey (01-06), 2015	568	645	780
	Sampling station	06	-	02
East Survey Area	Bahar Gum Deniz Survey, 2011 – Gum Deniz Area[2]	210	626	41950
	At Sampling Station	QD-11	-	QD-6
	Bahar Gum Deniz Survey, 2011 – Bahar 1 Area[2]	180	1080	3360
	At Sampling Station	B1-9	-	B1-10
	Hovsan WTP, 2009	<100	-[1]	6200
	At Sampling Station	8000m from shore	-	400-4500m from shore
	ACG pipeline corridor (6-9), 2012	1.5	223	271
	Sampling Station	06	-	09
	SWAP Survey (07-24a), 2015	13	429	3028
	Sampling station	24a	-	11

Notes:
1. Full data set not provided within the source document.
2. Reported as "Hydrocarbon concentration".

Historical data in the vicinity of the SWAP 3D Seismic Survey Area, indicate that THCs in sediment samples vary significantly across the surveys reviewed, with the highest mean concentration recorded near Baku Bay (Dredge spoil disposal site and Bahar Gum Deniz survey area) and lowest mean concentration recorded in Sangachal Bay (in an area largely sheltered from contamination).

Results from the 2012 Baku Bay EBS indicated that sediments throughout the Bay were substantially contaminated with mineral oil and PAH. Contamination was predominantly found near the shores, generally decreasing significantly with depth. Sediment contamination at the east shore was limited to the superficial layers (within the top 0.5m of sediment) while contamination towards the west shore (near an existing refinery) was observed in much deep layers (up to 2.5m depth).

The highest concentration recorded across all the surveys reviewed (reported as hydrocarbons) was 41950 mg/g at the QD-6 Bahar Gum Deniz Survey station which is located approximately 6km offshore from Hovsan. Similar results were also obtained at stations QD3 (located immediately next to QD-6) and QD1 located at the far edge of Baku Bay. The maximum concentration of 6200mg/g from the earlier Hovsan WTP Survey (undertaken in 2009) suggests that this area was subject to worsening hydrocarbon contamination between 2009 and 2011.

The results of the 2015 SWAP Survey towards the east of the SWAP 3D Seismic Survey Area indicated a large variation in contamination levels, with results varying greatly between stations located towards the Absheron National Park (stations 13-24a) and those located near Turkan (stations 7-12). Although no significant variation was observed at different water depths, THC levels were considerably lower in areas more exposed to wave energy (13 mg/g in station 24) and higher in sheltered areas (3028 mg/g in station 11).

The results for the ACG Export Pipeline Corridor stations 6 to 9 which are to the south east of the SWAP 3D Seismic Survey Area and in deeper waters indicate low levels of hydrocarbon contamination with THCs an order of magnitude less than those reported in the Bahar 1 and Gum Deniz Survey.

Similar but slightly higher THC concentration was recorded near Sangachal Bay located towards the west of the SWAP 3D Seismic Survey Area, during the 2004 and 2013 surveys and the 2012 ACG Export Pipeline Corridor (stations 13 to 15). Comparing results at these locations between the different surveys suggests that sediment hydrocarbon contamination in this area has reduced over time either due to the works associated with installation of pipelines between 2002 and 2009 within the ACG pipeline corridor, due to natural degradation processes or a combination of both.

Towards the west of Baku Bay, results from the 2015 SWAP Survey also indicated lower levels of contamination, which were shown to decrease slightly with distance from shore.

While data is not available for the entirety of the SWAP 3D Seismic Survey Area it is likely that sediment THC contamination will likely vary between moderate to low outside Baku Bay. Some shallow locations are expected to have higher THC concentrations given the industrial nature of the coastline between Bibiheybat and Sahil. Also, there may be localised areas of high hydrocarbon presence across the SWAP 3D Seismic Survey Area as a whole from historic oil and gas activities as well as natural hydrocarbons from seeps and mud volcanoes.

Heavy Metal Concentrations

With regard to heavy metals concentrations located within and in the vicinity of the SWAP 3D Seismic Survey Area, sediment samples for the surveys listed in Table 5.9 were analysed for concentrations of Arsenic, Barium, Cadmium, Chromium, Copper, Iron, Mercury, Lead and Zinc except for samples associated with the Hovsan WTP Survey (analysed for arsenic, cadmium and copper only).

Table 5.12 presents the maximum, minimum and mean average concentrations reported for each survey undertaken within and in the vicinity of the SWAP 3D Seismic Survey Area (with the exception of the Baku Bay 2012 EBS for which no numerical data was reported).

In general both the 2015 SWAP Survey and historical monitoring data showed that heavy metal concentrations in sediments vary little across the East and West of the SWAP 3D Seismic Survey Area, except in localised areas where higher concentrations were recorded. For mercury consistently higher concentrations were recorded across the Bahar Gum Deniz Survey area (stations QD-1 and B1-11). The reason for these high concentrations is not known.

Results from the 2012 Baku Bay EBS indicate that sediments showed substantial contamination with heavy metals throughout the Bay. Contamination was predominantly found near the shores, generally decreasing significantly with depth.

Arsenic concentrations vary little across the 2015 SWAP Survey and the historic surveys reviewed with the maximum concentration of 36µg/g recorded in Sangachal Bay in 2013 and minimum concentrations of less than 1µg/g at locations associated with the Hovsan WTP and Bahar 2 surveys. Barium concentrations across all surveys were found to generally vary between approximately 300 - 400µg/g, maximum concentrations of 1925µg/g at ACG Pipeline Corridor station 15µg/g and at 1140µg/g at station 62 of the Sangachal Bay 2013 Survey. Both locations are within Sangachal Bay.

Cadmium levels were found to vary little across all surveys except within the Bahar 1 Survey area where very low concentrations (<0.01µg/g) were reported. The reason for this is not known. With regard to chromium, while maximum concentrations of 111µg/g and 102µg/g were recorded at locations within the Gum Deniz Survey area and the Sangachal Offshore Survey respectively.

Mean copper concentrations across all surveys analysed were found to generally vary between 17-30µg/g with a very high maximum concentration of 910µg/g recorded at location 3 of the Hovsan WTP survey. Similar high concentrations were also recorded at 2 other Hovsan WTP survey stations, located 6km apart. The reason for the high concentrations could not be explained.

With regard to iron, mean concentrations across the surveys were found to vary between 6194µg/g and 35361µg/g, both in located within the ACG Pipeline corridor east of the Survey Area (stations 6 and 8 respectively) indicating no significant trends. The largest variation in iron concentrations were within Sangachal Bay with the lowest concentrations recorded in areas of coarser sediments.

Mercury concentrations were found to be high (up to 11µg/g) across the whole of the Bahar Gum Deniz Survey area (as compared to mean concentrations of approximately 0.1µg/g to 0.2µg/g across the majority of the other surveys considered). Lead concentrations, however, were found to vary little across surveys with mean concentrations across all surveys of between approximately 10-50µg/g.

Zinc concentrations were found to vary between a minimum of 11µg/g (at station 6 of the ACG Pipeline Corridor 2012) and a maximum of 237µg/g (at station QD13 of the Gum-Deniz Survey). Consistently higher concentrations were recorded at all stations across the Gum-Deniz Survey, however they were not significantly higher than those recorded across the other surveys considered.

Table 5.12: Minimum, Maximum and Mean Heavy Metal Concentrations Recorded in Sediment Surveys within and in the Vicinity of the SWAP 3D Seismic Survey Area

Parameter		West Survey Area										East Survey Area									
		Sangachal Offshore Survey, 2004		Sangachal Bay Survey, 2013		ACG pipeline corridor (13-15), 2012		Dredge Spoil Disposal Site Survey, 2004		SWAP Survey (01-06), 2015		Bahar Contract Area Survey - Gum-Deniz Section, 2011		Bahar Contract Area Survey - Bahar[1] Section, 2011		HWTP, 2009		ACG pipeline corridor (6-9), 2012		SWAP Survey (07-24a) 2015	
		Value	Station	Value	Station	Value	Station	Value	Station	Value	Station	Value	Station	Value	Station	Value	Station	Value	Station	Value	Station
Arsenic (µg/g)	Min	7.3	SO04 04	8.51	62	7.05	14	4.1	4	7.5	05	3	QD-9	2	B1-6	<1	1-6 and 11-12	10.2	08,09	7.3	19
	Max	14.5	SO04 11	36.1	44	9.35	13	13.2	6	10.1	03	14	QD-24	9	B1-11	11.2	8	17.3	06	14.1	23a
	Mean	10	-	17.4	-	13	-	5.7	-	8.7	-	7	-	5.56	-	-	-	13	-	9.9	-
Barium (µg/g)	Min	122	SO04 06	85	34	411	13	185	4	440.9	06	43	QD-22	279	B1-3	-	-	177	06	132.7	23a
	Max	660	SO04 10	1140	62	1925	15	629	2	874.9	01	896	QD-15	1422	B1-11	-	-	276	08	850.7	10
	Mean	301	-	354	-	966	-	411	-	575.1	-	382	-	753	-		-	966	-	318	-
Cadmium (µg/g)	Min	0.16	SO04 03	0.196	22	0.140	13	0.11	4	0.15	04	0.10	QD-5/6/7/8/10/11/13/21/22/25	<0.01	-	<0.4	All	0.125	08	0.11	19
	Max	0.30	SO04 09	0.429	29	0.230	15	0.49	8	0.20	06	0.70	QD-3	<0.01	-	<0.4	All	0.186	06	0.29	12
	Mean	0.22	-	0.277	-	0.164	-	0.25	-	0.17	-	0.26	-	<0.01	-	-	-	0.164	-	0.15	-
Chromium (µg/g)	Min	26.30	SO04 01	6.8	51	54.6	15	9.5	4	38.9	01	18	QD-9	42	B1-2	2.7	8	4.77	06	11	24a
	Max	101.80	SO04 09	80.9	24	60.11 4		94	8	65.0	06	111	QD-1	75	B1-11	41.4	5	64.5	08	69.1	12
	Mean	68.30	-	42.3	-	52	-	44.6	-	53.65	-	48	-	57.25	-	-	-	52	-	37.8	-
Copper (µg/g)	Min	13.90	SO04 01	8.6	42	21.0	13	7.7	4	16.8	01	1	QD-9	7	B1-5; B1-7; B1-14	4.3	7	29.0	07	3.9	24a
	Max	33	SO04 05	50	24	25.7	15	47	8	25.7	06	45	QD-1	12	B1-16	910.6	3	6.7	06	27.7	11
	Mean	28	-	27	-	23	-	23	-	21.3	-	17	-	8.75	-		-	23	-	17.1	-
Iron (µg/g)	Min	16770	SO04 01	8261	42	24305	15	6661	4	20819	01	11774	QD-5	23923	B1-3	-	-	6194	06	8415	24a
	Max	23153	SO04 05	43110	24	31913	13	26373	8	34965	06	27949	QD-1	34071	B1-11	-	-	35361	08	28066	20a
	Mean	20556	-	26155	-	28665	-	16331	-	26661	-	19453	-	29575	-		-	28665	-	23651	-

Parameter		West Survey Area										East Survey Area									
		Sangachal Offshore Survey, 2004		Sangachal Bay Survey, 2013		ACG pipeline corridor (13-15), 2012		Dredge Spoil Disposal Site Survey, 2004		SWAP Survey (01-06), 2015		Bahar Contract Area Survey - Gum-Deniz Section, 2011		Bahar Contract Area Survey - Bahar[1] Section, 2011		HWTP, 2009		ACG pipeline corridor (6-9), 2012		SWAP Survey (07-24a) 2015	
		Value	Station	Value	Station	Value	Station	Value	Station	Value	Station	Value	Station	Value	Station	Value	Station	Value	Station	Value	Station
Mercury (µg/g)	Min	0.15	SO04 01	0.023	46	0.161	15	0.34	8	0.09	01	1	QD-9; QD-12;	2	B1-1	<0.1	7,8,9,10	0.111	08	0.02	18
	Max	0.26	SO04 05	0.117	62	0.257	14	0.07	6	0.29	06	7	QD-1	11	B1-11	1.2	5	0.159	09	0.26	21a
	Mean	0.21	-	0.039	-	0.128	-	0.18	-	0.26	-	3	-	5.5	-	-	-	0.128	-	0.17	-
Lead (µg/g)	Min	28.80	SO04 01	9.3	43	18.3	13	4.9	4	14.5	01	1	QD-9	15	B1-1	3.8	10	12.2	06	6.9	24a
	Max	49.90	SO04 06	20.2	61	29.4	15	31.1	8	23.8	06	28	QD-1	28	B1-11	15.8	5	19.2	08	21.5	11
	Mean	38.80	-	14.9	-	19	-	19.5	-	21.7	-	11	-	19.94	-	-	-	19	-	13.7	-
Zinc (µg/g)	Min	63.90	SO04 01	20.6	34	75.5	13	19.4	4	56.3	01	107	QD-12	21	B1-1	-	-	11.4	06	18.5	24a
	Max	100.80	SO04 09	99	24	88.6	15	104.1	8	95.6	06	237	QD-13	43	B1-11	-	-	83.1	08	79.7	12
	Mean	86.60	-	59.3	-	69	-	62.6	-	77.3	-	162	-	33.06	-	-	-	69	-	63.5	-

5.5.4 Seabed Biological Environment

The biological benthic environment comprises marine flora (seagrass and algae) and benthic invertebrates.

5.5.4.1 Marine Flora

Reviews of historical data (comprising species lists from the 1960s and 1970s)[64] indicate seagrass beds were present along much of the coastline between Baku and Sangachal as well as in shallow waters surrounding the Shahdili Spit and the lagoons adjacent to Sahil. Recent data to confirm the presence and density of seagrass in these areas is not available. The presence and density of seagrass within Sangachal Bay, however, has been established through surveys between 2001 and 2014[65] indicating that the seagrass present comprises a single species, *Zostera noltii* and is found in waters depths less than 5m[66].

Marine flora is typically sensitive to changes in nutrient levels and turbidity, both of which can affect primary productivity for some species. For example, within the samples collected in the vicinity of the Hovsan WTP outfall, only the nutrient tolerant green alga, *Enteromorpha* sp. was observed.

Surveys completed prior to and after ACG pipeline installation works (i.e., towards the west of the SWAP 3D Seismic Survey Area) indicate that seagrass does not appear to be sensitive to physical disturbance and recovery is rapid following disturbance[67]. However, these seagrass are likely to be indirectly affected by coastal eutrophication, as this will tend to encourage the growth of green algae, which can take up nutrients directly from seawater and which are likely to outcompete and suppress seagrass, especially in turbid water.

The species lists available from the 1960s and 1970s and earlier surveys undertaken in Sangachal Bay in 2002 and 2003 suggest a number of red and green marine algae species were known to be present in the SWAP 3D Seismic Survey Area. However, the increase in discharges of wastewater to sea associated with increasing urbanisation of coastal areas, particularly in Baku, and the associated increases in nutrient levels and pollution, may have significantly affected the diversity, abundance, and distribution of floral species. Thus, the current diversity of flora in the SWAP 3D Seismic Survey Area is limited.

5.5.4.2 Benthic Invertebrates

The surveys completed within or in the vicinity of the SWAP 3D Seismic Survey Area where seabed (benthic) samples were taken and analysed are summarised in Table 5.13 (with the exception of the Baku Bay 2012 EBS for which no taxonomical data was reported).

Whilst these surveys took place across an eleven year period and at different times of the year, and there may be some minor seasonal pattern in the abundance of invertebrates, the data does show the general characteristics of the benthic communities observed in each of the surveys.

In areas where surveys have been carried out, the distribution and abundance of benthic fauna has been found to be very patchy. However, high spatial and temporal heterogeneity is fairly common in benthic habitats where settlement of larvae depends on a number of stochastic (chance) events and conditions.

The data from the surveys listed in Table 5.9 (refer to Figure 5.12) show that many species, particularly those found in low abundance such as amphipods and gastropods, are particularly patchy in distribution. Many are only occasionally sampled resulting in highly variable species composition

[64] Karayeva, Dr N., 2003. Literature review conducted by Dr Ninel Karayeva of the Institute of Botany, Azerbaijan National Academy of Sciences.
[65] There is no known available marine flora data from 1970 to 2001 for this area
[66] Envision Mapping Ltd., 2014, SD2-SB-Drop Down Video Survey, Sangachal Bay, Azerbaijan
[67] Azerbaijan-Georgia-Turkey Region, 2009, Integrated Environmental Monitoring Programme Annual Report

both between samples in a single survey and between different surveys. Thus, a useful indicator of community composition and health is the number of species representing each of the major taxonomic groups. The major groups of benthic invertebrates observed in the surveys are**:**

- Polychaetes;
- Oligochaetes;
- Cirripedia (barnacles);
- Cumacea (hooded shrimp);
- Amphipoda (small crustaceans);
- Decapods (crabs, prawns and lobsters);
- Bivalve molluscs (shellfish such as mussels); and
- Gastropoda (snails and slugs).

Table 5.13 presents a summary of the number of invertebrate species by major faunal group and percentage of total abundance reported within and in the vicinity of the SWAP 3D Seismic Survey Area.

Table 5.14 presents the species that were found in each of the benthic surveys reviewed and shows that many of the same species were found in all the surveys, regardless of location. Most of these are invasive species that have become well established in the Caspian Sea: the polychaete worm *Nereis diversicolor,* the barnacle *Balanus improvisus*, the crab *Rhithropanopeus harrisii* and the bivalves *Abra, Mytilaster, and Cerastoderma*.

The native polychaete *Hypaniola kowalewski* was also widely distributed across the region but most other native species, particularly amphipods were very patchy in distribution. There were very high numbers of barnacles at many stations and the most diverse communities were usually found at offshore areas. The stations with the most abundance fauna were at the dredge spoil disposal site near Baku, with high numbers of polychaetes, bivalves and barnacles. Samples taken from near the Absheron peninsula were found to be similar in diversity and abundance to samples in the other shallow water stations away from Baku.

During the 2012 Baku Bay EBS, no benthic macro fauna was observed near the Bay shoreline although samples taken in the middle of the Bay contained benthic life dominated by the barnacle *Balanus improvisus*.

Table 5.13: Number of Invertebrate Species (S) and Percentage (%) of Total Abundance Recorded in Benthic Surveys within and in the vicinity of the 3D Seismic Survey Area

Taxon Group	West Survey Area														East Survey Area							
	Sangachal Offshore Survey, 2004		Sangachal Bay Survey, 2013		ACG pipeline corridor (13-15), 2012		SOCAR 8 Mart survey 2014		SOCAR Baku bay survey 2012		Dredge Spoil Disposal Site Survey, 2004		SWAP Survey 2015		Bahar Contract Area Survey, 2011[1]		ACG pipeline corridor (6-9), 2012		SOCAR Gurgan-Deniz survey 2014		SWAP Survey 2015	
	S	N (%)	S	N (%)	S	N (%)	S	N (%)	S	N (%)	S	N (%)	S	N (%)	S	N (%)	S	N (%)	S	N (%)	S	N (%)
Polychaete	4	91.2	5	64.7	7	71.3	5	45.1	3	20.9	5	53.1	4	65.3	3	55.4	7	10.3	5	44.4	5	45.8
Oligochaete	3	0.4	4	15.8	4	3.7	3	6.5	2	2.1	2	0.7	1	7.5	2	7.4	4	9.6	4	32.2	2	3.3
Cumacea	0	0.0	2	<0.1	2	0.0	0	0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.3	3	2.2	1	0.1
Cirripedia	1	4.6	1	<0.1	1	9.1	1	28.4	1	51.5	1	16.3	1	22.1	1	21.2	1	3.8	1	9.4	1	35.3
Amphipoda	0	0.0	9	0.2	0	0.0	2	0.5	3	0.1	0	0.0	0	0.0	0	0.0	17	52.9	0	0.0	4	0.1
Decapod	1	0.2	1	<0.1	1	0.1	1	0.2	1	<0.1	1	0.1	1	0.1	1	0.9	1	0.1	1	2.6	1	0.1
Bivalve	3	3.6	3	16.3	4	15.8	4	4.6	4	22.1	4	29.8	3	1.6	4	15	4	23.2	4	9.1	3	15.0
Gastropoda	0	0.0	4	3.1	0	0.0	2	3.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	3	0.1
No. of species per sample	5-12		2-16		5-28		6-13		5-14		7-10		7-10		5-11		5-28		18-20		10-17	
No. of stations	12		57		3		45		9		10		6		41		4		6		18	
Total species per survey	12		29		19		19		16		13		11		11		36		21		28	
Average abundance/m^2		1024		6653		2130		2420		6015		27517		4641		2099		1432		3495		8263

Notes: S = number of species observed; N (%) = percentage abundance.
1. Average of Gum Deniz and Bahar 1 survey areas

Table 5.14: Benthic Species Presence in Surveys Conducted within and in the Vicinity of the 3D Seismic Survey Area

Species	SWAP survey 2015	Sangachal Offshore Survey, 2004	Sangachal Bay Survey, 2013	SOCAR 8 Mart survey 2014	SOCAR Baku bay survey 2012	ACG pipeline corridor (13-15), 2012	Dredge Spoil Disposal Site Survey, 2004	Bahar Contract Area Survey, 2011[1]	ACG pipeline corridor (6-9), 2012	SOCAR Gurgan-Deniz survey 2014
Oligochaetes										
Isohaetides michaelseni			✓	✓	✓	✓	✓	✓	✓	✓
Psammoryctides deserticola	✓		✓	✓		✓	✓		✓	✓
Stylodrilus cernosvitovi		✓	✓	✓	✓	✓		✓	✓	✓
Stylodrilus parvus	✓	✓	✓				✓			
Tubificidae spp.		✓								
Polychaetes										
Ampharetidae spp.									✓	
Nereis diversicolor	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Nereis succinea	✓		✓			✓			✓	
Fabricia sabella	✓	✓	✓	✓		✓	✓		✓	✓
Hypaniola kowalewskii		✓	✓	✓	✓	✓	✓	✓	✓	✓
Hypania invalida				✓	✓					
Manayunkia caspica	✓	✓	✓	✓		✓	✓		✓	✓
Sabellidae spp.						✓				
Crustaceans - Cumaceans										
Pterocuma pectinata	✓		✓							✓
Pterocuma rostrata										
Schizorhynchus eudorelloides									✓	
Stenocuma diastyloides										
Stenocuma gracilis			✓							✓
Stenocuma graciloides									✓	✓
Crustaceans - Cirripedia										
Balanus improvisus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Crustaceans - Amphipoda										
Amathillina pusilla			✓						✓	
Amathillina spinosa										
Caspicola knipovitschi										
Corophium chelicorne									✓	
Corophium curvispinum			✓						✓	
Corophium monodon			✓						✓	
Corophium mucronatum			✓						✓	
Corophium nobile									✓	
Corophium robustum									✓	
Corophium spinulosum									✓	
Corophium volutator			✓						✓	
Dikerogammarus aralensis										

Species	SWAP survey 2015	Sangachal Offshore Survey, 2004	Sangachal Bay Survey, 2013	SOCAR 8 Mart survey 2014	SOCAR Baku bay survey 2012	ACG pipeline corridor (13-15), 2012	Dredge Spoil Disposal Site Survey, 2004	Bahar Contract Area Survey, 2011[1]	ACG pipeline corridor (6-9), 2012	SOCAR Gurgan-Deniz survey 2014
Dikerogammarus haemobaphes			✓						✓	
Dikerogammarus oskari										
Gammaridae spp.	✓									
Gammarus ischnus									✓	
Gammarus pauxillus			✓						✓	
Gammarus warpachowskyi										
Gmelina brachyura	✓								✓	
Gmelina costata										
Gmelinopsis aurita										
Iphigenella acanthopoda	✓									
Iphigenella andrussovi										
Niphargoides carausui	✓				✓					
Niphargoides caspius										
Niphargoides deminutus										
Niphargoides derzhavini									✓	
Niphargoides grimmi										
Niphargoides paradoxus										
Niphargoides similis				✓	✓					
Jaera sars caspica										
Saduria entomon caspia										
Crustaceans - Decapoda										
Rhithropanopeus harrisii	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mollusca - Gastropoda										
Caspia gmelini	✓		✓							
Caspiohydrobia curta	✓		✓	✓						
Caspiohydrobia cylindrica			✓	✓						
Caspiohydrobia gemmata	✓		✓							
Mollusca - Bivalves										
Abra ovata	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cerastoderma lamarcki	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Didacna profundicola									✓	
Dreissena caspia							✓			
Dreissena rostriformis grimmi										
Dreissena rostriformus distincta				✓	✓			✓		✓
Mytilaster lineatus	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

5.5.5 Water Column Physical and Chemical Environment

5.5.5.1 Water Temperature and Salinity

Differential climatic conditions between the Caspian Basins cause large latitudinal variations in sea surface temperature. During the winter, the Northern Caspian Basin freezes while temperatures in the Central and Southern Caspian Basins remain well above freezing (10 to 11°C), although some ice may form during severe winters.

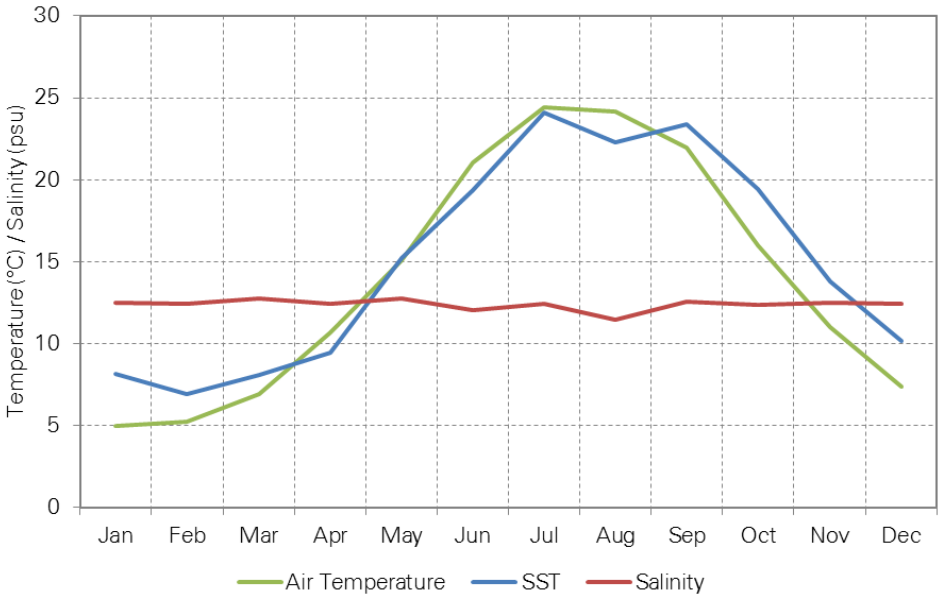
During summer, the temperature of the waters in the Southern Caspian Basin becomes stratified and a strong thermocline develops that inhibits vertical mixing at depths of 20 to 50m. Surface water temperatures can reach a maximum of 28ºC in August[68]. Temperatures at depth remain approximately 6ºC all year round.

During summer and autumn the thermocline moves deeper reflecting the increase in solar energy warming the surface water and forcing denser cold water to sink. As the thermocline deepens, the temperature stratification becomes less significant until the thermocline eventually breaks down during late autumn and winter months.

Surface salinity levels vary with water temperature (due to evaporation rates), distance to fresh water sources and the riverine input. Salinity in the Southern Caspian basin increases from west to east due to the lack of freshwater inputs along the east Caspian coast. The salinity of near seabed and in the central water column is more stable in comparison with surface water salinity. The salinity of the surface water in the vicinity of the SWAP 3D Seismic Survey Area is considered to be relatively constant all year round at approximately 13 parts per thousand (ppt) (Figure.5.13). To the south of the SWAP 3D Seismic Survey Area where there is increasing freshwater input due to the influence of the Kura Delta, salinity is typically in the range 12.7-12.8 ppt.

Figure 5.13 shows the expected variation[69] of air temperature, sea surface temperature (SST) and sea surface salinity (SSS) in the SWAP 3D Seismic Survey Area.

Figure.5.13: Monthly Average Air Temperature, Sea Surface Temperature and Sea Surface Salinity Within the SWAP 3D Survey Area



[68] OceanMetrix, 2009, Shah Deniz Wind, Wave, Surge and Current Criteria V3.1a. Report developed for BP Exploration Operating Company Ltd

[69] Data obtained from NOAA National Virtual Ocean Data System. Available at: http://ferret.pmel.noaa.gov/NVODS Accessed November 2015

5.5.5.2 Oxygen Regime

The deep water areas of the Southern Caspian Basin are characterised by lower dissolved oxygen levels compared to the Northern and Central Caspian Basins. This is caused among other factors, by poor penetration of sunlight and reduced photosynthesis activity, the deficiency of large river inflows and the stratification of the water column during the thermocline. Dissolved oxygen levels in the Southern Caspian Basin decrease with depth and saturation can reach levels as low as 10% at 600m depth[70].

Oxygen levels in the Southern Caspian Basin are also highly influenced by anthropogenic pressures and marine contamination. In the nearshore waters of Azerbaijan, the oxygen regime and concentration are understood to be greatly influenced by anthropogenic factors, particularly by wastewater and sewage discharges. While oxygen levels across the Northern Caspian Basin are known to vary between 4.9 and 10.6 mg/l, oxygen levels recorded in Baku Bay vary between 3-5 mg/l[71].

Throughout the year the surface waters of the Southern Caspian Basin are characterised by high oxygenation with high saturation levels occurring in the spring due to phytoplankton activity. During summer, the water column becomes stratified resulting in decreased oxygen levels below the thermocline[72].

5.5.5.3 Water Quality

Water column surveys during which samples were taken to analyse physical, chemical and biological parameters are listed in Table 5.9. While the parameters analysed across surveys varied, the following were generally measured:

- Water quality and nutrient indicators including total suspended solids (TSS), total nitrogen, total phosphorus, nitrate, nitrite, ammonia, phosphate, silicate, Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD);
- Heavy metals concentrations including arsenic, barium, copper, chromium, cadmium, iron, lead, mercury and zinc; and
- THC, polynuclear aromatic hydrocarbon (PAH) and phenol.

Table 5.15 summarises the nutrient levels recorded across the surveys within and in the vicinity of the SWAP 3D Survey Area, while a summary of the minimum, maximum and average heavy metal concentrations is presented in Table 5.16. The tables do not include the results for the Baku Bay 2012 EBS, for which no numerical data was reported.

Results from the 2012 Baku Bay EBS indicate that water quality showed high concentrations of heavy metals and hydrocarbon contamination in localised points although mostly samples did not exceed the detection limit within the Bay. Contamination was predominantly associated with suspended solids, BOD/COD and presence of coliforms (discussed below).

[70] Jamshidi S., Bakar N. B. A., 2011, Variability of dissolved oxygen and active reaction in deep waters of Southern Caspian Sea, near the Iranian Coast. Available at: http://www.pjoes.com/pdf/20.5/Pol.J.Environ.Stud.Vol.20.No.5.1167-1180.pdf Accessed August 2015

[71] GIWA and UNEP, 2006, Regional Assessment Report 23 – the Caspian Sea, Global International Waters Assessment Program

[72] RSK, 2005, SDX-4 Drilling Programme Environmental Technical Note - Addendum to Shah Deniz Exploration Drilling EIA

Table 5.15: Chemical Analysis & Nutrient Levels Recorded in Water Column Surveys Within and in Vicinity the SWAP 3D Seismic Survey Area

		West Survey Area								East Survey Area							
		Sangachal Offshore Survey, 2004		Sangachal Bay Survey, 2013		ACG Regional (ACGR63/64), 2012		SWAP Survey (W1/W2), 2015		Bahar Contract Area Survey, 2011[1]		HWTP, 2009		ACG Regional (PL06/09), 2012		SWAP Survey (W3/W8a) 2015	
Parameter		Value	Station	Value	Station	Value	Station	Value	Station	Value	Station	Value	Station	Value	Station	Value	Station
TSS (in mg/l)	Min	<2	SO0401/ 03/11	3	W5	<2	All	3	All	13.4	QD-20	1.8	8	<2	All	<2	All
	Mean	4.85	-	9		<2	-	3	-	28.9	--	5	-	<2	-	<2	-
	Max	6.35	4,5,6,12	17	W1	<2	All	3	All	81.0	QD-12	8.8	1	<2	All	<2	All
BOD-5	Min	<0.5	SO0401/02/ 03/07/08/09/ 10/11	11	W5	<0.5	All	7.8	W2	-	-	-	-	<0.5	All	6.9	W8a
	Mean	0.433	-	14		<0.5	-	7.9	-	-	-	-	-	<0.5	-	7.6	-
	Max	0.5	4.5.6.12	17	W1	<0.5	All	8.1	W1	-	-	-	-	<0.5	All	8.2	W6
COD	Min	28.4	SO0407/08/ 09/10	29	W5	<4	All	18.8	W2	-	-	-	-	<4	All	16.7	W8a
	Mean	34	-	35		<4	-	19.2	-	-	-	-	-	<4	-	18.5	-
	Max	44.7	4,5,6,12	45	W1	<4	All	19.6	W1	-	-	-	-	<4	All	19.8	W6
Nitrites NO_2–N	Min	<0.2	All	<0.2	W2	0.41	ACGR64	0.2	W2	0.15	QD-18	<10	All	<0.2	All	<0.2	W4,W7,W8a
	Mean	<0.2	-	0.4		0.52	-	0.33	-	0.55	--	<10	-	<0.2	-	0.3	-
	Max	<0.2	All	0.5	W3	0.63	ACGR63	0.43	W1	1.04	B1-11	30	11	<0.2	All	0.36	W5
Nitrates NO_{2+3} –N	Min	27	SO0401/02/ 03/11	<10	All	<10	All	<10	All	0.37	QD-18	50	10,11	<10	PL6	<10	All
	Mean	44	-	<10		<10	-	<10	-	0.6	--	55	-	N/A	-	<10	-
	Max	54	4,5,6,12	<10	All	<10	All	<10	All	0.91	QD-13	330	4	43	PL9	<10	All
Ammonium NH_4-N	Min	<10	All	<10	All	<10	All	<10	All	0.14	QD-7	60	12	<10	All	<10	All
	Mean	<10	-	<10		<10	-	<10	-	0.75	--	167	-	<10	-	<10	-
	Max	<10	All	<10	All	<10	All	<10	All	0.41	QD-14, QD-16, QD-21	853	1	<10	All	<10	All
Total N,	Min	120	SO0401/02/ 03/11	384	W4	420	ACGR64	382	W1	-	-	-	-	570	PL6	382	W7
	Mean	237	-	398	-	425	-	412.5	-	-	-	-	-	584	--	445	-
	Max	370	7,8,9,10	417	W3	430	ACGR63	443	W2	-	-	-	-	597	PL9	535	W8a
Phosphates, PO_4 –P	Min	<5	All	<1.6	W2,W3, W4,W5	<1.6	All	<1.6	All	-	-	<10	6,8,9,10, 11,12	2.2	PL6	<1.6	All
	Mean	<5	-	1.5	-	<1.6	-	<1.6	-	-	-	94	-	2.4	--	<1.6	-
	Max	<5	All	1.9	W1	<1.6	All	<1.6	All	-	-	900	2	2.6	PL9	<1.6	All
Total P	Min	<2	All	4.7	W4	5.6	ACGR64	9.6	W1	-	-	<100	8,9,12	6.9	PL6	6.5	W8a
	Mean	<2	-	15	-	6.3	-	10.1	-	-	-	1089	-	7.8	--	11.2	-
	Max	<2	All	43	W1	6.9	ACGR63	10.6	W2	-	-	1500	1,2	8.7	PL9	15.4	W6
Silicates SiO_2-Si	Min	480	SO0401/02/ 03/11	27	W4	245	ACGR63	196	W2	-	-	-	-	169	PL6	133	W5
	Mean	633	-	40	-	251	--	199.5	-	-	-	-	-	190	-	160.5	-
	Max	730	7,8,9,10	57	W1	256	ACGR64	203	W1	-	-	-	-	211	PL9	218	W4

Notes: 1. Average of Gum Deniz and Bahar 1 survey areas

Table 5.16: Heavy Metal Concentrations Recorded in Water Column Surveys Within and in Vicinity the SWAP 3D Seismic Survey Area

		West Survey Area								East Survey Area							
		Sangachal Offshore Survey, 2004		Sangachal Bay Survey, 2013		ACG Regional (ACGR63/64), 2012		SWAP Survey (W1/W2), 2015		Bahar Contract Area Survey, 2011[1]		HWTP, 2009		ACG Regional (PL06/09), 2012		SWAP Survey (W3/W8a) 2015	
Parameter		**Value**	**Station**	**Value**	**Station**	**Value**	**Station**	**Value**	**Station**	**Value**	**Station**	**Value**	**Station**	**Value**	**Station**	**Value**	**Station**
Arsenic	Min	<5	All	-	-	-	-	-	-	<2	All	<0.01	All	-	-	-	-
	Max	<5	All	-	-	-	-	-	-	<2	All	<0.01	All	-	-	-	-
	Mean	-	-	-	-	-	-	-	-	<2	-	-	-	-	-	-	-
Barium	Min	9.4	SO0401/ 02/03/11	-	-	-	-	-	-	8.0	QD-19; B1-9	<0.01	All	-	-	-	-
	Max	15.4	SO0404/ 05/06/12	-	-	-	-	-	-	57.0	QD-9	<0.01	All	-	-	-	-
	Mean	-	-	-	-	-	-	-	-	24.2	-	-	-	-	-	-	-
Cadmium	Min	0.016	SO0407/ 08/09/10	<0.01	W3, W5	0.011	ACGR63	<0.01	All	<0.1	All	-	-	<0.01	PL9	<0.01	All but W4 & W7
	Max	0.018	SO0404/ 05/06/12	0.018	W4	0.017	ACGR64	<0.01	-	<0.1	All	0.016	One location[2]	0.028	PL6	0.01	-
	Mean	-	-	-	-	0.014	-	<0.01	All	<0.1	-	-	-	-	-	0.03	W7
Chromium	Min	<2	All	-	-	-	-	-	-	<0.1	All	<0.01	All	-	-	-	-
	Max	<2	All	-	-	-	-	-	-	<0.1	All	<0.01	All	-	-	-	-
	Mean	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-	-
Copper	Min	0.579	SO0401/ 02/03/11	1.02	W4	0.87	ACGR64	1.4	W2	0.9000	QD-17; QD-20	<0.01	All	0.77	PL6	1.1	W5
	Max	0.695	SO0407/ 08/09/10	1.56	W1	1.01	ACGR63	1.99	-	5.9	QD-8	<0.01	All	4.12	PL9	1.96	-
	Mean	-	-	-	-	0.94	-	2.54	W1	2.9	--	-	-	-	-	2.77	W3
Iron	Min	<10	All	13	W5	8.21	ACGR64	18.6	W1	10.0	QD-20	<0.01	All	11.6	PL9	5.5	W5
	Max	<10	All	161	W1	12.8	ACGR63	19.3	-	76.0	QD-5	<0.01	All	12.4	PL6	6.29	-
	Mean	-	-	-	-	10.5	-	20.1	W2	40.0	-	-	-	12	-	17.9	W8a
Lead	Min	0.034	SO0404/ 05/06/12	0.095	W4	0.09	ACGR64	0.1	W1	0.10	70% of all samples	<0.01	All	0.349	PL6	0.1	W5
	Max	0.054	SO0407/ 08/09/10	0.257	W1	0.14	ACGR63	0.17	-	0.6	B1-8	<0.01	All	0.383	PL6	0.18	-
	Mean	-	-	-	-	0.115	-	0.23	W2	0.2	-	-	-	0.36-	-	0.27	W7
Mercury	Min	<0.01	All	-	-	-	-	-	-	<0.1	All	<0.01	All	-	-	-	-
	Max	<0.01	All	-	-	-	-	-	-	<0.1	All	<0.01	All	-	-	-	-
	Mean	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-	-
Zinc	Min	0.751	SO0401/ 02/03/11	2.15	W4	1.14	ACGR63	4.0	W1	3.7	QD-23	<0.01	All	3.86	PL9	2.7	W8a
	Max	1.017	SO0407/ 08/09/10	5.87	W5	1.28	ACGR64	7.39	-	30.5	B1-3	<0.01	All	4.71	PL6	3.32	-
	Mean	-	-	-	-	1.21	--	10.8	W2	14.3	-	-	-	4.29	-	22.4	W7

Notes: 1. Average of Gum Deniz and Bahar 1 survey areas 2. Location not provided in the report

Table 5.15 shows in general, TSS vary between <2mg/l and 9mg/l across all the surveys considered except across the Bahar Gun Deniz Survey area where TSS concentrations of up to 81mg/l were recorded. This is understood to be due to the entrainment of sediment within samples taken at depth. BOD-5 concentrations were found to vary little across all surveys except the Sangachal Bay 2013 survey where higher levels were recorded. It was noted that these levels were significantly higher than in the previous survey completed in 2011. However, as dissolved oxygen levels were similar, oxygen available to biota was considered to be unaffected.

COD concentrations were found to be similar across the surveys completed within or adjacent to Sangachal Bay with lower concentrations (<4µg/l) recorded across the ACG Regional survey locations. Nitrite and nitrate concentrations were found to be consistent across all survey locations except within the Bahar Gum Deniz survey area where high concentrations up to 30 µg/l (nitrite) and 330µg/l (nitrate) were recorded. No explanation for these high levels was provided.

With regard to ammonium concentrations, these were generally found to be low across the surveys considered except for the Hovsan WTP locations where a very high level of 853µg/l was recorded. The station where this concentration was measured was located in the immediate vicinity of the existing discharge outfall from the Hovsan WTP and the high level was considered to be due to the biological load present in the discharge.

Total nitrogen concentrations across all surveys were found to be consistently low as were phosphate and total phosphorus concentrations which exception to very high maximum concentrations recorded during the Hovsan WTP survey (900 and 1500µg/l respectively). This maximum was found to occur at one station approximately 400m from the existing outfall and was thought to occur due to mineralisation of the phosphorus in the wastewater discharge. At locations further from the outfall the concentrations were found to fall to approximately 10µg/l.

There was no discernible trend in silicate concentrations across the surveys, which were consistently low.

It should be noted, however, that the surveys are generally conducted over short periods generally during the summer and therefore it cannot be inferred that contamination is low at all times of the year. Nevertheless, the results do indicate no evidence of persistent contamination.

With regard to heavy metals Table 5.16 indicates that in general, all heavy metals concentrations recorded were low and, with very few exceptions, were well below the maximum allowable concentrations for good fisheries water quality (Azerbaijan MAC Fisheries Waters).

Concentrations of arsenic, mercury, cadmium, lead and chromium were consistently low across all surveys. Barium levels varied between 8 and 57µg/l with the lowest concentrations recorded in Sangachal Bay Offshore Survey and the highest concentrations recorded at location QD-9 of the Bahar Gum Deniz Survey. Copper levels were generally consistent varying between <0.01 at all locations associated with the Hovsan WTP Survey to 5.9µg/l at location QD-8 of the Bahar Gum Deniz Survey.

Iron concentrations were generally low varying between 5.5µg/l and 161µg/l with the highest levels recorded in Sangachal Bay 2013 Survey. Conversely the lowest zinc levels were associated with the Hovsan WTP Survey and the Sangachal Bay Offshore Survey.

Table 5.17 presents the microbiological results of the 2015 SWAP Survey as well as the results from the 2009 Hovsan WTP survey. Total and faecal coliforms concentrations are higher at the Hovsan WTP discharge point (station 1) and sharply decrease away from shore. They do however remain very high within 4 km distance from shore (station 5). Concentrations start fading 6 km away from the shoreline (stations 7 to 12).

These results concur with those from the 2012 Baku bay EBS, which indicate high concentrations of coliform at the Bay, mostly related to outlets discharges.

Results from the 2015 SWAP Survey indicate that most stations have very low concentrations of coliforms, with the exception of stations 12, 18 and 19 located near Turkan and the Shahdili split respectively.

Table 5.17: Microbiological Concentrations Recorded in Water Column Surveys within the SWAP 3D Seismic Survey Area

Station	Total Coliforms (MPN/100ml)	E.coli (MPN/100ml)	Faecal Coliforms (MPN/100ml)
HWTP, 2009			
1	160000	-	16000
2	50000	-	9500
3	30000	-	4400
4	24000	-	3600
5	9400	-	920
6	2800	-	600
7-12	<900	-	<300
SWAP Survey, 2015			
1	461	28	<1
2	46	1	<1
11	92	79	<1
12	1553	387	2
17	345	17	<1
18	>2420	1120	1
19	>2420	1986	<1
24a	1553	36	<1

Although no national standards regulate the quality of recreational waters, publications of the Ministry of Health mention a guideline value for *Escherichia coli* in bathing water of 500/100 ml[73].

While limited historical information is available regarding microbiological contamination in Azerbaijan and collected data is not available for the entirety of the SWAP 3D Seismic Survey Area it is likely that *E. coli* contamination will likely be lower in deeper waters and/or away from the shoreline. Some shallow locations, especially in the surroundings of Greater Baku, are expected to have higher concentrations of *E.coli* given the high numbers of untreated waste discharge points.

According to results of the Ministry of Health beach monitoring 2008 spring-summer campaign in 2008, bathing waters did not comply with EU standards with respect to pathogen contents. Stations at beaches such as Shikh and Hovsan, showed level of faecal coliforms higher than 100,000 per litre (5 times higher than the EU standards for recreational waters).

5.5.6 Water Column Biological Environment

5.5.6.1 Plankton

The water column surveys relevant to the SWAP 3D Seismic Survey Area where biological analysis was completed (i.e. plankton) are shown in Figure 5.12 and Table 5.9.

Phytoplankton

The phytoplankton of the southern Caspian Sea is comprised of marine, euryhaline, and brackish water forms. Species diversity decreases southwards as the input of freshwater, and consequently the number of freshwater species is lower. A total of 71 species were recorded in the Southern Caspian in the period 1962 to 1974 (but more recently over 100 species have been identified).

The most numerous phytoplankton of the Southern Caspian, in terms of both numbers and taxa are diatoms, followed by dinoflagellates and cyanophytes (blue-green algae). Of the diatoms, the invasive species *Rhizosolenia calvaris* is often the most abundant and is now found to be generally present throughout the year. This species has an exceptionally large cell size, and combined with its abundance, it can be responsible for up to 90% of the total phytoplankton biomass.

[73] Safety, Environment and Emergency Response Associates, 2013, Sangachal Bay Environmental Survey 2013 Interpretive Report, Azerbaijan International Operating Company

There are some broad spatial patterns in productivity evident in the Caspian Sea with higher levels of production (as measured by chlorophyll concentration) observed in some shallow water areas compared to open ocean, particularly where nutrient levels are high near urban coastal areas. For example, in the waters around Hovsan Bay, there were high levels of primary production in comparison to values measured off-shore and the sampled sea water was considered to be eutrophic or mesotrophic[22].

Table 5.18 shows the phytoplankton community observed in a number of surveys reviewed for the 3D SWAP area is also typically composed of diatoms, dinoflagellates, chlorophyta (green algae) and cyanophyta (blue-green algae). In general diversity is dominated by diatoms but the abundance of the phytoplankton groupings changes. For example, in the SWAP 2015 surveys the phytoplankton community is dominated by high numbers of blue-green algae and very few diatoms though the number of diatom species is high.

Phytoplankton growth and composition follows a seasonal cycle with two 'blooms' of peak biomass in the Caspian Sea - a large bloom in the autumn and a smaller bloom in the spring. The seasonal cycle of production reflects seasonal changes in sunlight and water temperature and the availability of nutrients. During the winter phytoplankton production is low due to low water temperatures, low light levels and a mixed water column. Changes in light and temperature in the spring, and the resulting stratification of the water column trapping nutrients in the upper layers, results in a dramatic increase in growth, particularly by diatoms such as *Rhizosolenia calcaravis*.

Growth remains high during the summer but there may be a successional shift from diatoms to dinoflagellates, typical of phytoplankton cycles in marine systems. Through the autumn the warm waters continue to be productive, often with a second higher peak in production levels, before phytoplankton biomass decreases again in winter[74].

Thus, the timing of phytoplankton surveys can be a strong determinant of the phytoplankton community observed; high abundance with many diatoms in the spring compared to more dinoflagellates and lower abundance overall in the summer and towards winter. These seasonal changes are typical of marine environments at northern latitudes.

Table 5.18: Summary of Phytoplankton Community Composition in the SWAP 3D Seismic Survey Area

Taxon Group	West Survey Area				East Survey Area							
	Sangachal Bay, 2013		SWAP survey 2015		Bahar Gum Deniz, 2011[1]		HWTP, 2009		ACG Regional (PL06/09), 2012		SWAP survey 2015	
	S	N (%)	S	N (%)	S	N (%)	S	N (%)	S	N (%)	S	N (%)
Diatoms	10	83.1	19	0.2	10	58.3	5	29.5	10	83.7	31	1.8
Dinoflagellates	6	2.8	1	29.4	5	25	2	23.1	8	8.6	4	15.5
Green algae	0	0	6	0.4	2	8.4	3	18.7	1	0.9	7	0.1
Blue-green algae	4	14.1	3	70.0	4	11.6	3	28.7	3	6.6	7	82.6
Total species observed	20		29		21		13		22		49	

Notes: S = number of species observed; N (%) = percentage abundance.
1. Average of Gum Deniz and Bahar 1 survey areas

Table 5.19 presents the species that were found in each of the plankton surveys reviewed and shows that diatom species of the genera Chaetoceros and Coscinodiscus, were observed in most surveys but there was no one diatom species seen in all surveys which is likely to reflect seasonal changes in community composition.

[74] BP, 2000. Inam Exploration Drilling Environmental Impact Assessment (ERT).

Table 5.19: Species of Phytoplankton Observed in within and in the Vicinity of the SWAP 3D Seismic Survey Area

Species	SWAP survey (West) 2015	SWAP survey (East) 2015	Sangachal Bay, 2013	HWTP, 2009	Bahar Gum Deniz, 2011[1]	ACG Regional (PL06/09), 2012
Diatoms						
Actinocyclus ehrenbergii	✓	✓				✓
Actinocyclus paradoxus						✓
Amphiprora paludosa		✓				
Amphora ovalis	✓	✓				
Chaetoceros rigidus			✓			
Chaetoceros subtilis			✓			
Chaetoceros mirabilis					✓	
Chaetoceros pendulus	✓	✓				
Chaetoceros peruvianus	✓	✓				
Chaetoceros sosialis					✓	
Chaetoceros wighamii		✓	✓	✓		
Coscinodiscus gigas		✓				✓
Coscinodiscus granii	✓	✓	✓		✓	✓
Coscinodiscus jonesianus			✓		✓	✓
Coscinodiscus perforatus	✓	✓				
Coscinodiscus radiatus	✓	✓				✓
Cyclotella caspia					✓	
Cyclotella meneghiniana	✓	✓				
Cymbella affinis		✓				
Cymbella parva		✓				
Diploneis bombus						✓
Diploneis interrupta		✓				
Fragilaria capucina		✓				
Gyrosigma balticum						✓
Navicula cryptocephala v. veneta	✓	✓				
Navicula hungarica	✓	✓				
Navicula pupula		✓				
Navicula radiosa	✓					
Nitzschia acicularis	✓	✓				
Nitzschia closterium		✓	✓			✓
Nitzschia holsatica		✓				
Nitzschia reversa	✓	✓				
Nitzschia sigma		✓				
Nitzschia sigmoide		✓				
Pleurosigma angulatum w. Sm. Var angulatum		✓				
Pleurosigma elongata	✓	✓				
Pleurosigma salinarum	✓	✓				
Psevdosolenia calcar-avis	✓	✓				
Rhizosolenia calcar avis				✓	✓	✓
Rhizosolenia fragilissima					✓	
Sceletonema costatum				✓	✓	
Synedra tabulata			✓			✓
Synedra ulna	✓	✓				
Tabellaria fenestrata v. intermedia		✓				
Thalassionema nitzschioides			✓			
Thalassiosira variabilis						
Thallasionema nitzschioides	✓	✓		✓	✓	✓

Species	SWAP survey (West) 2015	SWAP survey (East) 2015	Sangachal Bay, 2013	HWTP, 2009	Bahar Gum Deniz, 2011[1]	ACG Regional (PL06/09), 2012
Thallassiosira decipiens				✓	✓	✓
Dinoflagellates						
Exuviaella marina					✓	
Glenodinium danicum			✓			✓
Glenodinium lenticula						
Goniaulax polyedra		✓	✓		✓	✓
Goniaulax digitale			✓	✓	✓	✓
Goniaulax polyedra	✓					
Peridinium achromaticum						
Peridinium crassipes						
Peridinium conicum	✓	✓				
Prorocentrum cordatum			✓	✓	✓	✓
Prorocentrum marinum						
Prorocentrum micans		✓				
Prorocentrum obtusum						
Prorocentrum scutellum		✓	✓		✓	✓
Cholorophytes						
Ankistrodesmus acicularis	✓					
Ankistrodesmus longissimus var acicularis		✓				
Ankistrodesmus pseudomirabilis v. spiralis	✓	✓				
Binuclearia lauterbornii	✓	✓		✓	✓	
Binuclearia var. crassa	✓	✓				
Chlamydomonas sp.	✓	✓				
Oocystis lacustrix				✓		
Pediastrum duplex				✓	✓	
Pediastrum Boryanum v longicorrne	✓	✓				
Ulotrix zonata		✓				
Cyanophytes						
Anabaenopsis cunningtonii	✓	✓				
Gloecapsa minuta				✓		
Gloeocapsa turgida						
Gamphosphaeria aponima					✓	
Gamphosphaeria lacustris					✓	
Lyngbya limnetica			✓	✓		✓
Merismopedia pynktata	✓					
Microcystis pulverea			✓	✓	✓	✓
Microcystis grevillei					✓	
Oscillatoria brevis		✓				
Oscillatoria chalybea	✓	✓				
Oscillatoria geminata		✓	✓			✓
Oscillatoria limosa		✓				
Oscillatoria redekei			✓			✓
Oscillatoria tanganyikae var. caspica		✓				

Notes:
1. Average of Gum Deniz and Bahar 1 survey areas

Zooplankton

The southern region of the Southern Caspian Basin has been reported to support around 180 species of zooplankton comprising protists, rotifers, copepods, cladocera and pelagic crustaceans such as mysids and the larvae of a range of invertebrate organisms[75]. The three main types of zooplankton found in the Caspian Sea are:

- **Copepods** - small, shrimp-like animals often no more than 1mm long, some native to the Caspian Sea and some introduced from other areas;
- **Cladocerans** - 'water fleas', often larger than copepods (1 - 5mm long), predominantly native to the Caspian; and
- **Ctenophore** - 'comb jelly' - one species, which is not native to the Caspian Sea and was first recorded in the Caspian Sea in 1999. This species may have been transported into the Caspian Sea from the Black Sea.

Prior to 2000, the zooplankton was largely dominated by naturalised and endemic species of cladocera and copepods. Since 2003, however, native and endemic taxa have been rare or absent in BP-sponsored surveys, whilst the predatory invasive ctenophore *Mnemiopsis leidyi* has become progressively more abundant and common. This species seems to have established itself as a permanent member of the zooplankton community in the Central Caspian Basin.

A number of zooplankton surveys, as listed in Table 5.9, show a similar zooplankton community structure in the SWAP 3D Seismic Survey Area. Table 5.20 shows that zooplankton communities in all surveys were dominated by copepods, cladocerans and benthic invertebrate larvae. The invasive copepod *Arcartia tonsa* is widespread, being found in all areas of the SWAP 3D Seismic Survey Area, and is often the dominant copepod present. The invasive ctenophore, *Mnemiopsis leidyi*, was the only species observed in all the surveys investigated and was observed in high abundance (for example, the density of this species was greater than 100 individuals per m^2 at all stations surveyed in 2015). Seasonal abundance of zooplankton is closely related to that of phytoplankton with peaks in spring and autumn (approximately one month later). Thus, there are large temporal changes in both the abundance and presence of zooplankton species and so surveys conducted at different times of the year cannot be directly compared.

Table 5.20: Species of Zooplankton Observed within and in the Vicinity of the SWAP 3D Seismic Survey Area

Species	SWAP survey (West) 2015	SWAP survey (East) 2015	Sangachal Bay, 2013	ACG pipeline corridor (13-15) and (6-9), 2012	HWTP, 2009	Bahar Gum Deniz, 2011[1, 2]
Cladocera						
Evadne anonus prolongata						✓
Evadne anonus typica		✓				✓
Podonevadne trigona						✓
Podonevadne trigona typica						✓
Cercopagis pengoi					✓	✓
Polyphemus exiguus						✓
Pleopis polyphemoides	✓	✓				
Copepoda						
Calanipeda aguae dulcis						✓
Eurytemora grimmi				✓		✓
Eurytemora minor				✓		✓
Acartia tonsa	✓	✓	✓	✓		✓
Helicyclops sarsi						✓
Heterocope caspia						✓
Ctenophora						
Mnemiopsis leidyi	✓	✓	✓	✓	✓	✓

[75] Kasimov, A.G., 1994, The Ecology of the Caspian Sea. Azerbaijan Publishing House, Baku

Species	SWAP survey (West) 2015	SWAP survey (East) 2015	Sangachal Bay, 2013	ACG pipeline corridor (13-15) and (6-9), 2012	HWTP, 2009	Bahar Gum Deniz, 2011[1, 2]
Larvae						
Larvae Mollusca		✓	✓			✓
Larvae Balanus	✓	✓	✓			✓
Larvae Copepoda	✓	✓	✓			✓
Larvae Polychaete		✓	✓			

Notes: 1. Average of Gum Deniz and Bahar 1 survey areas
2. The reason for the greater number of species recorded during the Bahar Gum Deniz 2011 is not known but may be associated with survey methodology that was used or specific conditions in this area

5.5.6.2 Fish

According to latest literature reviews, approximately 151 species and subspecies of fish are found in the Caspian Sea and associated river deltas[76]. Due to the Caspian Sea's isolation from other water bodies, the sea is characterised by the presence of many endemic species and harbours 54 endemic fish species[77].

In general, the main distribution of fish species in the southern Caspian is within the shallow water shelf areas. Maximum concentrations of fish are typically found at depths of up to 50m for the majority of the year, with only seasonal migrations into deeper water. Some fish overwinter in the warmer waters of the southern Caspian and migrate to the nutrient rich shallow areas of the north or river deltas in the spring/summer for spawning and feeding[1,2]. The coastal region, including the 3D Seismic Survey Area, will be important for non-migratory (resident) species providing breeding and nursery habitats for a number of species during spring, summer and autumn. The distribution and seasonal patterns of the most important groups of fish are described below.

It is understood that the area to the south of the Absheron Peninsula is an important as a nursery area for almost all commercial fish species. This area is particularly sensitive in early spring, summer and autumn, when resident species are spawning. In addition, migration of sturgeon, roach, grey mullet and other species take place through the SWAP 3D Seismic Survey Area. This occurs from the south to north in the spring and north to south in the autumn.

Fish commonly found in the Southern Caspian Sea can be categorised into the three following types:

- **Migratory species**: this includes sturgeon and shad species whose spawning grounds are the river Kura and other rivers of the south-western and southern Caspian. These species will only be present in the SWAP 3D Seismic Survey Area as individuals passing through;
- **Other species (semi migratory)**: this includes kilka (herring family), the most abundant fish in Caspian fisheries and mullet. Kilka have a wide distribution in the Caspian with important areas in the Southern and the Central Caspian Sea, which is likely to include some parts of the SWAP 3D Seismic Survey Area and have been observed out at depth (SD Contract Area) in the winter. Kilka are also important prey for other species such as sturgeon, salmon and the Caspian seal. Mullet were introduced from the Black Sea in the 1930s and normally overwinter in the southern Caspian. They migrate in the spring to feeding grounds in the Central and Northern Caspian. Spawning takes place in deep waters between June and September. Mullet are not likely to be in the SWAP 3D Seismic Survey Area in any great numbers; and
- **Resident species**: several non-commercial species such as gobies are found in all regions of the Caspian Sea, predominantly in shallower areas (up to 30-70m in spring and summer, migrating to greater depths in winter). Gobies are second only to herring in the number of species in the Caspian Sea.

[76] Ivanov V.P., Komarova G.V., 2008, Fishes of Caspian Sea (systematics, biology, industry), Astrakhan, p.224
[77] GIWA UNEP 2006, Regional Assessment Report 23 – the Caspian Sea, Global International Waters Assessment Program

The migration routes and spawning areas of the key fish species passing through the SWAP 3D Seismic Survey Area are shown in Figure 5.14 and the depths where fish are likely to be present are shown in Table 5.21.

Figure.5.14: Migration Routes for Herring/Shad, Mullet, Sturgeon, Kilka and Beluga

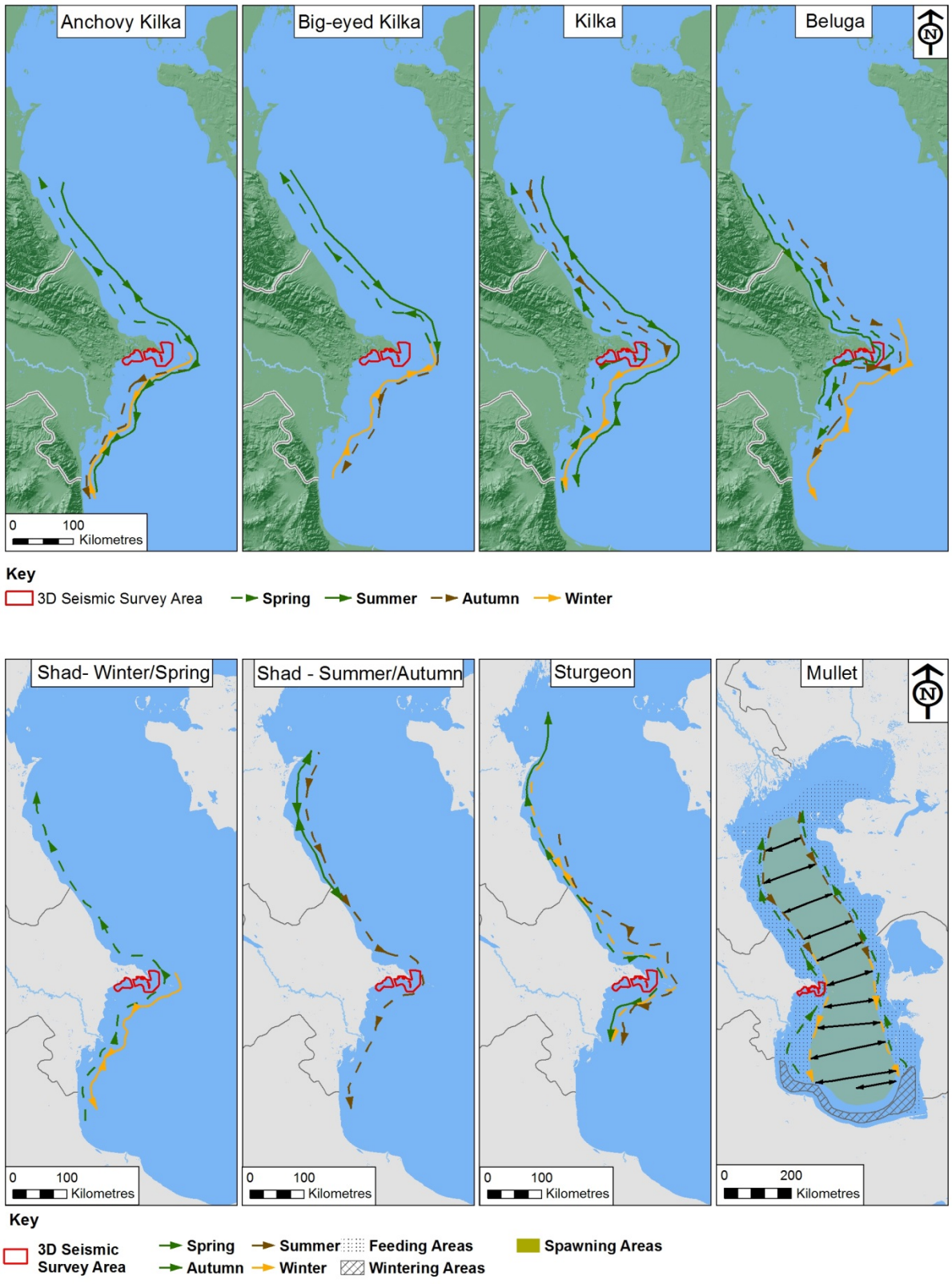


Table 5.21: Summary of the Fish Species Expected to Present in the Southern Caspian Sea

Name of Species	Common name	Hearing group	IUCN Red List Status	Seasonal presence in Southern Caspian Sea	Spring/ Summer Depth (m)	Autumn/ Winter Depth (m)
STURGEON (Family Acipenseridae)						
Huso huso	Beluga	SB	EN #	Spring and autumn migration	Up to 70	80-100
Acipenser guldenstadti	Russian sturgeon	SB	EN #			
Acipenser güldenstädtii persicus natio cyrensis	Kura (Persian) sturgeon	SB	EN #			
Acipenser nudiventris	Kura barbel sturgeon	SB	EN #			
Asipenser stellatus stellatus natio cyrensis	Kura (South-Caspian) stellate sturgeon	SB	EN #		Up to 50	75-100
KILKA (genus *Clupeonella*, family Clupeidae – herring)						
Clupeonella engrauliformis	Anchovy kilka	SB/HS	LV	Migrating along coastline in spring/ summer and winter	Up to 40	A: ≤ 60-80 W: ≤ 100-130
Clupeonella grimmi	Big-eyed kilka	SB/HS	LV		Up to 80	A: up to 80-100 W: up to 130-450
Clupeonella delicatula caspia	Caspian common kilka	SB/HS	LV		Up to 40	
SHAD (genus *Alosa* Cuvier, family Clupeidae – herring)						
Alosa caspia caspia	Caspian shad	SB/HS	LC	Spring and autumn/ winter migration route	Up to 40	A: up to 30-40 W: deeper but depth not known
Alosa brashnikovi autumnalis	Big-eyed shad	SB/HS	LC			
Alosa kessleri volgensis	Volga shad	SB/HS	LC		Depth not known	A: depth unknown W: > 100
Alosa kessleri kessleri	Black-backed shad	SB	LC			
CARP (family Cyprinidae)						
Rutilus frisii kutum	Kutum/Black Sea Roach	SB	LC	Feeding summer/ autumn	Up to 20-50	
Rutilus rutilus caspicus	Caspian roach/Kulma	SB	LC	Year round migration	Up to 10-25	
Alburnus chalcoides (or Chalcalburnus chalcoides)	Danubian bleak	SB	LC	Southwest migrations in coastal waters	Up to 20-30	
Vimba vimba	Bream	SB	LC	North-south migrations	Up to 20-25	
Cyprinus carpio	Common carp	SB	VU	North-south migrations in autumn/ winter and migration to shallow waters in the spring	Up to 8-20	
MULLET (family Mugilidae)						
Lisa auratus	Golden mullet	SB	LC	Summer feeding and spawning	Up to 400-500	
Lisa saliens	Leaping mullet	SB	LC		Up to 200-300	
OTHERS						
*Atherina mochon pontica nation caspia**	Big-scale sandsmelt	SB	-	Migrations to shallow coastal waters in spring and summer	Up to 50	
Gasterosteus aculeatus	Three-spined stickleback	SB	LC	Migrations in sea	Up to 20	
Salmo trutta caspius	Caspian trout	SB	LC	Feeding migrations during the year	Western coastal areas of middle and southern Caspian at depths up to 40-50 m.	

Name of Species	Common name	Hearing group	IUCN Red List Status	Seasonal presence in Southern Caspian Sea	Spring/ Summer Depth (m)	Autumn/ Winter Depth (m)
Syngnathus nigrolineatus caspius	Pipefish/needle fish	No SB	LC	Present all year in shallow coastal areas	Up to 10	
Sander marinus	Estuarine perch	Not known	LC	Migrations in sea	Up to 50-100	
MULLET (family Mugilidae)						
Lisa auratus	Golden mullet	SB	LC	Summer feeding and spawning	Up to 400-500	
Lisa saliens	Leaping mullet	SB	LC		Up to 200-300	
GOBY (family Gobiidae)						
Neogobius caspius	Caspian goby	V	LC	Resident species predominant in shallow water but also found offshore in winter	Up to 70	> 70 up to 500
Neogobius melanostomus affinis	Round goby		LC			
Neogobius syrman eurystomus	Caspian syrman goby		LC			
Neogobius fluviatilis	Monkey goby		LC			
Knipowitschia longicaudata	Knipovich long-tailed goby		LC			
Neogobius kessleri gorlap	Caspian big-headed goby		LC			
Benthophilus grimmi	Grimm big-headed goby		LC			
Neogobius bathybius	Deepwater goby		LC			
Knipowitschia Iljini	-		LC			
Mesogobius nonultimus	-		LC			
Anatrirostrum profundorum			LC			
Benthophilus ctenolepidus	Persian Goby		LC			

Key:
Hearing Type: SB – fish with swim bladder; V – sometimes lacking swim bladder depending on species; HS – hearing specialists with wide frequency hearing range
IUCN Red list: EN – endangered; LV – low vulnerability, LC – least concern, # also included in Appendix II of CITES
Seasons: A – autumn, W – winter
* Also known as *Atherina boyeri caspia*.

The timing of species most likely to be present in the deeper waters of the SWAP 3D Seismic Survey Area (between approximately 10 and 25 m) are:

- Sturgeon – spring and autumn migration route passes through shallow coastal waters;
- Kilka – most likely to be in shallow waters during spring and summer migrations;
- Shad – spring (northwards) and autumn (southwards) migration in shallow waters;
- Mullet – spawning in the summer months on east and west coastal areas;
- Roach – Black Sea and Caspian roach present in spring months (February to April);
- Sandsmelt – present in the contract area all year round; and
- Gobies – widely distributed in shallow waters all year round, breeding between April and July.

The only data immediately available on nearshore fish populations is contained in a series of reports of studies conducted for BP in Sangachal Bay between 2000 and 2014. The majority of these studies have focused on chemical and biomarker analyses conduced on resident fish populations of gobies and sandsmelt, and have not attempted to make overall assessments of fish community composition and abundance.

During recent years distribution and abundances of kilka has altered in response to a number of factors including overfishing, and the presence of the invasive ctenophore (*Mnemiopsis leidyi*). Data from Department on Protection and Reproduction of Aquatic Bioresources (DPRAB) indicates that the total quantity of kilka (traditionally the most important species for the fishing industry) landed in the

Azerbaijan Sector of the Caspian Sea has consistently reduced by 96% from 2002 (10,950 tonnes) to 2011 (485 tonnes).

As well as a reduction in catch size the proportional share of species in catches has changed, from being dominated by anchovy kilka (*Clupeonella engrauliformis*) to ordinary Caspian kilka (*Clupeonella cultriventris)* being the dominant species in fish catches. In addition major aggregations of kilka have been observed in nearshore locations in less than 50 m of water, such as at Oily Rocks rather than in deeper waters at the traditional fishing banks.

Most of the fish species, including sturgeon which are IUCN classified 'endangered' possess a swim-bladder, a gas-filled sac found in most bony fishes of the class Osteichthyes which provides buoyancy and can act as a sound-producing organ. The swim-bladder can enhance the hearing capability of the fish species through the amplification of underwater sound. Fish with swim-bladders therefore tend to be more sensitive to sound than those that do not possess such an organ. Subsequently, there is potential for such species of fish to be more susceptible to underwater sound than fish with no swim-bladder.

Fish of the herring family and its relatives (Clupeiformes) are regarded as hearing specialists because their hearing below 1,000 Hz is generally similar to other fish but their hearing range extends to at least 4,000 Hz and some species (e.g. American shad) are able to detect sounds to over 180 kHz[78].

Hearing specialist fish, in particular kilka, are likely to be found in the SWAP 3D Seismic Survey Area year round although in smaller numbers in winter, outside the main spawning and migration periods.

5.5.6.3 Caspian Seals

The Caspian seal (*Phoca caspica*) is the only marine mammal present in the Caspian Sea. The species is endemic to the Caspian Sea and has been listed on the IUCN Red List of Threatened Species as 'Endangered' since October 2008. The population of Caspian seal has decreased by more than 90% since the start of the 20th century and continues to decline, considered to be due to a combination of commercial hunting, habitat degradation (through introduction of invasive species), disease, industrial development, pollution and fishing operations using nets. The population is now thought to be around 100,000 individuals though this estimate is disputed by Russian scientists (refer to Appendix 5A).

Caspian seals are observed in many regions of the Caspian Sea depending on the season as they undertake annual migrations between breeding locations in the north and feeding locations in the south[79] (Figure.5.15). In the winter, seals are found in the north of the Caspian Sea where pupping and mating occurs on the ice before migrating in the spring to the summer feeding grounds in the south of the Caspian Sea.

Pupping occurs between the end of January and the beginning of February although this can vary by up to a month depending on weather. About a month after giving birth, females finish nursing the pups and once lactation has finished seals mate on the sea ice.

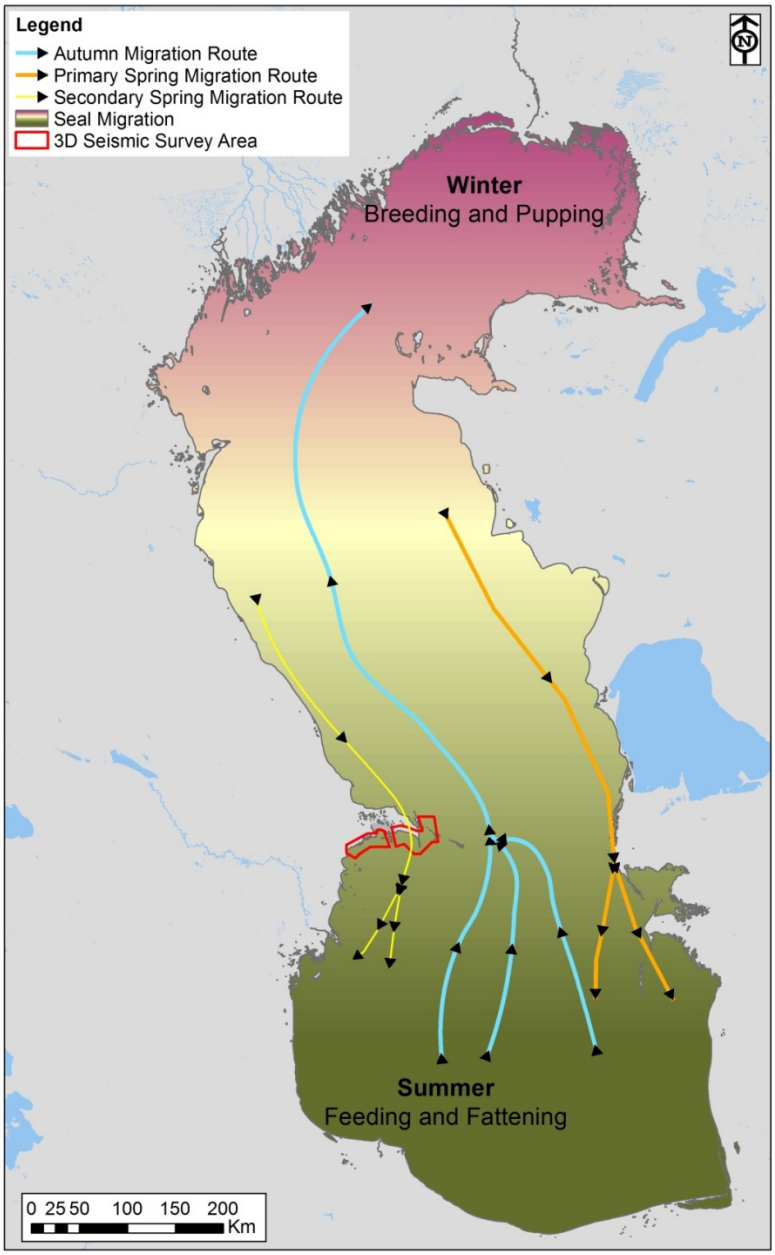
When the sea ice melts the seals begin their southern migration in two directions - most travel along the east coast of the Caspian Sea while the remainder, between 15,000 and 20,000 seals, travel south along the west coast (Figure.5.15) though some 3,000-5,000 individuals remain in waters to the north of the Absheron peninsula. The western spring migration is observed as a wide strip to the centre of Caspian and so seals may observed in a wide area. The route passes between Pirallahi Island, Chilov Island and Oily Rocks near the Absheron Peninsula (Figure.5.15).

[78] Popper, A.N. 2012, Fish Hearing and Sensitivity to Acoustic Impacts. Appendix J. Atlantic OCS proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas, Draft Programmatic Environmental Impact Statement. OCS EIS/EA BOEM 2012-005. March 2012. 2 vols. Available from http://www.cbd.int Accessed August 2015

[79] Eybatov, T. M., 2015, Long term observations of seal population numbers and migration patterns by the seal research team at the Zardabi Natural History Museum

Historically, southwards migrating seals have appeared in the waters of Azerbaijan from late April to early May with peak numbers of seals observed in the vicinity of the Absheron Peninsula and the adjacent islands to the east between late April and May. However, since 2009, seals have been observed in the waters of Azerbaijan at the beginning of April. These earlier observations, from aerial data collected by helicopter pilots and seal tracking[80], are thought to be the result of earlier melting of the sea ice and the need for seals to feed in the south for longer due to lower stocks of fish in general, and kilka in particular. There are no longer any permanent seal rookeries in Azerbaijani waters though temporary haul out sites are observed in the spring and autumn migrations.

Figure 5.15: Spring and Autumn Migration of the Caspian Seal



In early or mid-May most seals move from the islands of Absheron Peninsula and oil rocks and head east and southeast towards the central part of the Caspian Sea (refer to Appendix 5A). However, around a third of these seals do not travel further south, remaining around the north of the Absheron

[80] Liliya Dmitrieva, 2015, *Pers Comms*

Peninsula during the summer time. They usually keep a distance of 1-2 km away from the coastline but can be observed anywhere between the coast and the central part of the Caspian Sea. The maximum concentration is usually between 2 km and 8 km from the coastline.

From the area to the east of the Absheron Peninsula, seals have been observed to migrate south in two directions. The main route taken is directly south to the Southern Caspian where seals feed on anchovy kilka and herring. A secondary route, parallel to the south-west coastline of Azerbaijan (Figure 5.15) is taken by fewer seals towards the Kura River delta where they feed on roach or towards the fishing nets installed near Shirvan National Park. Their migration routes are closely linked with the migration and distribution of kilka, which is the main source of food for seals. Thus, there may be minor numbers of seals travelling south-west in the spring.

It is understood that seals generally avoid the shallow coastal waters south of the Absheron Peninsula due to high turbidity in the area generated by currents and the relatively shallow water. The spring migration is considered to be the most sensitive period for seals in the vicinity of the Absheron Peninsula as they are more vulnerable as they have depleted fat reserves following the winter pupping and mating season. In spring a significant number of seals rest on the islands of the Absheron Peninsula.

The winter migration northwards starts in October, following similar routes in the opposite direction. Thus, seals are again observed in the waters of Azerbaijan, particularly in the vicinity of the Absheron Peninsula and the adjacent islands to the east from October to mid-December, with peak numbers generally observed in November. However, in recent years the northwards migration has been delayed and it is now expected that significant numbers of seals will be still present in Azerbaijani sector of Caspian Sea during the first half of December. In contrast to the spring migration the autumn migration is not characterised by high speed movement of seals and therefore the islands of the Absheron archipelago are usually not massively crowded during the autumn migration months.

Recent seal observation data, from 2010 to 2015, in the area around the Absheron Peninsula have been collected by helicopter pilots and compiled by the Zardabi Natural History Museum[81]. These observations give an indication of the presence of seals in areas in and adjacent to the SWAP 3D Seismic Survey Area. The records of these observations are provided within Table 5.22 with the approximate areas where seals were observed shown on Figure 5.16. It should be noted this data from aerial observations can only provide indicative information with regard to areas known to be used by seals as the observations are not systematic.

[81] Eybatov, T. M., 2015, Caspian Seal Status Report for Seismic Project SWAP, Zardabi Natural History Museum

Table 5.22: Location of Caspian Seal Seasonal Sightings from Aerial Observations in the Period Spring 2010 to Spring 2015

Season	Location	Observations Made
Spring	Pirallahi Island Kichik Tava Island Boyuk Tava Island Tava Alti Island Dardanella Chilov Island Oily Rocks Shahdili Spit Gugushu Garabatdag Island Urunos Island	Early migrations (observations seals at the beginning of April) in 2011 and 2014. Seals observed in small to large (200-400 individuals) groups, particularly in the islands south of Pirahilli Island. Large numbers observed in 2011 and 2013 in particular.
Summer	Yalama to Lankaran Oily Rocks South of Shahdili Spit Between Chilov Island and Oily Rocks	Smalls groups of seals observed offshore. Occasional observations of seals following supply boats and small groups at night around ships with bright lights.
Autumn	Pirallahi Island Chilov Island Around the Absheron Peninsula and Shahdili Spit Gizilagach resort Shirvan resort	Observations in the autumn range from small to very large groups (consisting of several hundred seals) seen around the Absheron peninsula and islands in late October and November.
Winter	Chilov Island including southern spit Tava Alti Island Urunos Island Garabatdag Island Dardanelli Kichik Tava Island	Seals either absent or seen only as individuals or very small groups during winter.

The data currently available, supplemented with local specialist knowledge, indicates that that the area to the south east and east of the Absheron Peninsula including Pirallahi and Chilov Islands and the other islands in this area is the most sensitive with regard to Caspian Seals. Seals are known to be present in these locations, sometimes in large groups, from late April to early July, the end of May and from October to mid-December. The peak months with regard to sensitivity, are April, May and November with the spring months of higher sensitivity due to the vulnerability of the seals as their fat reserves are depleted after the months spent on sea-ice in the north during these months in particular.

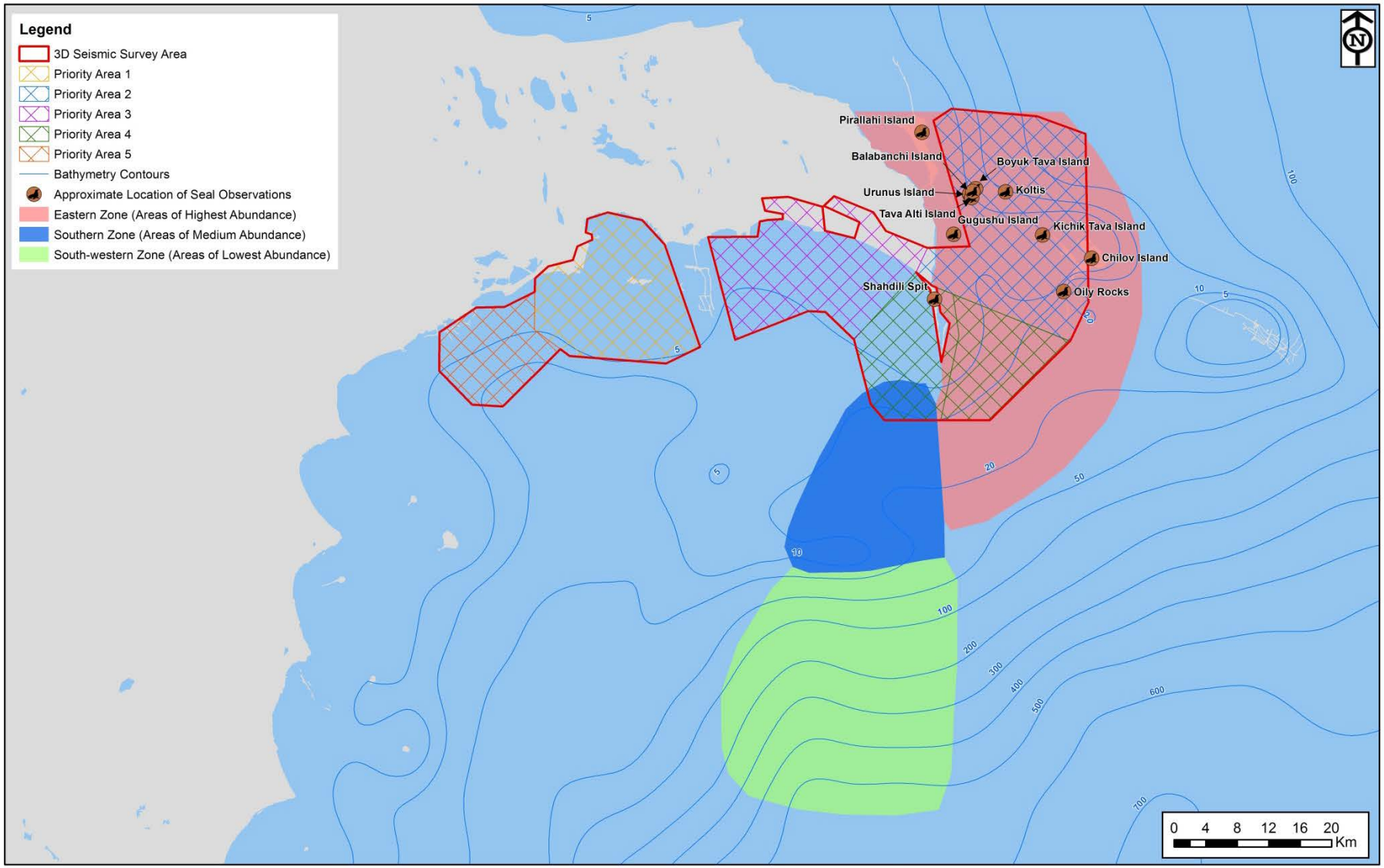
In liaison with local specialist, Tariel Eybatov, indicative areas have been determined relative to the 3D Seismic Survey Area in which seals are considered particularly sensitive during the spring and autumn migration periods and specifically during April, May and November. There are three indicative areas, an eastern zone most frequently visited by seals during the spring and autumn migration, a southern area where seals may be also be observed during migration but in lower numbers and a south-western area that has the lowest attendance of seals and are present only in the summer months. These areas are shown in Figure 5.16.

In general the hearing of all seal species is restricted to the 10Hz - 100kHz frequency range, therefore they are highly sensitive to low frequency sound of the type generated by seismic surveys with effects ranging from potential auditory injury to an avoidance response depending on source sound level and the distance from the source[82].

It should be noted that no systematic scientific Caspian seal surveys have been undertaken in Azerbaijani waters for 20 years. As such there is a high level of uncertainty around the data presented in this section which is based on available information and expert advice at the time of writing.

[82] Southall, B. L., A. E. Bowles, William T. Ellison, J. J., J. J. Finneran, R. L. Gentry, C. R. G. Jr., D. Kastak, D. R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas, and P. L. Tyack. 2008. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals 33:1-521.

Figure 5.16: Approximate Locations of 2010-2015 Observations of the Caspian Seal and Location of Sensitive Seal Areas During Migration in the Vicinity of the SWAP 3D Seismic Survey Area



5.6 Cultural Heritage

5.6.1 Terrestrial Archaeology and Cultural Heritage

A non-intrusive archaeology and cultural heritage field reconnaissance survey was undertaken between 30th October and 6th November 2015 in liaison with archaeologists from the Institute of Archaeology and Ethnography (IoAE). The purpose of the survey was to confirm the presence of potentially important archaeological and cultural heritage sites present or anticipated to be present within the onshore 3D Seismic Survey Area.

Prior to commencing the survey, potentially important archaeological and cultural heritage sites were initially identified from lists of locally and nationally designated archaeological, cultural and historical sites provided by the Ministry of Culture and Tourism (MoCT). Geographic information provided for these sites was limited. Historic cartographic sources[83] and satellite mapping[84] were also reviewed.

During the survey, in addition to the expert knowledge of the IoAE archaeologists, further information was gathered from local community members to identify the location of sites and from resources held within local museums and institutions, who also provided information and records relating to previous finds within the area and chronological information.

The sites identified within or immediately adjacent to the onshore 3D Seismic Survey Area (within 200m) are summarised within Table 5.23 below. The locations of these sites are shown within Figures 5.17 and 5.18.

Full details of the survey approach, a description of previous archaeological investigations in the area, a chronological review and a detailed inventory of sites found with coordinate information and site photographs is contained in Appendix 5D.

[83] U.S. Army Map Service, 1954, 1:250,000, Eastern Europe Series N501, NK 39-10 Baku. Available at: http://www.lib.utexas.edu/maps/ams/eastern_europe/txu-oclc-6519747-nk39-10.jpg Accessed October 2015
U.S. Army Map Service, 1954, 1:250,000 Eastern Europe Series N501, NK39-11 Buzovny. Available at: http://www.lib.utexas.edu/maps/ams/eastern_europe/txu-oclc-6519747-nk39-11.jpg. Accessed October 2015
Joint Operations Graphic U.S. National Geospatial Intelligence Agency, 1970, 1:250,000. Russia, NJ39-11. Available at: http://www.lib.utexas.edu/maps/jog/russia/nk-39-11-baku-ussr.pdf. Accessed October 2015
Soviet General Staff map K-39-XXXII, 1987, 1:200,000, Baku Portion. Available at: http://www.lib.utexas.edu/maps/commonwealth/baku_87.jpg Accessed October 2015
Republic of Azerbaijan Geodesic Committee, 1991, 1:100,000, Absheron, Baku.
Russia Joint Operations Graphic U.S. National Geospatial Intelligence Agency, 1998, 1:250,000, NJ39-1. Available at: http://www.lib.utexas.edu/maps/jog/russia/nj-39-1-salyan-azerbaijan-iran.pdf Accessed October 2015
Russia Joint Operations Graphic U.S. National Geospatial Intelligence Agency, 1998, 1:250,000, NJ39-10. Available at: http://www.lib.utexas.edu/maps/jog/russia/nk-39-10-kyurdarmir-ussr.pdf Accessed October 2015.

[84] Satellite imagery supplied by BP for the Absheron Region, August – November 2014

Table 5.23: Summary of Archaeology and Cultural Heritage Survey Sites and Findspots Identified within SWAP 3D Seismic Survey Area

Site ID	Summary	Location	Description	Importance[1]
Area PA1				
ACH023	Mosque	Bibiheybat settlement, Sabail District	Bibiheybat mosque. Post-Soviet. In active use.	Local/National[2]
ACH028	Memorial		1941-1945 memorial southwest of Bibiheybat new mosque.	-
ACH029	Cemetery		Bibiheybat cemetery (open). Visible headstones date from late 19th century onwards. Others, eroded or undated, may be earlier.	-
ACH030	Memorial		Memorial to martyr, 1994.	-
ACH033	Mosque (site of, demolished)		Site of former Bibiheybat mosque (no longer extant). Demolished during Soviet era. Was located in area of present mosque.	-
ACH034	Memorial	Sabail District, Bag Park	Graveside memorial to Polish engineer Pavel Pototski (1879 -1932), oil pioneer, erected in 2005.	Local/National[3]
ACH035	Historic settlement		9th to 12th century medieval settlement core of Bibiheybat.	Local/National[4]
Area PA2				
ACH001	Field of burial mounds	Khazar District.	Group of at least three Bronze Age burial mounds, some with kerbed sides, with square central chambers excavated since 2000. Surrounded by extensive quarrying. Adjacent is a set of braided prehistoric trackways (ACH002) cut into the limestone pavement.	National[5]
ACH002	Trackway		Part of a series of extensive braided parallel trackways cut into limestone pavement, between the island of Pirallahi and the villages of Gala, Turkan, Hovsan, Zira and Surakhani. Possibly linking sacred sites/fire temple shrines. May date to 2nd or 3rd millennium BC.	National[6]
ACH014	Cemetery	Surakhani District.	Modern cemetery east of Hovsan (open).	-
ACH015	Cemetery		Small cemetery east of Hovsan. A couple of old graves; modern graves; one recent burial (open).	-
ACH016	Cemetery	Khazar District.	Modern cemetery northwest of Yeni Turkan (open).	-
ACH017	Cemetery		Small modern cemetery northwest of Yeni Turkan (open).	-
ACH018	Memorial		Martyr's memorial, 1994, adjacent to road west of Turkan.	-
ACH022	Field of burial mounds		Bronze Age kurgan burial mound field, Turkan. 3rd to 1st millennium BC. Some were excavated in 1950s and 1960s prior to the development of the stone quarry north of Turkan but some survive within a walled plot. Two likely and three possible kurgans either located in gaps between limestone pavement, or in burial chambers beneath low mounds.	National[7]
ACH024	Field of burial mounds		Bronze Age kurgan burial mound field, Turkan. 3rd to 1st millennium BC. Some were excavated in 1950s and 1960s prior to the development of the quarry north of Turkan but at least one burial mound and two other possible small kurgans.	National[7]
ACH019	Historic military base		Abandoned and ruined Soviet era military base. Mess building, corrugated iron huts, wooden barracks, local shelly limestone-built barracks, plastered in various colours. Concrete hardstanding. Bunkers are present, blast walls and hatches are visible.	-
ACH020	Late medieval pottery scatter		Pottery scatter principally noted on partly quarried stable and vegetated sand dunes, also a thin and probably reworked or redeposited scatter on beach/flat area south of road. Thin shells/pottery above sand - no deposit depth or stratification. Free sections of eroding dune/quarried areas reveal stratified shell/storm deposits.	Potential National[8]
ACH027	Historic settlement		Area of archaeological potential. Ruined domestic stone structures and ruined culvert/cistern, probably 19th century. Possibly cleared or abandoned village.	-
ACH031	Historic military structure		The remains of a substantial reinforced concrete structure that has been demolished almost to ground level.	-

Site ID	Summary	Location	Description	Importance[1]
ACH032	Historic military structure		The remains of an approximate square earthwork enclosure located close to possible military structures, and of possible post-1940 date.	-

Notes: 1. Importance is based on whether site is protected under international and/or national law and includes UNESCO World Heritage Sites, Registered Archaeological Monuments, Architectural Monuments, Monuments of History, War Memorials, Reserve Areas/Habitats Protected by the State and Monument Protection Zones
2. Designation in progress (Temporary Inventory No. 62)
3. Designation in progress (Temporary Inventory No. 93)
4. Designation in progress (Temporary Inventory No. 155)
5. Archaeological monument. Inventory No. 502.
6.. Located adjacent to site ACH001 (National Inventory No. 502), a group of excavated Bronze Age kurgans. Included with an archaeological protection zone defined by the MoCT.
7. Archaeological monument. Inventory No. 500
8. IoAE indicated that this site could be a candidate for the national inventory

Figure 5.17: Archaeological & Cultural Heritage Sites Identified Within Priority Area 1

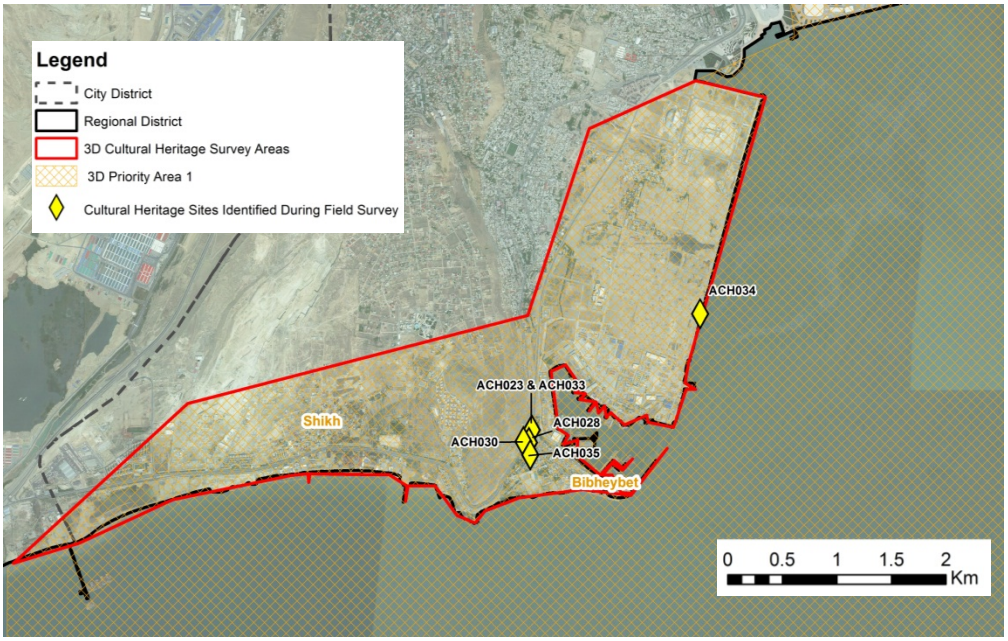
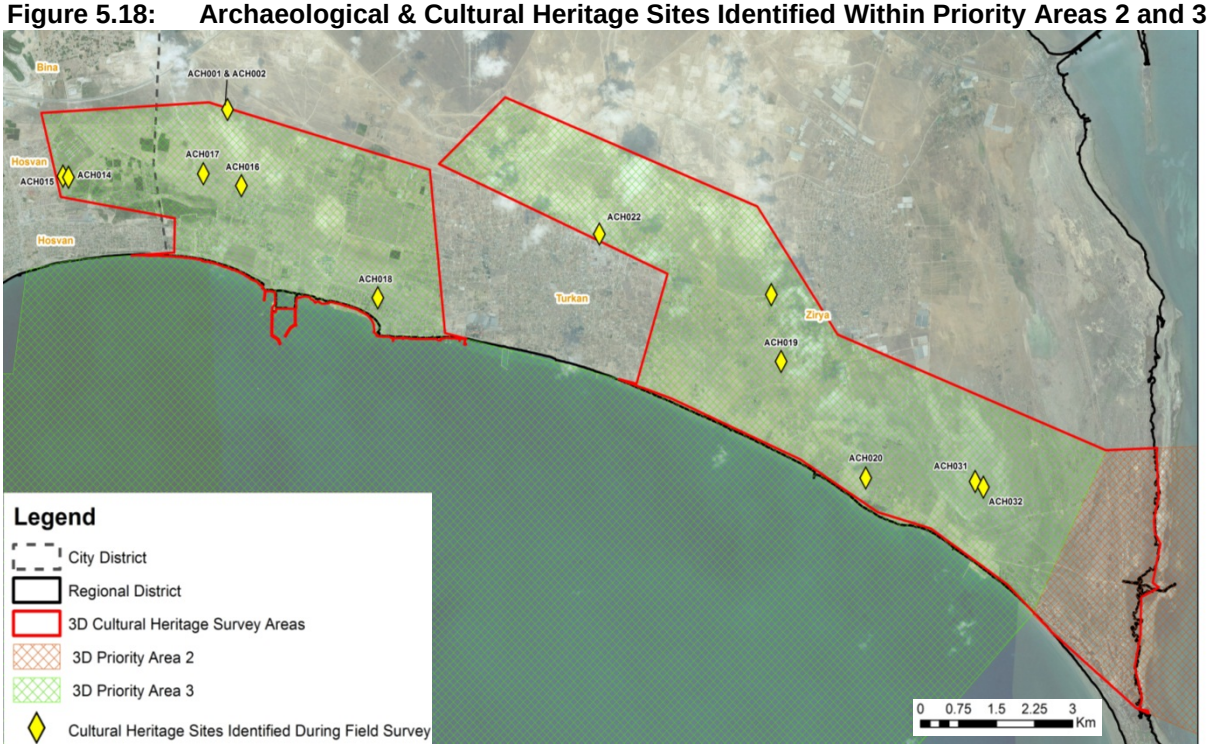


Figure 5.18: Archaeological & Cultural Heritage Sites Identified Within Priority Areas 2 and 3



As Table 5.23 shows there are no internationally recognised or designated cultural heritage features or areas within the onshore 3D Seismic Survey Area however two nationally designated archaeological, cultural and historical sites have been identified. These comprise two groups of Bronze Age burial mounds located northeast of Hovsan and north of Turkan (sites ACH001 and ACH022 & ACH024 respectively). The latter two were located within the vicinity of the area used for quarrying rock (refer to Section 5.4.1)

Prehistoric stone-cut trackways or cart-ruts between Turkan and Hovsan (ACH002) are associated with nationally designated archaeological monument burial mounds northeast of Hovsan (ACH001). These trackways are surrounded by a Protection Zone designated by the MoCT.

In addition three sites were identified which are in the process of being designated by the MoCT. These comprise:

- the modern mosque at Bibiheybat (ACH023)
- the graveside memorial of an oil pioneer at Bibiheybat (ACH034); and
- the 9th to 12th century medieval settlement core of Bibiheybat (ACH035)

One late medieval pottery scatter located on sand dunes and the coastal plain in the south of Area PA2, near the seashore (ACH020) could be a candidate for the national inventory.

It should be noted that a number of sites on the MoCT list of protected sites and monuments thought to be potentially located within the onshore 3D Seismic Survey Area were not identified during the survey. This is likely to be due to a number of factors. Specifically the Absheron Peninsula including extensive areas of the onshore 3D Seismic Survey Area, have been subject to urban, industrial, military and agricultural development, quarrying, oil exploration and land reclamation. Other areas have been subdivided by property boundaries. These activities are expected to have resulted in the widespread loss of archaeological remains in the onshore 3D Seismic Survey Area and beyond. In addition many archaeological sites are relatively shallow surface sites with little depth of stratigraphy, due to erosion and limited soil formation above the limestone pavement. As such, where present and intact, sites may have been buried by wind-blown sands.

Previous intrusive investigations across the Absheron Peninsula (refer to Appendix 5.D) have recorded archaeological remains dating from the Palaeolithic to the post-medieval period. Therefore in addition to the sites listed in Table 5.23, there is some potential for the presence of further archaeological sites across the onshore 3D Seismic Survey Area, particularly in areas that have not been subject to development or ground disturbance.

5.6.2 Marine Cultural Heritage

The ancient Paratethys Sea was a large shallow sea that stretched from the region north of the Alps in Europe to Central Asia. From the start of the Pliocene period (approximately five million years ago), the Paratethys Sea became progressively shallower; the Caspian Sea is a remnant of this. The Caspian has been subject to extensive fluctuation in sea levels, with recorded sequences of succession and regression[85]. As a result a number of ancient settlements and fortifications have been claimed by rising sea levels, resulting in submerged archaeological landscapes.

Baku and the Absheron Peninsula have a rich cultural heritage dating back to the late Stone Age. The coastal plains were vulnerable to attack from the sea and consequently a number of fortifications were built along the coastline primarily during the 13th to 15th centuries. As the sea level of the Caspian Sea has fluctuated over time a number of the cultural heritage assets have been become inundated by the sea. There has been little marine archaeological research in Azerbaijan since the end of the

[85] Kvachidze, V.A., and Veliyev, S.S., 1997, "*Periodichnost izmeneniya urovnya Kaspiyskogo morya v istoricheskoye vremya*" (Periodicity of change in the level of the Caspian Sea in history). Reports of the Academy of Sciences of Azerbaijan, 1997, No. 1 [In Russian]; Karpychev, Y.A., 2001. "Variations in the Caspian Sea Level in the Historic Epoch," Water Resources 28/1,5

Soviet era[86]. No recent survey has been undertaken to identify potential marine cultural heritage, however two confirmed marine archaeological sites[87] located within the 3D Seismic Survey Area in (refer to Figure 5.19) are known:

- **Bayil Castle** – located approximately 350m from the shoreline, the castle was built on the Bayil Hills in the 13th century by Shirvanshah Fariburz III. As a result of an earthquake in 1306, the castle collapsed and subsequent sea level rises caused the complete submergence of the castle. Since 1306 the Caspian Sea level has fluctuated and in the 18th century the castle ruins were visible again due to a fall in the sea level. However, recent sea level rises have completely submerged the castle again. The site was investigated by the Institute of History, Academy of Science, between 1939 and 1969; and
- **Ancient fortress** ('Zira Fortress') - this site is located on the shelf of the eastern boundary of the Absheron Peninsula. The structure appears to have been significantly altered by the action of silt and/or sand drift. The site is not known to have been subject to archaeological investigation.

In addition, there is a high potential for submerged marine archaeology, including shipwrecks and possibly buried former land surfaces across the SWAP 3D Seismic Survey Area. There is a high probability that the approaches to Baku and Hovsan contain archaeological shipwrecks. A number of medieval and early post-medieval shipwrecks in the vicinity of Absheron Peninsula were investigated by the History Museum of Azerbaijan between the 1960s and 1980s[88].

It is understood the MENR have recently undertaken a study to identify and remove and/or salvage the shipwrecks of modern vessels around the Absheron Peninsula to clear navigational and environmental hazards[89]. In total it is understood that 99 modern shipwrecks were identified in areas just outside of Baku Bay, offshore of Sahil and Bibheybat. To date it is understood that 20 shipwrecks have been removed. Data identifying the locations of the modern wrecks is not currently available.

Figure 5.19 shows the indicative location of Bayil Castle and the ancient fortress.

[86] Kvachidze, V.A., 2001, "*Podvodnyye arkheologicheskiye issledovaniya Muzeya Istorii Azerbaydzhana – k 30-letiyu nachala rabot*" (Underwater archaeological studies of the History Museum of Azerbaijan – on the 30th anniversary of the start of work). History Museum of Azerbaijan – 80. Baku, 2001 [In Russian]

[87] Khalilova T. Sh., and Khalilov, E.N, 2011, Traces of an Ancient Civilization at the bottom of the Caspian Sea. Page 94- 99. Proceedings of the International Congress "Natural Cataclysms and Global Problems of the Modern Civilization". Istanbul, 19-21 September, 2011. Available at: *https://ascendingstarseed.files.wordpress.com/2012/11/international-committee-on-geochange2.pdf* Accessed August 2015

[88] Ibrahimov, K., 2014, "Shipwrecks and Ceramics- Archaeology off the Absheron coast". Visions of Azerbaijan. Available at: http://www.visions.az/art,547/ Accessed August 2015

[89] Trend News Agency, 2007, 99 Shipwrecks in Azerbaijani Part of the Caspian Sea. Available at: http://az.trend.az/azerbaijan/society/928448.html [In Azeri] Accessed August 2015

Figure 5.19: Known Marine Cultural Heritage Sites