South Stream Offshore Natural Gas Pipeline – Turkish Sector

Black Sea – Turkish Exclusive Economic Zone

EIA REPORT

Final EIA Report

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Acronyms

Acronym	Definition
3LPP	three-layer-polypropylene
ALARP	As low as reasonably practicable
API	American Petroleum Institute
As	Arsenic
ASNT	American Society for Non-destructive Testing
ASTM	American Society for Testing and Materials (ASTM)
AUT	Automated Ultrasonic Testing
AUV	Autonomous Underwater Vehicles
Bcm	billion cubic metres
BOD	Biological Oxygen Demand
BSI/BS	British Standard Institution
BUCR	Back Up Control Room
CCR	Central Control Room
Cd	Cadmium
CO_2	Carbon dioxide
COD	Chemical Oxygen Demand
Cr	Chromium
Cu	Copper
DNV	Det Norske Veritas
DP	Dynamic Positioning
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
ENVIID	Environmental and socio-economic Issues Identification
EP	Equator Principles
ESD	Emergency Shutdown
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management Systems
Fe	Iron
FEED	Front End Engineering Design
GIIP	Good International Industry Practice
GSP	Grup Servicii Petroliere
H_2S	Hydrogen sulphide
HAZCON	Hazard Construction
HAZID	Hazard identification
HAZOP	Hazard and Operability
Hg	Mercury

Acronym	Definition
HSSE	Health, Safety, Security and Environment
HSSE-IMS	Health, Safety, Security and Environment – Integrated Management System
IFC	International Finance Corporation
ISO	International Organisation for Standardisation
JSA	Job safety analyses
kg	Kilograms
kg/m^3	Kilogram per cubic metre
km	Kilometres
kW	Kilowatts
LNG	Liquefied Natural Gas
m	Metres
MAH	Major accident hazards
mm	Millimetres
mmscm	Million metric standard cubic metres
mmscm/d	Million metric standard cubic metres per day
Mn	Manganese
Mo	Molybdenum
MoEU	Ministry of Environment and Urbanisation
MoFA	Ministry of Foreign Affairs
mol%	Mole percent
MPa	Mega Pascal
N_2	Nitrogen gas
NACE	National Association of Corrosion Engineers
NDE	Non-Destructive Examination
Ni	Nickel
^oC	Degrees centigrade
OCP	Organochlorine pesticides
OECD	Organisation for Economic Co-operation and Development
OH&S	Occupational Health and Safety
Pb	Lead
PIG	Pipeline Inspection Gauge
PIMS	Pipeline Integrity Management System
PS	Performance Standards
PSD	Process Shut Down
ROTV	Remotely Operated Tow Vehicle
ROV	Remotely Operated Vehicle
SAWL	Submerged Arc Welding Longitudinal
SCADA	Supervisory Control and Data Acquisition
Se	Selenium
SIMOPS	Simultaneous operations

Acronym	Definition
TCS	Telecommunication System
TPAO	Turkish Petroleum Corporation
UGS	United Gas Supply Ltd
UXO	Unexploded ordnance
Zn	Zinc
µm	Micrometres

1 GENERAL FEATURES OF THE PROJECT

This Environmental Impact Assessment (EIA) Report has been prepared on behalf of South Stream Transport B.V. (South Stream Transport) for the proposed South Stream Offshore Natural Gas Pipeline – Turkish Sector (the Project).

1.1 General Features of the South Stream Natural Gas Pipeline System

The South Stream Natural Gas Pipeline System will provide a new supply route that will enhance the long-term reliability of gas supplies from Russia to the countries of Central and South-Eastern Europe via the Black Sea. It will have a design capacity of 63 billion cubic metres (bcm) per year and will extend over more than 2,300 kilometres (km) (**Figure 1.1**).

Figure 1.1: South Stream Pipeline System

The South Stream Offshore Natural Gas Pipeline is the offshore component of the South Stream Natural Gas Pipeline System and comprises four adjacent 32-inch (813 millimetres) diameter pipelines extending approximately 931 km across the Black Sea from the Russian coast near Anapa, through the Turkish Exclusive Economic Zone (EEZ), to the Bulgarian coast near Varna **(Figure 1.2**). 1/25,000 scaled maps of the Project Area are shown in **Appendix 1.A**.

1.2 General Features of the South Stream Offshore Natural Gas Pipeline – Turkish Sector

The Turkish part of the South Stream Offshore Natural Gas Pipeline is known as the 'South Stream Offshore Natural Gas Pipeline – Turkish Sector' and is referred to as 'the Project' throughout this EIA Report. Where this EIA Report refers to the 'South Stream Offshore Natural Gas Pipeline' the intent is to refer to the overall South Stream Offshore Natural Gas Pipeline covering all three countries (Russia, Turkey and Bulgaria).

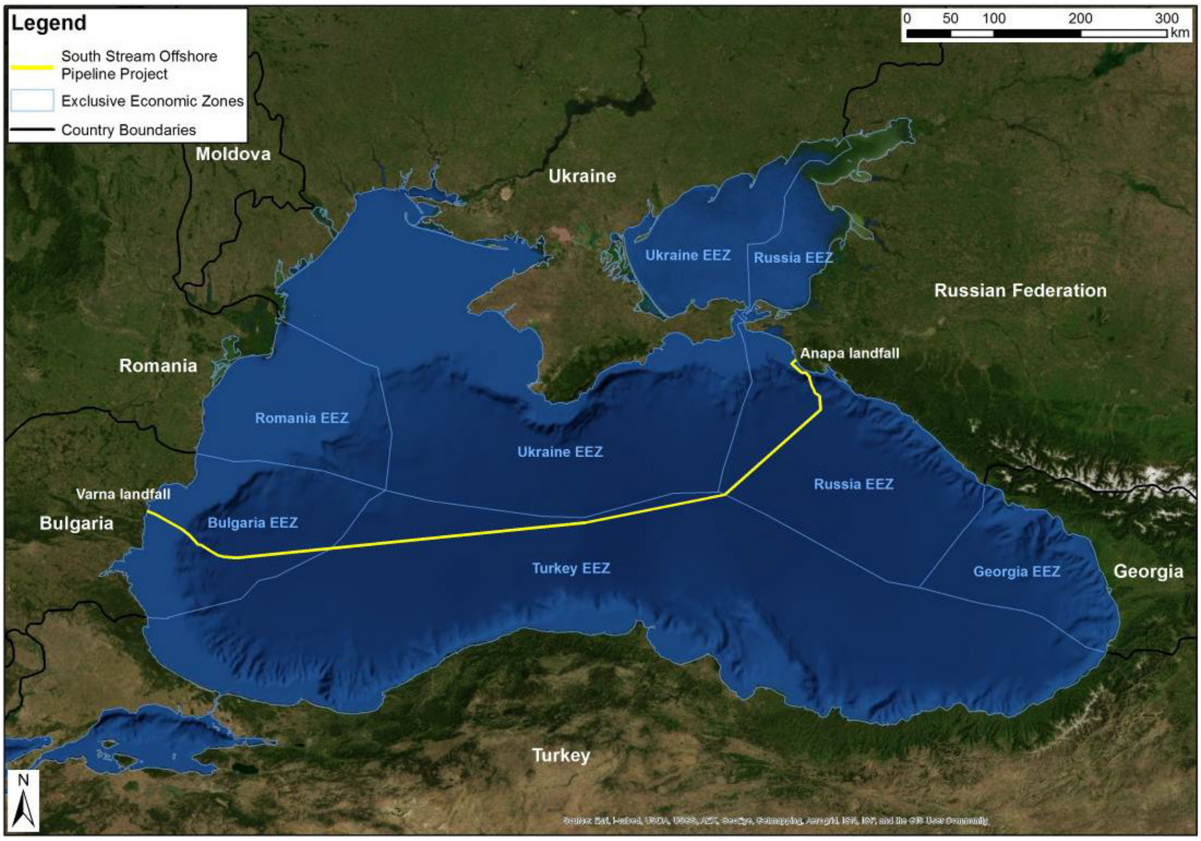

Figure 1.2: South Stream Offshore Natural Gas Pipeline

The Project will comprise the construction and commissioning, operation and decommissioning of four 32 inch diameter (813 mm) subsea steel pipelines running over a distance of some 470 km in the Turkish EEZ. The four pipelines will be laid directly on the seabed within a 2 km wide corridor.

No excavation of or filling over the seabed is anticipated. There will be no landfall facilities within the Turkish Sector.

For the purpose of this EIA, the "Project Area" is defined by a 2 km wide corridor extending 470 km across the Turkish EZZ from the Russian / Turkish EEZ border in the east to the Turkish / Bulgarian EEZ border in the west. This area has been defined based on the extent of the exclusion area around the construction spread that will be temporarily closed for entry for ensuring construction safety.

In addition an operational safety zone, extending either side of the outermost pipelines on the seabed and across the entire pipeline route in the Turkish EEZ, will be determined in consultation with the relevant Turkish authorities in compliance with Turkish requirements and relevant industry and international standards prior to construction. Information on the safety zones proposed is given in Section 6.8 of this EIA Report.

South Stream Transport is committed to implementing Good International Industry Practice (GIIP) in relation to environmental and social performance in all phases of the South Stream Offshore Natural Gas Pipeline and will also follow the standards and guidelines of certain financing organisations.

These guidelines include the Equator Principles (EPs), the Organisation for Economic Co-operation and Development (OECD) Common Approaches, and the International Finance Corporation's Performance Standards (IFC PS).

1.3 The Project Owner

All three Sectors (Russia, Turkey and Bulgaria) of the South Stream Offshore Natural Gas Pipeline are being developed by South Stream Transport B.V., an international joint venture established on 14 November 2012 in Amsterdam, the Netherlands, for the planning, construction, and subsequent operation of the offshore gas pipeline through the Black Sea. South Stream Transport B.V. took over the management of the South Stream Offshore Natural Gas Pipeline from South Stream Transport AG, which managed it from October 2011 to November 2012. Prior to October 2011, the Project was developed by OAO Gazprom. The Russian company OAO Gazprom holds a 50% stake in South Stream Transport B.V.; the Italian company Eni S.p.A. has a 20% stake and the French energy company EDF Group and German company Wintershall Holding GmbH (BASF Group) each hold 15%.

1.3.1 OAO Gazprom, Russia (50%)

OAO Gazprom is the world's largest supplier of natural gas, accounting for approximately 15% of global gas production in 2012. It was established as a joint stock company in 1993, and is partly owned by the Russian state (50%). The company's core activities include the exploration, production, transportation, storage, processing and marketing of hydrocarbons, as well as the generation and marketing of heat and electric power.

Gazprom controls approximately 70% of Russian gas reserves, produces 78% of all Russian natural gas and generates 17% of electricity in Russia. A leading company in the construction and operation of gas pipelines, it controls a 161,700 km gas pipeline network, which transports roughly 660 bcm of natural gas per year.

1.3.2 Eni S.p.A., Italy (20%)

Headquartered in Italy, Eni is one of the world's major integrated energy companies. It operates in the oil and gas, electricity generation and sale, petrochemicals, oil field service construction, and engineering industry sectors. Eni is engaged in all phases of the gas value chain: supply, trading and marketing of gas, infrastructure and Liquefied Natural Gas (LNG) supply and marketing. Eni sells more than 60% of its gas outside Italy and has a leading position in the European gas market. Active in 90 countries, Eni employs 78,000 people and is committed to sustainability.

1.3.3 EDF Group, France (15%)

The EDF Group, one of the leaders in the European energy market, is an integrated energy company active in all areas of the business: generation, transmission, distribution, energy supply and trading. The Group is the leading electricity producer in Europe. In France, it has mainly nuclear and hydroelectric production facilities where 96.5% of the electricity output is carbon dioxide (CO_2) free.

EDF's transmission and distribution subsidiaries in France operate 1,285,000 km of low and medium voltage overhead and underground electricity lines and around 100,000 km of high and very high voltage networks. The Group is involved in supplying energy and services to approximately 27.9 million customers in France alone.

1.3.4 Wintershall Holding GmbH, Germany (15%)

Wintershall Holding GmbH, based in Kassel, Germany, is a wholly-owned subsidiary of BASF which is headquartered in Ludwigshafen. The company has been active in the exploration and production of crude oil and natural gas for over 80 years. Wintershall focuses on selected core regions such as Europe, North Africa, South America, as well as Russia and the Caspian Sea region. In addition, these operations are complemented by the company's growing exploration activities in the Arabian Gulf. Today, the company employs more than 2,000 staff worldwide from 40 nations and is now Germany's largest crude oil and natural gas producer.

1.4 Agreements Signed for the Project

A Protocol between the Government of the Russian Federation and the Government of the Republic of Turkey on Cooperation in the Gas Sphere – to increase the cooperation between two governments – was signed on 6th of August 2009 (**Appendix 3.A**).

On 28th of December 2011, Ministry of Foreign Affairs, Republic of Turkey, issued a letter to the Embassy of the Russian Federation providing an affirmative decision regarding the permit for the construction of the Project provided that certain conditions and legal and technical requirements are fulfilled (**Appendix 1.B)**.

Further information on these agreements is provided in **Chapter 3 Statutory, Political and Administrative Framework** of this Report. Relevant correspondence is provided in **Appendix 1.B** of this EIA Report.

1.5 Scope of Project Phases

1.5.1 Design and Basic Engineering Works

Design and basic engineering works fall under two phases: Feasibility and Development. The Feasibility Phase was initiated by OAO Gazprom. This phase involved the development of feasibility studies in which a number of gas pipeline routes and landfall options were assessed and a preliminary engineering (conceptual) design was developed. Studies undertaken to identify Project engineering and environmental constraints during this phase are listed in **Table 1.1**.

Table 1.1: Surveys Undertaken in Turkish waters during Feasibility Phase

Survey	Number of stations sampled	Parameter
Ecology Surveys (2009)		
Plankton	10	Bacterio-, phyto-, zoo- and ichthyo-plankton
Seabirds	10 stations 6 transects	Seabird observations were conducted whilst at sampling stations and during certain sailing transects
Marine Mammals	10 stations 6 transects	Marine mammal observations were conducted whilst at sampling stations and during certain sailing transects
Ecological Surveys (2011)		
Oceanography	15	Temperature, salinity, turbidity, current speed and direction, sea level, water temperature, waves
Hydrochemistry	15	Odour, colour, pH, dissolved oxygen, hydrogen sulphide (H_2S), Biological Oxygen Demand (BOD), phosphorous, nitrates, nitrites, silicon, Ammonium Nitrogen (N- NH_4), Total and Organic Nitrogen, Silicate Alkalinity.
Plankton	15	Bacterio-, phyto-, zoo- and ichthyo-plankton
Water Quality (Pollution)	5	cadmium (Cd), mercury (Hg), lead (Pb), zinc (Zn), copper (Cu), nickel (Ni), arsenic (As), manganese (Mn), iron (Fe), chromium (Cr), selenium (Se), molybdenum (Mo), Chemical Oxygen Demand (COD), Surfactants, phenols, suspended solids, organochlorine pesticides (OCP)
Bottom Sediments	4	Cd, Hg, Pb, Zn, Cu, Ni, As, Mn, Fe, Cr, Se, Mo, petroleum hydrocarbons, surfactants, phenols, organic carbon, grain size, pH,
Seabirds	12 stations (11 transects)	Seabird observations were conducted whilst at various sampling stations and during sailing transects
Marine Mammals	12 stations (11 transects)	Marine mammal observations were conducted whilst at various sampling stations and during sailing transects
Geophysical / Geotechnical Surveys (2010-2012)		
Bathymetry and seabed morphology	~2 km wide corridor (wider at some locations)	Multi beam echo sounder, side scan sonar
Sediment distribution	~1.2 km wide corridor (wider at some locations)	Sub-bottom profiler
Sediment characterisation	Around 50 sediment cores and 30 chemicals cores	Sediment cores, gravity cores, Conductivity-Pressure-Temperature, piston cores, box cores
Geo-hazards analysis	Identified fault lines	2D high resolution seismic survey
Analysis of geological anomalies	20 targets identified during side scan sonar survey	Unknown sonar contacts / geological anomalies identified during previous side scan sonar were investigated by Remotely Operated Vehicles (ROV)

The Development Phase was undertaken by South Stream Transport. This Phase involves development of the Front End Engineering and Design (FEED) together with the country-specific EIA for national permitting requirements.

This Phase also includes development of an Environmental and Social Impact Assessment (ESIA), an Environmental and Social Management System (ESMS) and an Environmental and Social Management Plan (ESMP) in line with GIIP and to meet the applicable standards and guidelines of financing organisations. Further information is provided in **Chapter 3 Statutory, Political and Administrative Framework** of this EIA Report.

1.5.2 Construction Phase

The Construction and Pre-Commissioning Phase in Turkey will involve all construction and pre-commissioning activities.

This section describes the activities that will take place during the Construction Phase of the Project. Pipe-laying is planned to commence at the border of the Russian and Turkish EEZ, and will be the continuation of the construction of the South Stream Offshore Natural Gas Pipeline – Russian Sector.

Construction of the Project ends at the boundary of the Turkish and Bulgarian EEZ. The main construction activities include:

- Surveying of the pipeline route (pre-lay) and of the pipe-laying installation process (as-laid); and
- Offshore pipe-laying.

1.5.2.1 Surveying

A number of key surveys will be required before, during and after installation of the pipelines to ensure the pipelines avoid any obstacles, are laid along the correct route and are laid without defect.

Pre-Lay Surveys

Pre-lay surveys will be carried out along each pipeline route approximately 45 days prior to commencement of the pipe-lay works to confirm the previous route surveys undertaken during the Feasibility and Development Phases, and to help to finalise the route of the pipelines.

The survey will include a range of geophysical survey techniques and a visual survey using a Remotely Operated Vehicle (ROV) or Remotely Operated Tow Vehicle (ROTV).

These surveys will also confirm the need for and guidance of the removal of boulders, rocks or potentially unexploded ordnance (UXO). Surveys carried out to date in the Turkish EEZ have not identified potential UXO; however, in the event that the pre-lay surveys identify UXOs, these will either be avoided as the pipeline is laid. A UXO clearance plan (if required) will be developed in close conjunction with relevant national authorities at the appropriate time.

All survey results will be submitted to the Ministry of Foreign Affairs (MoFA), the Turkish Naval Forces, the Navigation Hydrography and Oceanography Department, the Coast Guard Command (the Black Sea District Command at Samsun) and any other relevant authorities such as, the Provincial Directorate of the Ministry of Transportation, Maritime and Communication and/or Port Authorities.

Touch-down Monitoring and As-Laid Surveys

During pipe-laying, touch-down monitoring will be conducted in real time to ensure correct installation of each pipeline on alignment and with respect to lateral separation criteria for adjacent pipelines and avoidance of obstacles. An as-laid survey will be performed once each pipeline has been laid on the seabed. The surveys will establish the as-laid position (horizontal and vertical) and condition of the pipelines and may comprise bathymetry and other survey sensors in conjunction with visual inspection by ROV.

1.5.2.2 Offshore Pipe-laying Process

Contracts for the construction of the Project are not in place presently. Consequently, the procurement of materials, equipment and labour as well as the mobilisation of vessels are yet to be determined. However, the pipes to be used for the installation of the Project are anticipated to come from technically qualified pipe mills located in Russia, Europe, Japan, and/or India.

There will be no marshalling yards in Turkey. Materials and equipment for use on the Project may be delivered to marshalling yards in Bulgaria and Russia via rail or sea. If delivered by sea, up to five handysize (a size class of vessel) bulk carriers of 36,000 tonnes capacity per month are anticipated. These vessels will enter the Black Sea through the Istanbul Straits. Goods will be delivered to marshalling yards from Q4 2014 to Q3 2017.

Each pipeline would be laid in an east-west direction, and sequentially from north (Pipeline One being most northerly) to south. Laying of Pipeline Two would commence one month after completion of Pipeline One. Laying of Pipeline Three would commence in the Russian Sector as Pipeline Two leaves the Turkish Sector. Construction of Pipeline Four would commence in the Russian Sector as Pipeline Three leaves the Turkish Sector. Note that there will be no overlapping construction in Turkish waters at any time.

Notwithstanding that construction contracts are yet to be finalised, the following is a general description of typical pipeline laying arrangements.

Offshore pipe-laying is accomplished by the sequential alignment, welding and lowering of pipe segments from a pipe-laying vessel. Pipe-laying may be performed by the S-lay or J-lay technique, the method chosen mainly depends on water depth and/or cost/availability of a vessel. The technique(s) to be employed for pipe-laying are yet to be confirmed. The final choice will be defined after award of the construction contracts following a competitive tendering process with qualified contractors. Therefore, it is assumed that either technique may be used for the Project. The two types of vessel and the two methods which could be used for this Project are both assessed within **Section 1.10**.

During pipe-laying, the pipe segments are carefully stacked on board the pipe-lay vessel using deck cranes and are then transported to the pipe bevelling station where they are made ready for welding. The pipe segments are moved to the first welding station where the pipe segments are clamped and joined together using various automatic welding techniques, including root pass and hot pass welds[1]. When welding has been completed, the welded pipe segment is moved to the inspection station where the weld is subject to Non-Destructive Examination (NDE), performed by visual inspection and Automated Ultrasonic Testing (AUT), to ensure the weld meets the required specification. Any welds not meeting the required specification are removed by cutting out the cylinder of pipe containing the weld. The pipe is then re-welded and subject to another full NDE. Following successful weld testing, the pipe segments move along to the coating stations.

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[1] Root pass welds are the first layer of a multi-layer weld. Hot pass welds are the second layer, which cleans out any remaining slag from the root pass welds.

The number of coating stations depends on the pipe-lay vessel used. In the coating stations, a field joint coating is applied to the welds for corrosion protection. Coating is discussed in **Section 1.6.6.1**.

The pipe-lay vessel utilises dynamic positioning (DP), a computer controlled system that drives the vessel's thrusters (directional propellers) to maintain position or move the vessel forward.

Once the pipe segments have exited the pipe-lay vessel, the vessel stops forward motion, and work commences on welding the next pipe segments together.

After each pipeline has been installed a number of activities, known as pre-commissioning activities, are undertaken to ensure that the pipelines meet operational requirements. The primary objective of these activities is to verify that the pipeline has been laid without defects and is ready to be filled to transport the gas. Pre-commissioning activities include cleaning, gauging, drying and hydro-testing[2] of the installed pipelines.

Cleaning, gauging and drying will be undertaken along the entire route of the South Stream Natural Gas Offshore Pipeline and hence also within the Turkish Sector. No hydro-testing is required in the Turkish EEZ. The pipeline system has been designed in compliance with the design code Det Norske Veritas (DNV) OS F101, modified in this case by a DNV waiver of hydro-testing for the pipelines laid in water depths greater than 30 m. Hence the Project Area within the Turkish Sector will not be impacted by any pre-commissioning activities.

The S-Lay technique (**Figure 1.3**) requires the transport of single 12 m pipe segments to the pipe-lay vessel and welding the pipe segments together horizontally. The pipe segments are continuously 'fed' over the vessel's pipe-laying stinger from the stern of the vessel as the vessel moves forward in such a way that the pipeline forms an "S" shape from the vessel's exit point to the touchdown point on the seafloor. Sufficient tension is required during the S-Lay process to avoid overstressing the pipeline. This tension is maintained via tensioning rollers and a controlled forward thrust to prevent the pipe from buckling. The average pipe-lay rate for S-Lay technique is expected to be approximately 3.5 km per day (24 hour period), depending on weather conditions. **Figure 1.4** shows a typical S-Lay vessel.

J-lay pipeline installation (**Figure 1.5**) was developed for laying pipe in deep waters (>600 m). In the J-Lay method, the pipeline sections are quad or double jointed i.e. 48 m or 24 m long sections. For J-Lay, some of the welding is done onshore at the marshalling yards in Bulgaria or Russia. Pipe segments are then assembled and welded vertically in a tower erected on the centre or side of the pipe-laying vessel.

A pipe tensioner or support frame is used to lower the pipeline through the tower. As the pipe-lay vessel moves forward, the pipeline is lowered in a J-shape down to the seafloor. The average pipe-lay rate using J-Lay technique is expected to be approximately 2.75 km per day (24 hour period), depending on weather conditions. **Figure 1.6** shows a typical J-Lay pipe-lay vessel.

[2] Testing the pipeline with water.

Under both techniques, the weight of the pipeline will cause it to sink to the sea bed, and settle on the bottom sediment. There will be no fixing mechanisms required to secure the pipeline on the sea bed.

No excavation and no fill materials are expected to be required to create a level platform for the pipelines. Based on bathymetry data presented in **Section 6.2.2.3** and **6.2.2.6** of this EIA Report, the sea bed through the Project Area is understood to be flat and featureless. The intention therefore is to lay the pipelines directly on the sea bed.

The number, types and technical specifications of vessels associated with the pipe lay process, and the associated requirements for the transport of personnel (via ship or helicopter) will be determined on appointment of the principal construction contractors. For the purposes of this EIA Report, a typical array of construction vessels, machinery and equipment has been assumed; details are provided in **Section 1.6.9**, **Table 1.8** and **Figure 1.7**, at the end of this Chapter.

No marking signs are proposed. The pipe lay barge and other vessels involved will be illuminated in accordance with maritime regulations. All vessels will be in contact with the Coastguard authorities. Their positions will be known and notified to other marine traffic.

A construction exclusion zone of 2 km radius will be established around the pipe-lay vessel during construction, as explained in **Section 6.8** of this EIA Report.

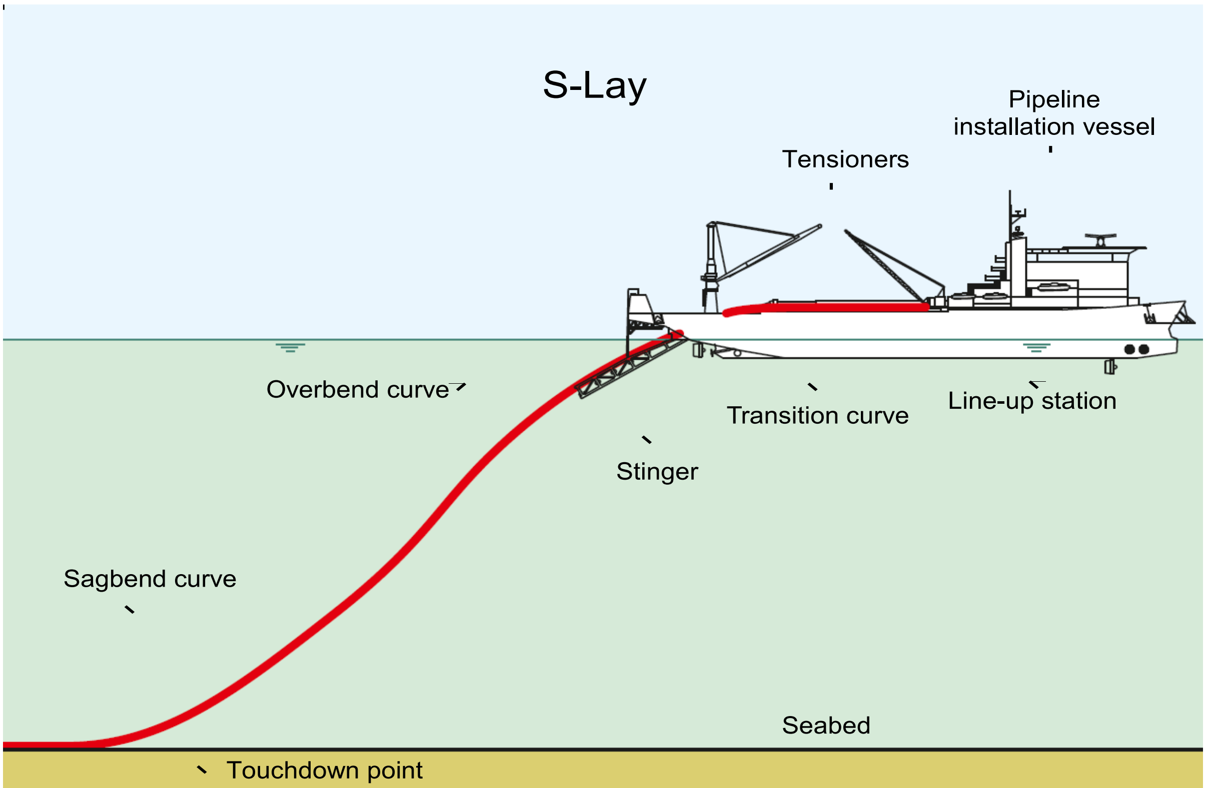


Figure 1.3: Schematic of S-Lay Pipe Laying Method

Figure 1.4: Example of typical Deep Water S-Lay Vessel *Image supplied courtesy of Allseas, Switzerland*

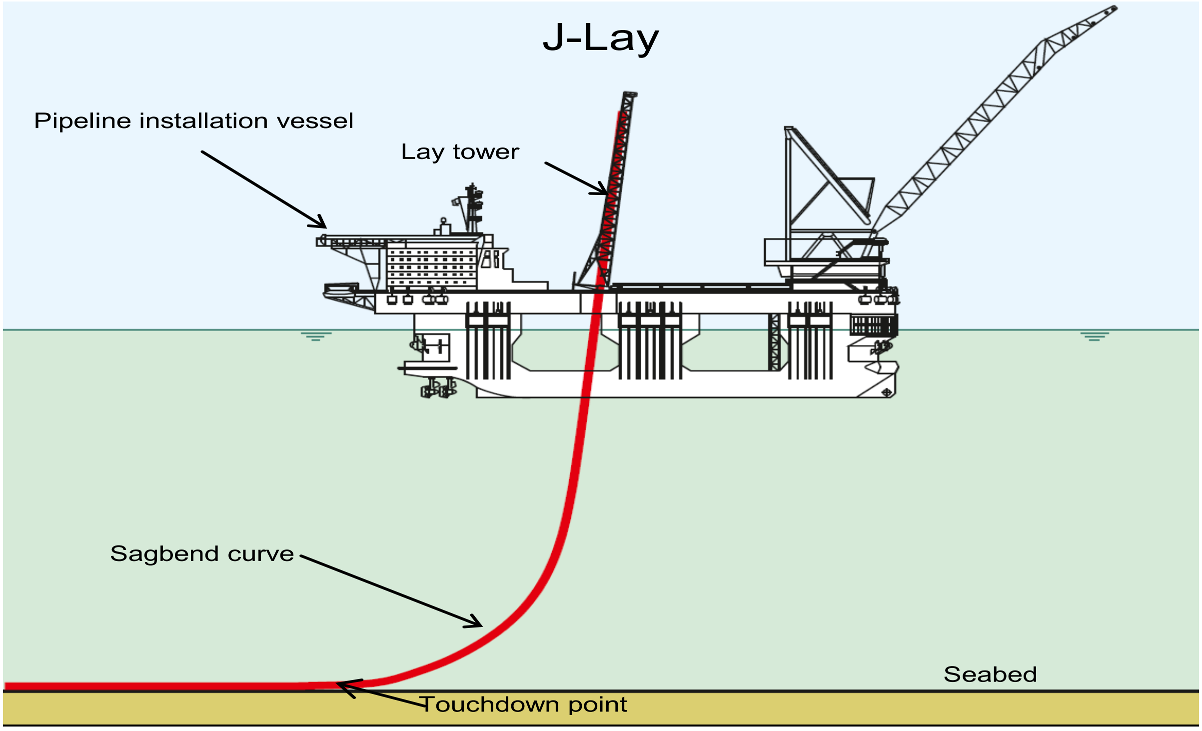


Figure 1.5: J-Lay Pipe Laying

Figure 1.6: Typical Deep Water J-Lay Vessel ***Image supplied courtesy of Saipem***

1.5.3 Operation Phase

Each of the four Project pipelines will be commissioned and come into operation separately. This will be done only after all control and monitoring systems (discussed in **Section 1.5.3.2**) have been commissioned. The first pipeline will come into operation in 2015 with the Full Operational Phase for the South Stream Offshore Natural Gas Pipeline (all four pipelines in operation) running from the end of 2017 for 50 years.

1.5.3.1 Commissioning

Gas from the Russian gas network will be introduced into the first completed pipeline, enabling gas to flow through the Russian, Turkish and Bulgarian Sectors of the South Stream Offshore Natural Gas Pipeline to the Bulgarian landfall facilities.

Before becoming operational, gas in each pipeline is analysed at the Bulgarian landfall facilities to confirm that it meets the quality required for export. Once this has been confirmed, the gas is vented and the valves at the Bulgarian landfall are closed and pipeline pressurisation can commence. It is anticipated that each pipeline will take approximately ten days to fill with gas and commissioning activities will take approximately two weeks to complete. The estimated timeframe for commissioning is shown in **Table 1.3**.

In order to confirm that there is no leakage during start-up, continuous metering of the temperature, flow rate and pressure will be performed at the landfall facilities in both Russia and Bulgaria. Checks will also be performed on all equipment used for detecting and sealing any gas leaks.

1.5.3.2 Operational Phase

The South Stream Offshore Natural Gas Pipeline will have a constant gas inventory for its operational life, i.e. there is always gas stored in the pipelines. The Pipeline will operate within the Pipeline gas inventory limits to maintain a safe and reliable system.

The Compressor Station in Russia and the Receiving Terminal in Bulgaria will determine the flow, pressure and temperature of the gas in the Pipeline during normal operation. These facilities are not part of the South Stream Offshore Natural Gas Pipeline. If it is necessary to reduce the gas transport volume, for example due to a fall in demand for gas, it is possible to either reduce the number of pipelines in operation or reduce the flow of gas across all four pipelines.

Pressure, temperature, flow, and gas composition will also be monitored remotely in a Central Control Room (CCR) and a Back Up Control Room (BUCR), both of which will be located in Amsterdam and will form part of the South Stream Offshore Natural Gas Pipeline. This will be performed by continuous real time monitoring of the pressure, temperature, flow rates and gas composition via the Supervisory Control and Data Acquisition (SCADA) system.

The aforementioned parameters will be monitored to estimate the gas inventory in each of the pipelines through the Pipeline Performance System (online simulator). As noted above, while monitoring will be performed by South Stream Transport, control will be carried out at the upstream Compressor Station in Russia and the downstream Receiving Terminal in Bulgaria.

The landfall facilities in Russia and Bulgaria will be equipped with a Telecommunication System (TCS). The TCS will connect the landfall facilities in Russia and Bulgaria with each other and with the CCR. A dedicated ‘hot line’ will also be provided which connects the landfall facilities in Russia and Bulgaria and the CCR and BUCR. This line will be independent from the TCS and local telephone network.

1.5.4 Decommissioning Phase

The South Stream Offshore Natural Gas Pipeline is designed to operate for 50 years, although its life may be extended subject to monitoring. It is likely that the technological options and preferred methods for decommissioning of pipelines will be different in 50 years’ time. The status of the pipeline at the time of decommissioning will also impact on the chosen decommissioning methods.

Decommissioning activities would be carried out according to the international and national legislation and regulations and GIIP regarding environmental and other potential impacts prevailing at the time.

The current practices for decommissioning of the offshore pipeline elements of the Pipeline are either removal of the pipelines or leaving the pipelines on the seabed after cleaning and filling them with water, along with a program of planned monitoring to ensure safety for other marine users.

Leaving the pipelines in place can be expected to result in the least environmental impact, as vessels will not be required and there will be no seabed disturbance. The activities likely to be associated with the two options are described in **Table 1.2**.

Table 1.2: Decommissioning Options

Option	Activities Likely to be Involved
Leaving the pipelines in place (in-situ)	• Pipeline cleaning by flushing with water and associated water displacement and disposal; • Water-filling; • Sealing; and • Performance of periodic surveys following decommissioning.
Removal of the pipelines from the seabed	• Disturbance of the seabed and marine environment as the pipeline is recovered; • Seabed intervention works; • Vessel operations similar in nature to those required for construction; • Pipe removal, recycling and disposal; and • Logistics support offshore and onshore.

1.6 Description of the Project

This section provides an outline of the Project including a description of the Project Area. The pipeline route, capacity, pipeline materials and the characteristics of the natural gas are also described. The schedule for construction of the Project and the lifetime of the Project are also outlined.

The Project is approximately 470 km in length and extends through the Black Sea from the border of the Russian EEZ in the east to the border of the Bulgarian EEZ in the west (**Figure 1.7**). Within the Turkish EEZ the pipelines will be laid directly on the seabed at water depths ranging between approximately 2,000 m and 2,200 m. At its closest location to the Turkish mainland the Project is located over 110 km from Sinop.

A number of geotechnical, geophysical and ecological surveys were conducted from 2009 to 2012 in the Turkish EEZ as part of the Project's Feasibility and Development Phases. These surveys were conducted to assist detailed pipeline routing information and to inform the environmental baseline of the Project Area.

The surveys undertaken will be discussed in more detail in **Chapter 6: Assessment of the Physical Environment** and **Chapter 7: Assessment of the Biological Environment** of this EIA Report.

1.6.1 Anticipated Project Route

The proposed route of the Project has been selected following a route alternative assessment process as described in **Chapter 4: Grounds for the Route Selection and Assessment of Alternatives** of this EIA Report.

In general the pipelines will be laid parallel to each other in a straight line in a corridor which is approximately 420 m wide, following the pipeline route defined during the FEED studies as much as possible, to minimise overall pipeline length.

In the unlikely event that changes outside of this corridor are required they will be notified to and discussed with the Ministry of Environment and Urbanisation (MoEU). The distance between the pipelines will be approximately 100 m, measured from the centreline of the pipelines. The route coordinates of each of the four pipelines are given in **Appendix 1.C** of this EIA Report.

1.6.2 Pipeline capacity

During normal operations, the gas inventory in each pipeline is evaluated to range between 104 and 111 million metric standard cubic metres (mmscm).

The maximum amount of gas that each pipeline can transport per day under normal conditions will be 47.9 mmscm. The four pipelines combined will transport a maximum of 63 bcm of gas each year. The pipelines will be operated seven days a week, 24 hours per day.

1.6.3 Project Implementation Timeline

The indicative programme from Construction Phase to first gas for the four pipelines is provided in **Table 1.3**.

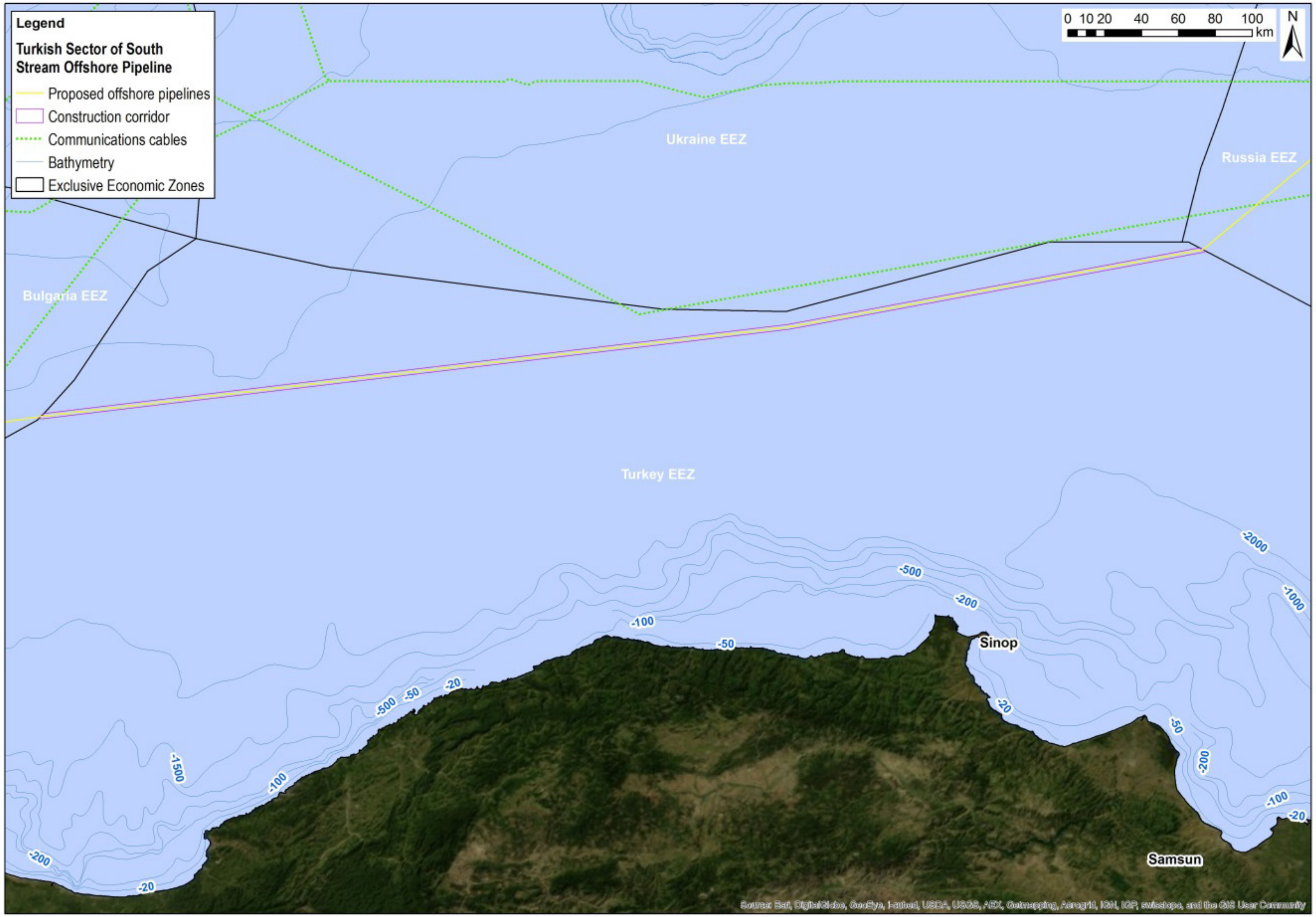
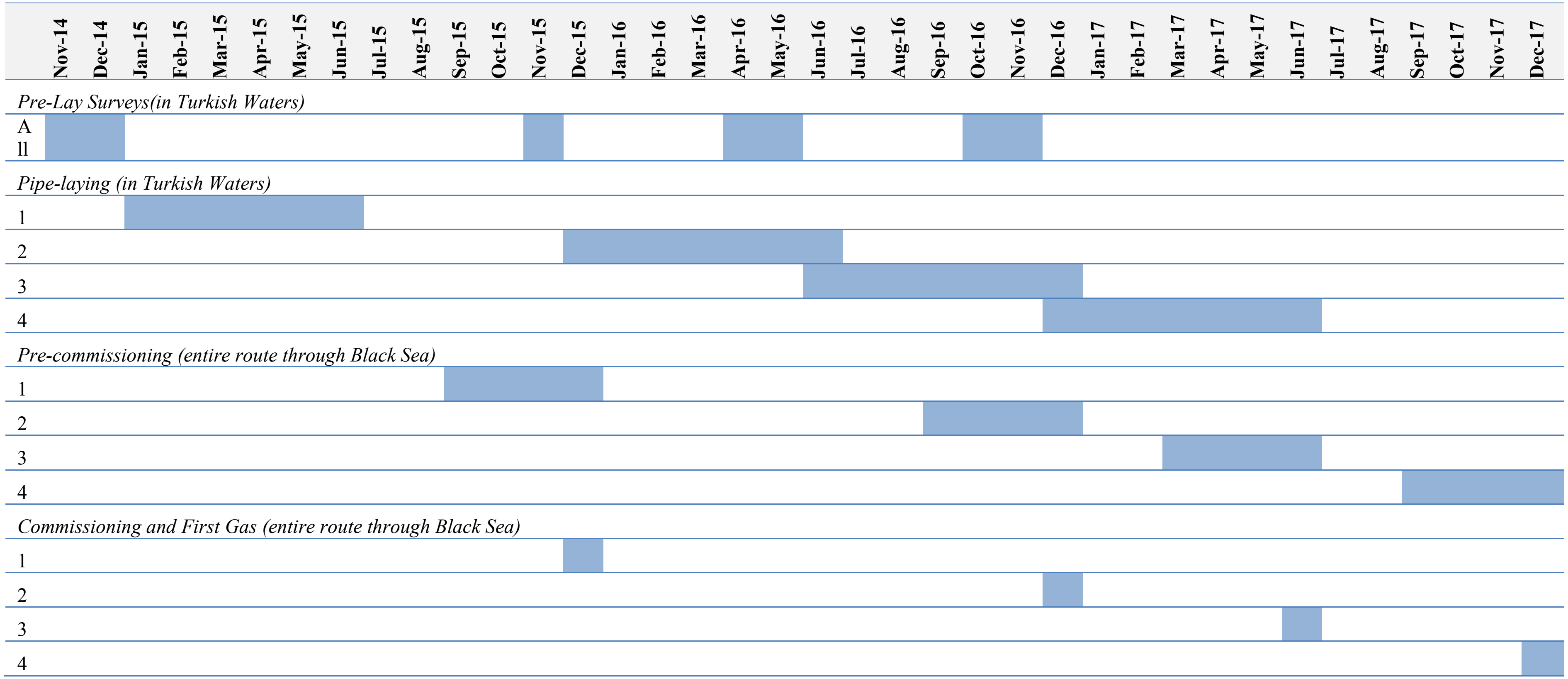


Figure 1.7: Map Showing the Project

Table 1.3: Indicative Programme from Construction Phase to First Gas for the Four Pipelines



1.6.4 Project Lifetime

The Project will have an operational design life of 50 years.

1.6.5 Length and Diameter of the Pipeline

The dimensions of the pipelines are presented in **Table 1.4.**

Table 1.4: Pipeline Dimensional Data of 32-inch Pipes

Parameter	Value
Pipe nominal outside diameter	32 inch (812.8 mm)
Pipe nominal inside diameter	734.8 mm
Length (per pipeline)	470 km (Turkish Sector)
Pipe segments (per pipeline)	12 m long sections (around 40,000 sections in total)

1.6.6 Material of the Pipeline and its Wall Thickness

The pipelines will be constructed of steel pipe segments which will be coated both inside and outside. The properties and thickness of the pipelines to be used for the Project are summarised in **Table 1.5**.

Table 1.5: Additional information on the 32-inch Pipes

Parameter	Value
Wall thickness	39 mm
Internal or external corrosion allowance	0 mm
Wall thickness fabrication tolerance	±1 mm
Thickness of three-Layer-Polypropylene (3LPP) outer coating	4 mm to 4.5 mm
Internal flow coating (epoxy paint)	100 micrometres (μm)
Field joint coating	5 mm to 8 mm
Steel density	7,850 kilograms per cubic metre (kg/m^3)
Young‘s Modulus	207 Mega Pascals (MPa)
Poisson‘s ratio	0.3
Material grade (per DNV OS-F101)	Submerged Arc Welding Longitudinal (SAWL) 450
Specified Minimum Yield Stress, SMYS	450 MPa
Yield stress to be used in design	447 MPa

The following discusses the internal and external coating protection system of the pipelines. It should be noted that no corrosion and no anti-fouling paints/chemicals are proposed.

1.6.6.1 Corrosion Protection System

The corrosion protection system of the pipeline is important to ensure pipeline integrity during installation and operation.

The primary corrosion protection will be by an external anti-corrosion coating with associated field joint coatings. To ensure the integrity of the pipelines over their design operational life, secondary anti-corrosion protection will be provided by sacrificial anodes of a zinc material, placed at regular intervals along the pipelines. This is called a cathodic protection system.

The cathodic protection design of the offshore pipelines is in accordance with the recommended practice design code DNV-RP-F103.The number of anodes required for Turkey is shown in **Table 1.6** .

Table 1.6: Total Anode Mass and Number of Anodes Required per Offshore Pipeline in Turkey

Required No. of Anodes	Total Anode Mass (in kilograms (kg))
1,650	620,000

1.6.6.2 Anti-Corrosion Coating

A three-layer-polypropylene (3LPP) external coating will be applied to further protect the steel pipelines from external corrosion. The 3LPP coating is strong and heat resistant (up to 105 ºC) and also has a high degree of resistance to chemical attack and coating adhesion loss.

The thickness of the external coating is selected to be 4.5 mm nominal and 4.0 mm minimum in order to provide high reliability protection against a severe environment, such as the hydrogen sulphide (H_2S) and anoxic environment of the Black Sea, in combination with a long lifetime.

1.6.6.3 Internal Flow Coating

An internal coating of epoxy paint will be applied to the pipelines to improve the efficiency of the flow of gas. This is called the flow coating and it will also assist in maintaining a dry internal pipe surface as less water will be absorbed by the coating. The proposed internal flow coating is two component epoxy paint with a thickness of minimum 100 micrometres (µm).

1.6.6.4 Field Joint Coating

Field joint coating of the weld area after completion of welding is an integral component of the pipeline protection system to ensure good corrosion protection. Given the peculiar chemical characteristics of much of the Black Sea (the deeper waters are anoxic and saturated with H_2S), it is important to protect the weld area in addition to the normal functions of field joint coating, which are to provide protection from impacts and against corrosion.

The selected field joint coating system is an injection moulded polypropylene coating on top of a fusion bonded epoxy layer. The field joint coating will consist of a heat shrink sleeve applied directly over the joint. The thickness will be 5 mm minimum over the weld and 8 mm minimum on the rest of the joint.

1.6.6.5 Buckle Arrestors

Buckle arrestors will be used to prevent the pipelines from buckling during installation. An integral ring[3] buckle arrestor approximately 4 m long with wall thickness of 74 mm (tapering down to 39 mm at either end) is proposed. It is proposed that a buckle arrestor spacing of 2,000 m is used.

All pipe segments will be welded together to form the separate pipelines. Only welding consumables such as electrodes, wires and fluxes that are similar and compatible with the composition of the pipe segment material will be used. The weld properties will have a minimum steel grade equal to that of the pipe segments. No other materials will be added during welding.

1.6.7 Characteristics of Natural Gas

The gas to be transported by the pipelines will have been treated to be made “dry” (i.e. having a water and hydrocarbon dew point of -22 °C @ 65 bar). The gas will consist of approximately 97 moles (mol%) of methane and the maximum CO_2 content will be 0.41 mol%. The gas density is anticipated to vary, as a function of pressure and temperature, between approximately 60 and 250 kg/m^3.

Table 1.7 provides a summary of the likely composition of the gas. The properties of the processed natural gas may vary slightly from those identified in the table, as these gas properties apply as design values only. However, any changes will be very small deviations and will not result in changes to the size and design of the main Project components.

Table 1.7: Gas Composition

Component	Mol%	Component	Mol%
Methane	97.5389	n-pentane	0.0171
Nitrogen gas (N_2)	0.9305	Hexane	0.0205
Carbon dioxide (CO_2)	0.4101	Heptane	0.0033
Ethane	0.8800	Octane	0.0004
Propane	0.1399	Nonane	0.0001
i-butane	0.0150	Water	0.0014

[3] heavy wall ring with the same inside diameter and greater outside diameter than the pipeline

Component	Mol%	Component	Mol%
n-butane	0.0249	Methanol	0.0005
i-pentane	0.0171	Hydrogen Sulphide (H_2S)	0.0003

1.6.8 Personnel to be Recruited through the Project

The exact number of workers required for the Construction and Pre-Commissioning Phase of the Project is not known at the time of preparing this EIA Report. Information on workforce numbers will only be available following the appointment of construction contractors and the commencement of construction. However, the maximum number of personnel anticipated to be employed by the Project during the peak of construction activity is approximately 1,000 people. This estimation is based on the average number of persons on board the vessels required, as shown in **Table 1.8**. It is anticipated that work will be carried out 24 hours per day, seven days per week during the Construction Phase. No full time workers shall be employed in Turkey during the Operational (including Commissioning) Phase of the Project.

Occupational Health and Safety (OH&S) including detailed work procedures, job safety analyses (JSAs), toolbox talks etc., for procurement, construction, installation and operations will be managed by South Stream Transport and the respective contractors.

Internationally recognised procedures to assure the OH&S of the workforce will be adopted along with the necessary equipment and training to make these effective.

1.6.9 Vessels, Machinery and Equipment to be Used for the Project

Construction activities associated with the installation of the offshore pipelines will require a number of vessels. The main vessel will be the pipe-lay vessel. Other vessels involved in the pipe-laying activities will include support vessels (survey, crew change) and supply vessels (pipes, fuel and provisions). As construction contracts have not been awarded, the exact type/ name of vessel are not known. **Table 1.8** presents a summary of the anticipated type and number of vessels that are planned to be used as well as an indication of the duration for which they will be required for the Project (Turkish waters only).

These figures are based on the duration per pipeline. The construction spread is shown in **Figure 1.8**.

The pipe-lay vessel is likely to include deck cranes, welding, NDE and field joint stations, a helipad, dynamic positioning system (including thrusters) and diesel generators.

Vessel operators will obtain all relevant operating permits at least six months in advance of construction.

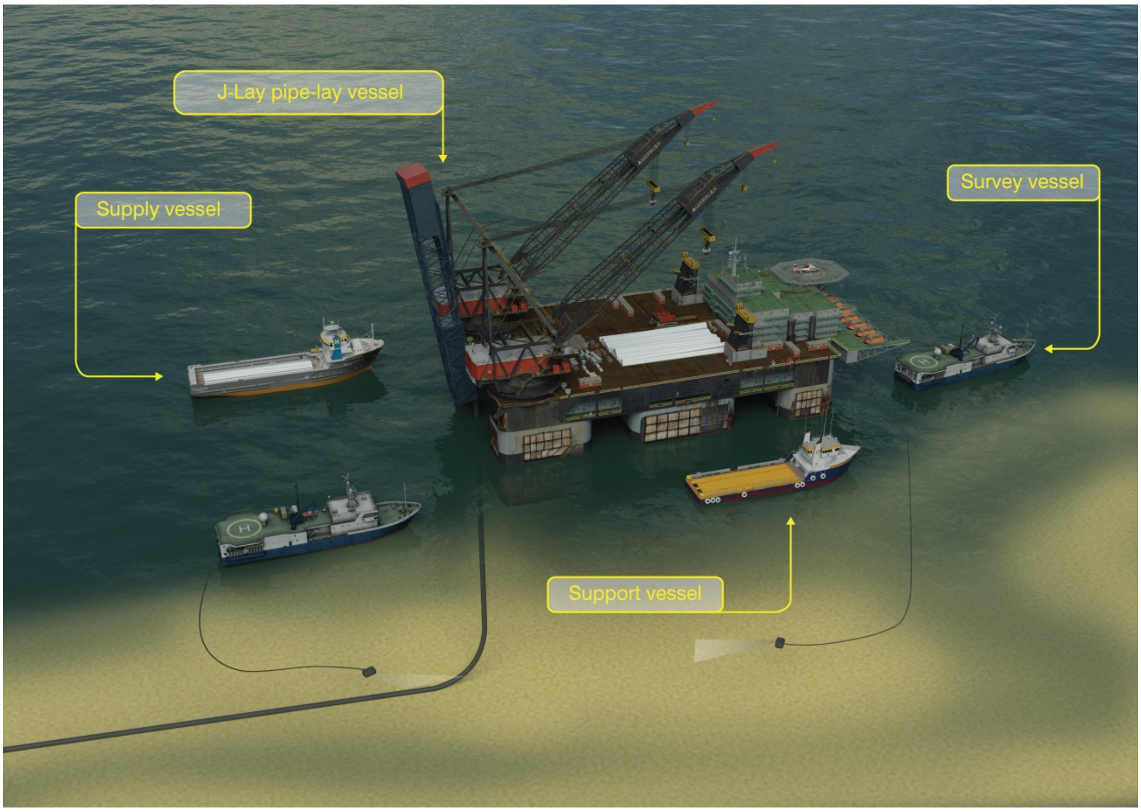


Figure 1.8: Construction Spread

Table 1.8: Typical Offshore Construction Spread per Pipeline

Construction Activity	Type of Vessel	Task	Number of Vessels	Duration (days) per vessel	Persons on Board	Utilisation (%)
Offshore Pipe-laying > 600 m water depth	Deep water pipe-lay vessel	Deep water pipe-laying	1	170 (based on length and vessel speed)	725	40
	Tugs	General support	1	As above	40	60
	Pipe-lay Supply Vessel (PSV)	Supplying pipe to pipe-lay vessel	5	As above	16	60
	Survey Vessel	Surveying the sea floor in front and behind the pipe-lay vessel	2	As above	62	60
	MSV (Multi Service Vessel)	ROV Support, Diving Support, Consumables supply, Bunker supply, Provisions supply Water supply	2	As above	70	60
	Crew boats, fast cats	Crew changes	1	5 (i.e. 10 half day trips)	70	60
	Maintenance vessel	Delivery of spare parts / equipment	1	9	16	60
	Fuel / waste water collection vessel	Waste water collection	1	9	5	60
	Rescue vessel	Safety and Rescue Operations	1	Only required in case of emergency	23	60

1.7 Fundamental Characteristics of Design

The Project has been designed in accordance with pipeline industry standards. The overall framework provided by the Offshore Standard *DNV OS-F101 code 'Submarine Pipeline Systems, 2010'* will be the basis for the design and will be supported, where required, by other recognised codes and standards including material design standards for pipelines and welding as stipulated in the codes and standards of the DNV OS-F101, American Petroleum Institute (API), American Society for Non-destructive Testing (ASNT), ASTME International (formerly known as American Society for Testing Materials (ASTM)), British Standard Institution (BSI/BS), International Organisation for Standardisation (ISO) and National Association of Corrosion Engineers (NACE).

Quality standards ISO 9000 and 9001:2008 are also applicable. There are no applicable national design standards for the Project. The pipelines will be laid in numerical order (one to four) with pipeline one being the northern most pipeline. All pipelines in Turkish waters will be laid from east to west.

1.7.1 Lifetime of the Design

The pipelines have been designed for the anticipated 50 year lifetime of the Project. An overview of the Project's lifetime from design and development to decommissioning is given in **Section 1.5**.

1.7.2 Safety Factors of the Design

A Health, Safety, Security and Environment – Integrated Management System (HSSE-IMS) will be developed in accordance with GIIP and in line with the requirements of ISO 14001:2004 (Environmental Management System) and OHSAS 18001:2007 (Health & Safety Management System).

As explained in **Section 1.5.2**, the pipeline system has been designed in compliance with the design code Det Norske Veritas (DNV) OS F101. Turkish EEZ as the pipeline system has been granted a waiver to not comply with the hydrotest part of the design code Det Norske Veritas (DNV) OS F101 in water depths greater than 30 m. This ensures a high level of pipeline integrity by the application of design factors and strict manufacturing tolerances.

With reference to the safety distances between pipelines, the space between the pipelines will be approximately 100 m, measured from the centreline of the pipelines. After each pipeline has been installed a number of activities, known as pre-commissioning activities, will be undertaken to ensure that the pipelines meet operational requirements.

The primary objective of these activities is to verify that the pipeline has been laid without significant defects and that it is in a suitable condition to be filled to transport the gas. Cleaning, gauging and drying will be undertaken along the Pipeline and hence within the Project in Turkey.

While pre-commissioning activities for the overall South Stream Offshore Natural Gas Pipeline include cleaning, gauging, hydrotesting and drying of the installed pipelines, no hydrotesting is required in the Turkish EEZ as the pipeline system has been granted a waiver to not comply with the hydrotest part of the design code Det Norske Veritas (DNV) OS F101 in water depths greater than 30 m.

The discharges associated with hydrotesting activities will occur in approximately 30 m water depth in Russia and Bulgaria. Discharges will consist of water treated with around 12, 000 litre of oxygen scavenger (sodium bisulphite). However, the Project Area within the Turkish Sector will not be impacted by any hydrotesting activities given the distance of the discharge locations from the Turkish EEZ (over 200 km).

1.7.2.1 Construction, Installation and Operational Safety

Safety is a key priority for the Project both during construction and operation. Accordingly, a Safety Management Plan will be prepared as part of the HSSE-IMS in order to reduce all risks to "as low as reasonably practicable" (ALARP).

Design hazards have been identified and assessed using internationally recognised tools throughout the FEED process. These tools are described in **Table 1.9** and include:

- Hazard Identification (HAZID) study;
- Environmental and socio-economic Issues Identification (ENVIID) study;
- Hazard and Operability (HAZOP) analysis;
- Hazard Construction (HAZCON) study; and
- Bowtie Analysis.

Table 1.9: Hazard Identification Tools

Tool	Description
HAZID	The HAZID is a tool for safety hazard analysis used at an early stage of the Project to inform the FEED study. The risks identified have been addressed through design measures aimed at reducing either the likelihood or the consequences (or both) of the risks. The risks identified have been assessed qualitatively and this assessment has been followed by an overall risk assessment that covered design, construction, installation, operations and simultaneous operations (SIMOPS) as required.
ENVIID	ENVIID is a tool for Environmental and socio-economic issues identification and analysis used at an early stage of the Project to inform the FEED study. The ENVIID process aids the FEED study in identifying any significant impacts of the Project and the associated controls and measures to be implemented into the design to remove or reduce the impact.
HAZOP	HAZOP is a tool for the identification of process hazards in the design and operation of a facility or infrastructure. The assessment consists of an examination of the pipeline design to determine whether the safety measures included in the design are sufficient to ensure that the pipelines are safe to operate, even under extreme or unusual conditions.
HAZCON	HAZCON is a safety study to identify and assess hazards before the start of construction. HAZCON 1 is generally carried out early in the project, prior to construction, to identify major hazards to client and contractor personnel, site visitors or the general public. HAZCON 2 is carried out to provide a detailed assessment of construction hazards, based on more detailed design information.
Bowtie Analysis	Bowtie analysis is part of the identification and management of key risks, and is used to identify risk controls, their effectiveness and corrective actions required. Before defining where to focus effort within

Tool	Description
	the analysis, key risk areas are identified via other risk assessments and risk registers.

During the FEED process, design approaches and methods that minimise risk to personnel (both during construction and operations) have been developed based on the results of the various risk assessment studies.

A FEED/Technical Risk Register is used to record all significant design Health, Safety, Security and Environment (HSSE) risks, as well as technical risks related to construction and operations identified by the FEED study. The Register is established, managed and maintained by South Stream Transport, utilising inputs related to FEED risks from the FEED Contractor, and forms part of the overall Project Risk Register.

Plans for dealing with Major Accident Hazards (MAH) from construction and operation of the Project such as increased vessel traffic, transportation of hazardous substances, waste water discharge, solid waste disposal etc. will be managed by South Stream Transport and their Project contractors. Further information on the various Project management plans to be implemented can be seen in **Chapter 11: Environmental and Social Management System**.

1.7.2.2 Pipeline Shut-Down and Restart Process

During the operation of the South Stream Offshore Natural Gas Pipeline there may be a requirement to shut down one or more pipelines from time to time. Different types of shut down exist. These are listed below and described in **Table 1.10**.

- Process Shut Down (PSD) which corresponds to a stop of gas flow (closure of external Emergency Shut Down valves); and
- Emergency Shut Down (ESD) which applies to a fire and gas detection scenario (closure of external and internal ESD valves).

Table 1.10: Shut Down Process

Shut Down Process	Detail
Process Shut Down (PSD)	A PSD may be necessary to carry out scheduled repairs or inspections. This is a planned event and will be undertaken under controlled conditions. The PSD will be carried out at the Russkaya CS and at the Bulgarian Receiving Terminal. Shut down and ramp-down of gas flow is done by reducing the flow progressively to the required flow rate or by completely shutting down the flow in and out of the system at the Russian Compressor Station and Bulgarian Receiving Terminal.
Emergency Shutdowns (ESD)	The landfall facilities will have local ESD and safety systems. Should there be an incident (unplanned event) the ESD system will be triggered and the pipelines will isolate themselves. The gas volume in the pipelines will then be automatically isolated from the landfall facilities by closing the landfall facilities inlet and outlet ESD valves, thereby maintaining a constant gas inventory within the offshore pipelines.

To ensure that the gas inventory requirements do not deviate from the low and high band volumes, for example 104 and 111 mmscm at maximum throughput, low and high alarms will be installed at the landfall facilities.

Should there be an irregularity (or deviation), this information will be transmitted from the landfall facilities to the CCR, the Compressor Station in Russia, and the Receiving Terminal in Bulgaria where the operators can carry out balancing operations, i.e. increasing or decreasing the gas inventory, which, in turn, may lead to an operational decision to shut down the gas supply to the Pipeline. Alarms will also be installed to detect changes in the gas pressures and temperatures.

Further to the alarm systems, trip systems will be installed at the landfall facilities which will overwrite control systems. The trip systems will be designed to automatically shut down the pipeline system if minimum or maximum design standards for gas pressure, temperatures or flows are detected by the SCADA system.

During commissioning, the extent of the South Stream Offshore Pipeline that could leak gas will be much less due to the fact that the pressure within the South Stream Offshore Pipeline will be reduced for the most part. Therefore, depending on where in the Black Sea damage occurs to the South Stream Offshore Pipeline, gas may or may not leak from the pipelines and escape through the sea. In the case of damage to a pipeline, gas will be vented from the pipeline at one or both landfall facilities, prior to a repair being made to reduce the inventory of gas in the pipeline.

Repairs

There are a large number of repair options for different magnitudes of event i.e. minor through to major damage incidents. The possible damage to the South Stream Offshore Pipeline and the resulting pipeline failure modes have been categorised into four categories; minor damage, major damage, multiple major damage and indirect related damage as described in **Table 1.11**.

Table 1.11 Pipeline Damage Categories

Damage Category	Definition
Minor Damage	Damage that does not require a sectional pipeline replacement. No system downtime is the preferred scenario, though this is not a requirement. Minor damage does not immediately affect the integrity and/or operability of the pipeline. The damage consists, typically, of a geometrical deformation, or a small leak.
Major Damage	Major damage (maximum of five pipeline joints damaged) is damage that requires a pipeline sectional (spool) replacement/repair. The repair can only take place when the damaged section of the pipeline is taken off stream and the damage is isolated.
Multiple Major Damages	Damage where the extent is so extensive that a normal spool repair (maximum of five pipeline joints) is insufficient to mitigate the pipeline damage. Repair can only take place when the damaged section of the pipeline is taken off stream and the damage is isolated.
Indirectly Related Damage	Damage that does not cause an immediate impact on the integrity of the pipelines, although it may have operational impact. The consequences of indirect damage usually reveal themselves at a later date. Indirect damage can only be repaired using special repair methods. Coating damage, hydrates and a blockage (PIG or hydrate formation) are considered to be indirect damage.

The list of typical causes of pipeline damage (during both the Construction Phase and Operational Phase) and their associated damage category is shown in **Table 1.12**.

Table 1.12 Overview of Damage Categories

Damage Types	Minor Damage	Major Damage	Multiple Major Damage	Indirect Damage
Hydrate plug*				X
Blockage^				X
Buckles^		X	X	
Crack^	X	X	X	
Metal loss*		X	X	
Dents^	X			
Coating damage^				X
Pinhole leak^	X	X		
Leak^		X	X	
Rupture^		X	X	
Gouge^	X			

* Operational Phase only
^ Construction and Operational Phases

Research was undertaken into repair equipment and repair methods within the local context of the pipelines, which resulted in the identification of technically feasible repair methods per section of pipeline. Selection criteria were used to assess the technically feasible options and to either eliminate them or prioritise them. This resulted in recommended repair methods for each damage category and for each section of the pipeline.

At least one repair method is recommended for each damage category and pipeline section. Where feasible, other repair methods were selected as a back-up method; possible but not recommended. For each recommended repair method, high level procedures have been developed and linked to the functional and technical specifications of appropriate hardware.

There are areas in Turkish waters where the external pressure around the pipeline (i.e. the pressure of the seawater) is greater than the pressure of the gas within the pipeline, specifically along approximately one third of the (western) extent of the pipeline in the Turkish EEZ. During commissioning, the extent of the South Stream Offshore Pipeline that could leak gas will be much less due to the fact that the pressure within the South Stream Offshore Pipeline will be reduced for the most part. Therefore, depending on where in the Black Sea damage occurs to the South Stream Offshore Pipeline, gas may or may not leak from the pipelines and escape through the sea. In the case of damage to a pipeline, gas will be vented from the pipeline at one or both landfall facilities, prior to a repair being made to reduce the inventory of gas in the pipeline.

Repairs

For different types of damage, different types of repair and re-commissioning methods are applicable. Preparation of a pipeline for repair will be aimed at minimising or avoiding any impact on pipeline integrity, therefore avoiding water ingress. If water ingress is inevitable, or has already occurred, then dewatering/replacing salt or contaminated water with chemically treated water will be essential to stabilise the pipeline condition and to minimise corrosion whilst a case specific repair plan is developed and executed. The preferred approach will be to isolate the defected area (using plugs if pigging is feasible) and create a safe work environment for repair. Prior to re-commissioning a repaired pipeline, the pipeline must be cleaned, dewatered and/or conditioned to ensure the pipeline is clean, without defect and free of water. After a repair is made, whether it is offshore or onshore, the pipeline will be commissioned through pigging and drying and then gas can be re-introduced into the pipeline, thereafter resuming normal operating conditions.

1.7.2.3 Restart Procedure

The restart procedure after a PSD or an ESD will depend on the pressure levels within the isolated systems (the pipelines). Pressure equalisation across the systems is planned to be achieved using bypass systems installed within the landfall facilities.

The restart can proceed if the following conditions are met:

- The cause of the ESD has been detected;
- The remedial actions have been completed (including eventual repairs and acceptance testing); and
- All safety related conditions have been met or exceeded.

Before the gas transportation can be restarted the ESD valves at the landfall stations in Russia and Bulgaria will need to be reopened. It is considered that it will take three days for pressure equalisation and ESD valve reopening to be completed.

1.7.3 Design Temperatures and Pressures

The operating pressure of the Pipeline will vary across its length, particularly in relation to ambient temperature conditions surrounding the pipelines. System operating data is summarised in **Table 1.13**.

Table 1.13: Summary of System Pressures and Temperatures

Parameter	Value
Maximum Design Pressure	300 bar at + 180 m reference elevation
Operating pressure in the Turkish EEZ	280-284.5 bar at the Russian/Turkish EEZ border and 178-186 bar at the Turkish/Bulgarian EEZ border
Design Temperature;	
• maximum	55 °C
• minimum	-10 °C
Operating temperature in the Turkish EEZ	8^0C to 8.7^0C

1.7.4 Design of Particular Crossings

There are no pipeline or cable crossings in the Turkish Sector. South Stream Transport will cooperate with Turkish Petroleum Corporation (TPAO) and/or other relevant organisations in the establishment of crossing agreements in the event of future pipeline or cables potentially crossing the Project.

1.7.5 Hydraulic Design

Flow rates of the pipeline are discussed in **Section 1.6.2** and pressure and temperature is given in **Section 1.7.3**. There is no additional information or issues to be discussed under this heading.

1.8 Maintenance of the Pipeline

The external condition of the offshore pipelines, including the condition of the cathodic protection system (see **Section 1.6.6**), will be monitored on a regular basis as set out in **Table 1.14** using ROV or Autonomous Underwater Vehicles (AUV) and inspection technologies including sonar scans and visual (camera) inspections mobilised from survey vessels such as those used during pre-construction surveys.

Table 1.14: Proposed Inspection Surveys for Pipelines

External Inspection	Inspection Method	Proposed Frequency of Inspection	Duration (per pipeline)
Entire Pipeline Route Survey	ROV	Before start up or within 1 year of operation commencing	60 days
	AUV	Every 5 years thereafter	23 days
Cathodic Protection Survey	ROV	Before start up or within 1 year of operation commencing After 5 years of operation Every 10 years thereafter	60 days

1.8.1 Internal Pipeline Surveillance

Following the completion of pre-commissioning tests, internal inspection of the pipelines using Pipeline Inspection Gauges (PIGs) is not expected to be required for about five years after initial start-up and operation. The frequency of testing can be increased or decreased depending on the results of previous inspections, survey information and regulatory requirements. The proposed frequency of internal inspections is shown in **Table** .

Table 1.15: Proposed Inspection Surveys for South Stream Offshore Natural Gas Pipelines

Internal Inspection	Inspection Method	Proposed Frequency of Inspection
Wall thickness measurement	Intelligent PIG	Before start up or within 1 year of operation commencing Every 5 years thereafter
Pipeline position	XYZ Mapping PIG	Before start up or within 1 year of operation commencing Every 5 years thereafter
Pipeline geometry	Gauging PIG	Before start up Prior to running calliper or intelligent pigs.
	Calliper PIG	Before start up Every 5 years thereafter

Internal pipeline cleaning during operation is not anticipated to be required due to the composition of the dry gas that will be transported through the pipelines. The gas composition and properties are given in **Section 1.6.7**. However, any cleaning that may be required will be undertaken using cleaning PIGs transported using gas. Furthermore, a Pipeline Integrity

Management System (PIMS) will be developed to control on-going monitoring and maintenance during system operation, with a specific focus on corrosion control. Maintenance operations will be performed with around 60% inventory of gas in the offshore pipeline, which includes the Turkish Sector.

Arrangements in the event of failure are set out in **Section 1.7.2.2**.

1.9 Sectors of the Pipeline in Russia and Bulgaria

As described in **Section 1.1**, the South Stream Offshore Natural Gas Pipeline has Sectors in Russia and Bulgaria as well as in Turkey. The Russian and Bulgarian Sectors include landfall sections with short onshore pipelines and landfall facilities.

1.9.1 General Characteristics of the Russian Sector

The Project Area for the Russian Sector has three sections: the landfall, nearshore and offshore sections (**Figure 1.9**).

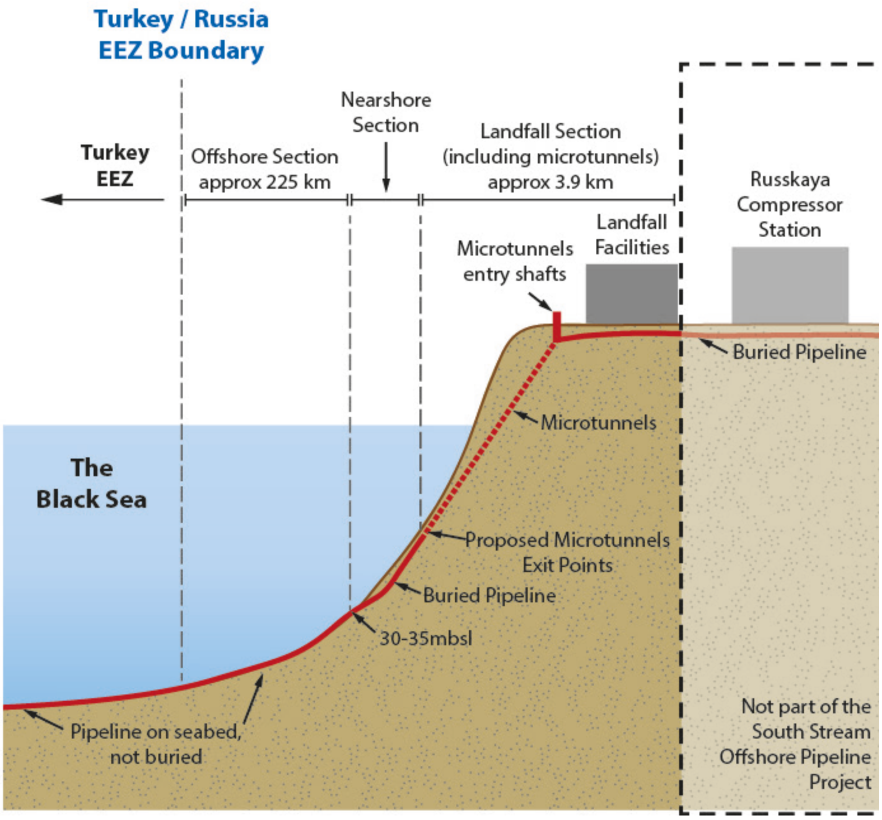


Figure 1.9: Landfall, nearshore and offshore sections of the Russian Sector of the South Stream Offshore Natural Gas Pipeline

The landfall section is approximately 3.9 km long and consists of the permanent landfall facilities, which will include a metering facility, PIG trap facilities, and ESD valve stations, along with the four buried pipelines. The four pipelines will be buried for 2.5 km and housed in microtunnels for 1.4 km where the pipelines cross the shore to the sea. The landfall facilities in Russia will be connected to the Russkaya Compressor Station via four onshore connecting pipelines, 2.5 km in length. The Russkaya Compressor Station, and the four connecting pipelines, are not part of the South Stream Offshore Natural Gas Pipeline and will be designed and installed as part of the project known as "*Expansion of the Russian Unified Gas Supply Ltd (UGS) to provide gas to South Stream pipeline*" that is being developed by Gazprom (**Figure 1.11)**. It is understood that in addition to the Russkaya station, there may be fourteen additional compressor stations within the Russian expansion project referenced above. The size and locations are not known at this stage.

The nearshore section consists of four buried pipelines and begins at the exit point of the microtunnels, located approximately 400 m from the coast, in a water depth of approximately 23 m. This section extends to a water depth of 30 m. In the nearshore section, some dredging will be done to bury the pipelines.

In the offshore section, the four pipelines, each approximately 225 km in length, will be laid from a maximum water depth of 30 m to the border between the Russian and Turkish EEZs. The four pipelines will be installed using a pipe-laying vessel and will be laid directly on the seabed in the same way as the pipelines are laid in Turkish waters.

A summary of the works to be undertaken in Russia is given in **Table 1.16**.

1.9.2 General Characteristics of the Bulgarian Sector

The Project Area for the Bulgarian Sector has three sections: the landfall, nearshore and offshore sections (**Figure 1.10**).

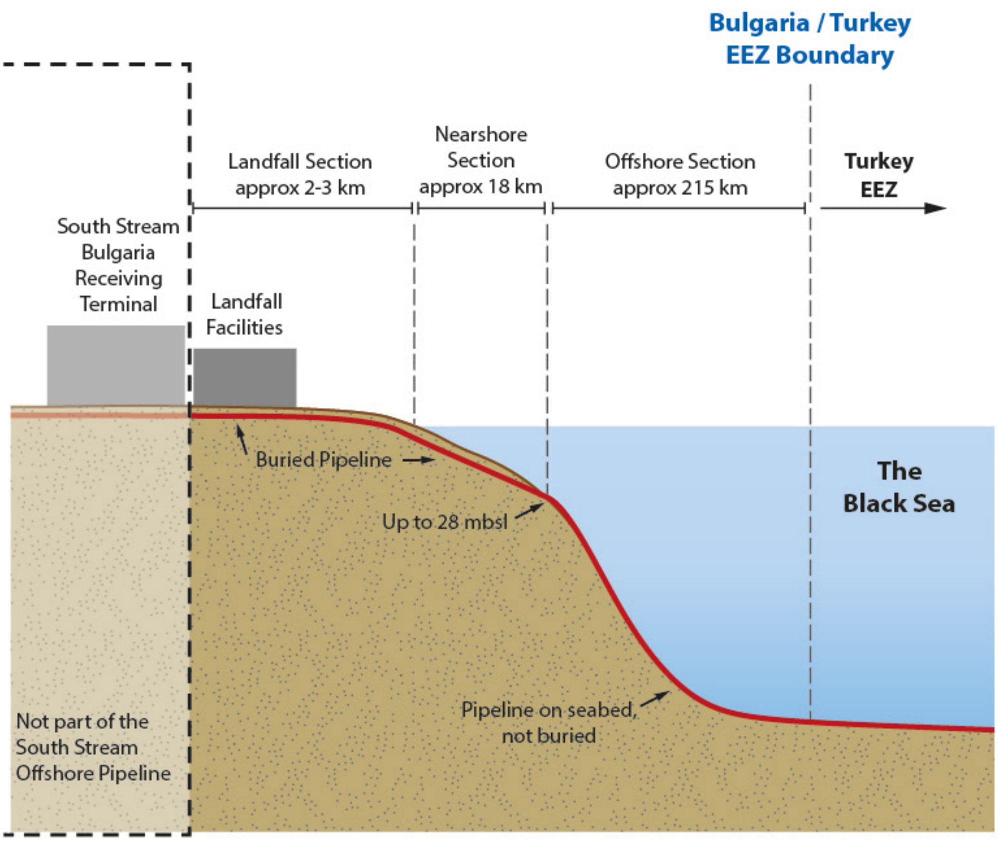


Figure 1.10: Landfall, nearshore and offshore sections of the Bulgarian Sector of the South Stream Offshore Natural Gas Pipeline

The offshore section extends for approximately 210 km, from the Turkish and Bulgarian EEZ border towards the Bulgarian coast until a water depth of approximately 35 m is reached (approximately 23 km from the coast). The four pipelines will be installed using a pipe-laying vessel and laid directly on the seabed in the same way as the pipelines are laid in Turkish waters.

The nearshore section begins approximately 23 km from the coast and extends to the proposed shore crossing on Pasha Dere Beach. In contrast to the offshore section, the pipeline within the nearshore section will be buried beneath the seabed, to a depth of approximately 2.5 m, to protect the pipeline from external damage and ensure the pipelines do not affect any beach or water users. In the nearshore section, some dredging will be done to bury the pipelines.

The landfall section will be up to 2.9 km long and comprise four buried pipelines extending from the shore crossing at Pasha Dere Beach to the landfall facility. The Bulgarian landfall section of the South Stream Offshore Natural Gas Pipeline will connect to a Receiving Terminal. The Receiving Terminal is not part of the South Stream Offshore Natural Gas Pipeline and will be designed and installed as part of the project being developed by South Stream Bulgaria AD as part of the "*South Stream Gas Pipeline in the territory of the Republic of Bulgaria*" (**Figure 1.12**). It is possible that four compressor stations may be included as part of the Bulgarian project, referenced above. Their size and location is presented in the EIA Report of the *South Stream Gas Pipeline in the territory of the Republic of Bulgaria*.

A summary of the works to be undertaken in Bulgaria is given in **Table 1.16**.

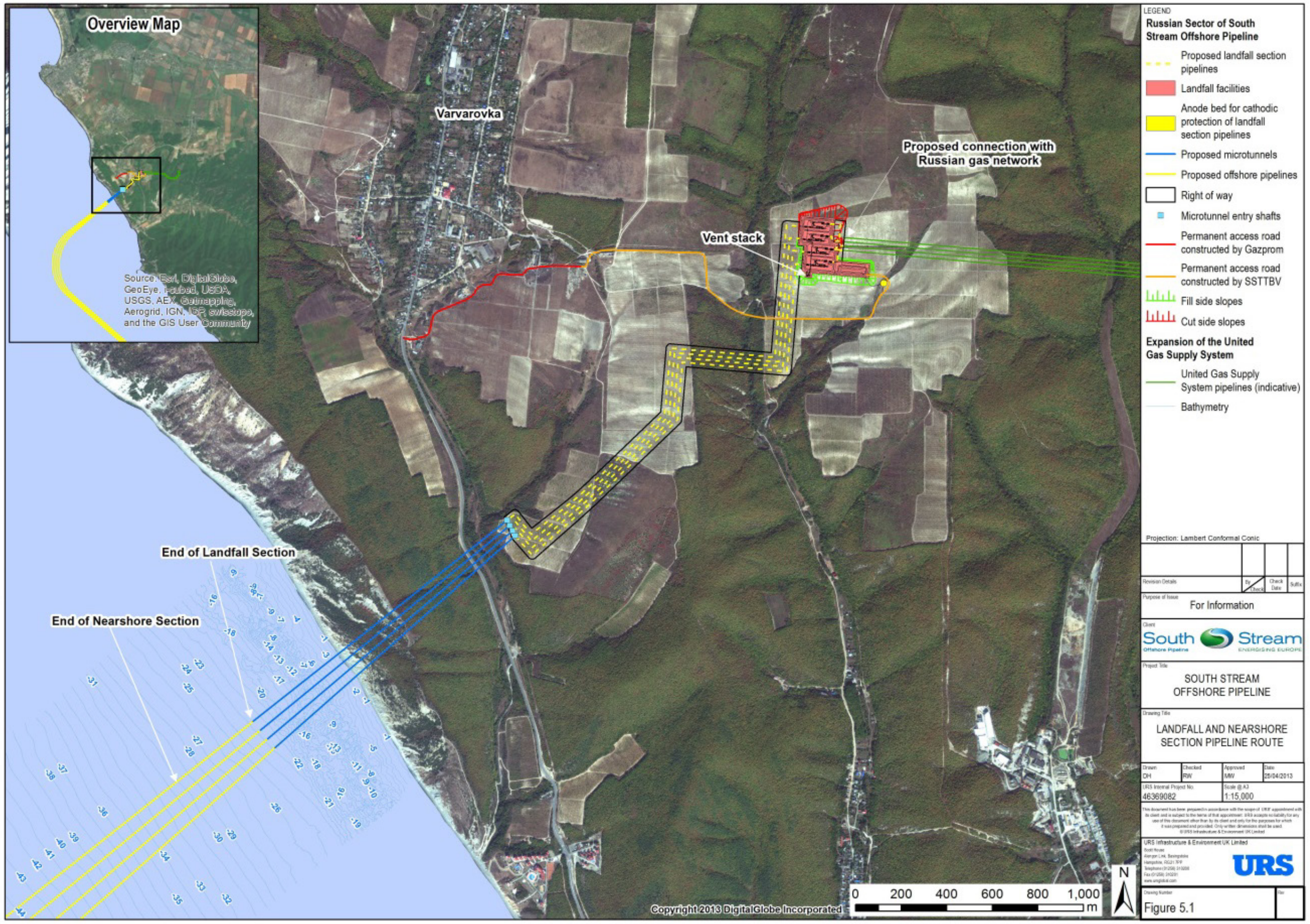


Figure 1.11: Landfall Section of the Russian Sector of the South Stream Offshore Natural Gas Pipeline

Figure 1.12: Landfall section of the Bulgarian Sector of the South Stream Offshore Natural Gas Pipeline

Table 1.16: Proposed South Stream Offshore Natural Gas Pipeline Russian and Bulgarian Sectors (as of October 2013 data)

Section	Details
Russia	
Landfall	• Approximately 3.9 km of onshore pipelines, 2.5 km will be buried and 1.4 km will be in micro-tunnels. The exit point of the micro-tunnels is approximately 400 metres (m) from the coast at a water depth of 23 m; and • Fenced landfall facilities, which will primarily consist of: ○ Operational metering equipment; ○ Four PIG trap facilities (one per pipeline); ○ Eight ESD valves (two per pipeline); ○ Eight block valves (two per pipeline); ○ Pre-fabricated containers housing electrical and instrumentation equipment; and ○ A vent stack.
Nearshore	• Four pipelines commencing at the exit point of the micro-tunnels extending approximately 425 m out to a water depth of 30 m. From the micro-tunnel exit point the pipelines will be buried for a distance of approximately 170 m.
Offshore	• Four pipelines each approximately 225 km in length laid directly on the seabed from the edge of nearshore section to the border of the Russian and Turkish EEZs in the Black Sea.
Marshalling yards	• Possibly two marshalling yards at locations yet to be determined, for the storage and distribution of pipe and equipment necessary to construct the offshore, nearshore and landfall sections of the South Stream Offshore Natural Gas Pipeline in Russia and to provide pipes for the Turkish EEZ.
Bulgaria	
Offshore	• Four pipelines each approximately 214 km in length laid directly on the seabed from the border of the Turkish and Bulgarian EEZs to approximately 19 km from the coast, where the water depth is approximately 30 m.
Nearshore	• Four pipelines commencing from the edge of the offshore section and extending to the shore crossing location on Pasha Dere Beach. From approximately 2.1 km offshore to the shore crossing the pipelines will be buried in a trench.
Landfall	• Approximately 3 km of onshore pipelines. Pipelines buried using open-cut construction techniques; and • Fenced landfall facilities, which will primarily consist of: ○ Operational metering equipment;

Section	Details
	○ Four PIG trap facilities (one per pipeline); ○ Eight ESD valves (two per pipeline); ○ Eight block valves (two per pipeline); ○ Pre-fabricated containers housing electrical and instrumentation equipment; and ○ A vent stack.
Marshalling yards	Possibly, three marshalling yards at locations yet to be confirmed for the storage and distribution of pipe and equipment necessary to construct the offshore, nearshore and landfall sections of the South Stream Offshore Natural Gas Pipeline in Bulgaria and to provide pipes for the Turkish EEZ.

Offshore construction activities in Russia and Bulgaria will be similar to the works undertaken in Turkish waters as described in **Section 1.5.2**.

1.10 Changes in Construction Methodology

The EIA Application File anticipated two pipeline construction strategies, referred in that document as “4 x 1” and “1+2+1”, the first being each of the four individual pipelines being laid in sequence and the second involving overlapping construction of the second and third pipelines. South Stream Transport has subsequently decided against the 4 x 1 strategy and is developing a modified 1+2+1 strategy that has overlapping construction of the second, third and fourth pipelines. Note however that there will be no overlapping of pipeline construction in Turkish waters. The result is that construction work in Turkish waters will last approximately 2.5 years.

1.11 Other Issues

In the course of preparing the EIA presented in this Report, South Stream Transport, and its EIA consultant, have collaborated with the following Government organisations and academics;

- Ministry of Foreign Affairs;
- Ministry of Culture and Tourism, Sinop Province Directorate of Culture and Tourism;
- Coast Guard Command, Turkish Armed Forces (Black Sea Region Directorate);
- Turkish Naval Forces Command (Office of Navigation, Hydrography and Oceanography);
- Ministry of Environment and Urbanisation, General Directorate of EIA, General Directorate of Permit and License, General Directorate of Environmental Management;
- Ministry of Energy and Natural Resources (MTA General Directorate, Office of Transit Oil Pipelines, BOTAŞ General Directorate and TPAO General Directorate);
- Ministry of Food, Agriculture and Livestock (General Directorate of Fisheries) and Sinop Province Directorate of Food, Agriculture and Livestock;

- Ministry of Transportation, Maritime Affairs and Communication (General Directorate of Shipyard and Coastal Structures, General Directorate of Marine and Inland Waters Administration, General Directorate of Coastal Security);
- Sinop University, Fisheries Faculty and Aydın University, Marine Faculty; and
- Bosphorus University, Civil Engineering Faculty.

Acronyms

Acronym	Definition
BOTAŞ	Petroleum Pipeline Corporation
CHO	Cultural Heritage Objects
DP	Dynamic Positioning
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIAAF	EIA Application File
ESMP	Environmental and Social Management Plan
EU	European Union
HSSE-IMS	Health, Safety, Security and Environment – Integrated Management System
IFC	International Finance Corporation
LNG	Liquefied Natural Gas
MoEU	Ministry of Environment and Urbanisation
MTA	Mineral Research and Exploration
NGO	Non-Governmental Organisations
PDEU	Provincial Directorate of Environment and Urbanisation
PP	Public Participation
REC	Review and Evaluation Committee
ROV	Remotely Operated Vehicles
SSFD	Scope and Special Format Determination
TPAO	Turkish Petroleum Corporation

2 ENVIRONMENTAL IMPACT ASSESSMENT APPROACH

The purpose of this Chapter is to discuss the EIA process and present the objectives of an EIA. It also outlines how the EIA process adopted for the Project complies with the national EIA requirements.

This Chapter presents the impact assessment methodology adopted for the Project in relation to prediction and assessment of impacts and how mitigation measures were developed when necessary. The identified impacts that have been assessed in the EIA Report are also briefly presented.

The EIA process is a systematic approach to identifying the environmental and social impacts of a project, and describing the mitigation, management and monitoring measures which will be implemented to address any impacts where it is deemed necessary. Ultimately, it allows the relevant competent authority to make informed decisions about development proposals, while also providing an opportunity for potentially affected stakeholders to participate in the approvals process.

2.1 EIA Process in Turkey

The EIA process adopted for the Project complies with the Turkish EIA Regulation (Ref. 2.1) which was entered into force on 7 February 1993 and has been revised on 23 June 1997 and 6 June 2002. The last revision, to comply with the European Union (EU) Directives 85/337/EEC (Ref. 2.2) and 97/11/EC (Ref. 2.3), was published on 17 July 2008.

Even if the aforementioned EIA Regulation is repealed with the new EIA Regulation which is enacted through publication in the Official Gazette dated 03.10.2013;

"*PROVISIONAL ARTICLE 1 – The EIA Application File/ Project Introduction File that had been submitted to the Governor or the Ministry before the date of entry into force of this Regulation; the provisions of the Regulation, which was effective on the date of application, are applied*."

Pursuant to the article and as the EIA Application File was submitted prior to the new EIA Regulation coming into force, the provisions of the regulation, dated 17.07.2008, are applied to the Project. This EIA Regulation is referred as the "Relevant EIA Regulation" in the report.

Within the relevant EIA Regulation this Project is listed under Annex I as follows:

"30 Oil, natural gas and chemicals to be transported with pipes longer than 40 km and greater than 600 mm diameter"

The generic EIA process in Turkey is governed by the EIA Regulation which regulates administrative and technical principles and procedures for the EIA process. The relevant EIA Regulation covers:

- Assessing whether projects require submission of an EIA Application File (EIAAF), EIA Report or project introductory file;
- Monitoring and auditing of projects, before, during and after construction;
- Administrative and technical procedures and principles in the EIA process; and

- The establishment of a Scope and Special Format Determination (SSFD) meeting (**Section 2.1.3**) and the Review and Evaluation Committee (REC) (**Section 2.1.1**).

The main objectives of EIA are:

- To identify and assess possible impacts on the environment including all beneficial and adverse impacts in all phases of the project; and
- To prevent potential adverse impacts where possible or to minimise and mitigate where the impact is not preventable.

2.1.1 Application

For projects that are subject to the EIA Regulation the project owner submits an EIAAF to the Ministry of Environment and Urbanisation (MoEU) prepared in accordance with Appendix III of the relevant EIA Regulation.

The MoEU reviews the EIAAF in terms of suitability to determine whether it is in line with Appendix III. If not, it will be handed back to the project owner to address any issues and resubmit.

If the MoEU decides that the EIAAF has been prepared appropriately then a REC will be established taking into consideration the information submitted within the EIAAF. The REC will consist of institutions that will be required to issue opinions for the project as well as those that will provide an expert opinion on the potential impacts and mitigation measures.

The REC is usually composed of representatives of the following:

- The relevant General Directorates and Local Governance of the MoEU (e.g., Provincial Directorate of Environment and Urbanisation (PDEU));
- Local administration of the organisations and authorities, assigned by the MoEU, which are relevant to the Project (e.g., Provincial Directorate for Culture and Tourism); and
- Municipalities and other relevant institutions and organisations.

The MoEU may invite universities, institutes, research and professional organisations, trade associations, unions, trade unions and representatives of non-governmental organisations (NGOs) to the meetings as REC members if considered necessary.

The dates and locations of the Public Participation (PP) (**Section 2.1.2**) and the SSFD (**Section 2.1.3**) meetings are to be attached to the EIAAF by the MoEU when submitted to REC members.

2.1.2 Public Consultation

The PP meeting(s) are to be organised before the SSFD meeting by the project owner and EIA Consultant (the institution that will prepare the EIA Report) at the project location (or another designated area determined by the MoEU) to inform the public of the proposed project and to collect their opinions and suggestions. The dates of the meeting(s) are to be agreed with the MoEU.

The PP meeting location(s) are to be identified by the MoEU and the project owner. While deciding the meeting location(s), consideration is given to ensure easy access to the most affected local people.

The project owner will advertise the PP meeting(s), including information on the date, time, location and subject, in a national and a local newspaper at least ten days prior to the meeting.

The PP meeting(s) are to be chaired by an official from the PDEU (regional branches of the MoEU) or their representative. Minutes of the meeting are to be sent to the MoEU. Minutes are recorded by the PDEU.

An assessment is required to identify which public groups are likely to be affected by reviewing the potential impacts arising from the Project. The public consultation process includes the following steps:

- Selection of the PP meeting(s) location;
- Consultation with the MoEU regarding the location of the PP meeting(s);
- Information relayed to the public via promotional tools, such as brochures, during the PP meeting(s);
- Meeting notes taken at the PP meeting(s);
- Establishment of a comment procedure (via telephone or email);
- Consultation with other relevant stakeholders such as universities, academies and NGOs;
- Assessment of the opinions and suggestions received during the PP meeting(s) in the SSFD meeting (**Section 2.1.3**); and
- Inclusion of public and other stakeholders' opinion via comment procedure within the EIA Report.

2.1.3 Scoping

According to the relevant EIA Regulation, the purpose of scoping is to determine the environmental and social topics that should be assessed as part of the EIA process.

The scope of the EIA, known as the Special Format, is determined in compliance with Annex III of the relevant EIA Regulation and takes into account the potential significant environmental impacts. Information to be included or excluded from the EIA Report is discussed by the REC during the SSFD meeting.

The MoEU inform the REC of the outcomes of the PP meeting(s). In addition to the PP meetings, REC members report their opinions and suggestions for the project which are used to determine the Special Format.

The SSFD meeting is undertaken by the MoEU within one week of the PP meeting(s). The opinions of the REC members are to be supplied in writing. Minutes of the meeting are recorded by the MoEU. The REC members may ask for additional project details from the project owner before they give their opinion.

The Special Format is determined according to the REC members' requests and provided to the project owner by the MoEU in the form of a table of contents which the EIA Report must follow.

2.1.4 Report Submission

The project owner is obliged to submit the EIA Report to the MoEU within one year after receiving the Special Format.

Within three days of submission of the EIA Report, the MoEU completes a review which is to check if the EIA Report complies with the Special Format and to confirm that the Report was prepared by the experts from the EIA Consultant.

Following the review, if it is identified that the EIA Report is not prepared by the experts of the EIA Consultant and/or it is not compatible with the Special Format then it will be handed back to the project owner for these matters to be addressed.

If a revised EIA Report is not submitted within three months from this review then the EIA Application will be declared null and void.

If the EIA complies with the Special Format and has been prepared by the experts of the EIA Consultant then further copies of the EIA Report are to be submitted to the MoEU.

2.1.5 Report Review and Evaluation

The commencement of the review and evaluation process and availability of the EIA Report for the public is announced by the MoEU. Those stakeholders who want to review the EIA Report may do so at the MoEU's office or the local PDEU to express their opinions within a timeframe that is announced and these public opinions are passed to the REC. Any opinions received following the completion of the review and evaluation process are not considered.

The EIA Report is assessed from five perspectives:

- If the report and appendices are adequate and suitable;
- If the review, calculations and assessments are based on sufficient data and information;
- If the possible environmental impacts of the project have been reviewed thoroughly;
- If the mitigation measures to prevent potential adverse impacts to the environment have been identified; and
- If solutions to issues raised in the PP meetings have been included.

A review and evaluation meeting is then undertaken in which the REC members must express the view of the organisation they represent. Minutes are taken of the meeting and the meeting chair may request the views of the REC organisations in writing. The REC may request that the project owner provides any information collected during the EIA. If in doubt the Project Area may be visited, samples may be taken and other experts may be invited to review the EIA Report. The project owner is obliged to pay the expenses. If important elements of the report are missing then the REC stops reviewing until the missing information is included in the EIA Report.

The review and evaluation process is completed within 12 working days following the review and evaluation meeting.

The project owner submits the final EIA Report to the MoEU within five working days of receiving the final evaluation report of the review and evaluation meeting. The project owner stipulates (with a written contract and signature) that the final EIA Report and appendices are their undertaking. If the EIA Report and the contract are not submitted within this timescale, without notification of the delay, the EIA Report will be declared null and void.

2.1.6 EIA Decision

Within five working days of submission of the final EIA Report, the MoEU decides whether the outcome is "EIA Positive" or "EIA Negative" taking into account the review and evaluation report completed by the REC. The MoEU informs the project owner and relevant organisation and institutions of their decision in writing and announces the decision, and the reasons behind it, to the public.

Projects with an "EIA Positive" decision must commence construction within seven (7) years of the decision; if not the positive decision will be invalid. A project with an "EIA Negative" decision can submit a new application, if all the design features resulting in the rejection of the project are removed.

The Turkish EIA process is summarised in **Figure 2.1**.

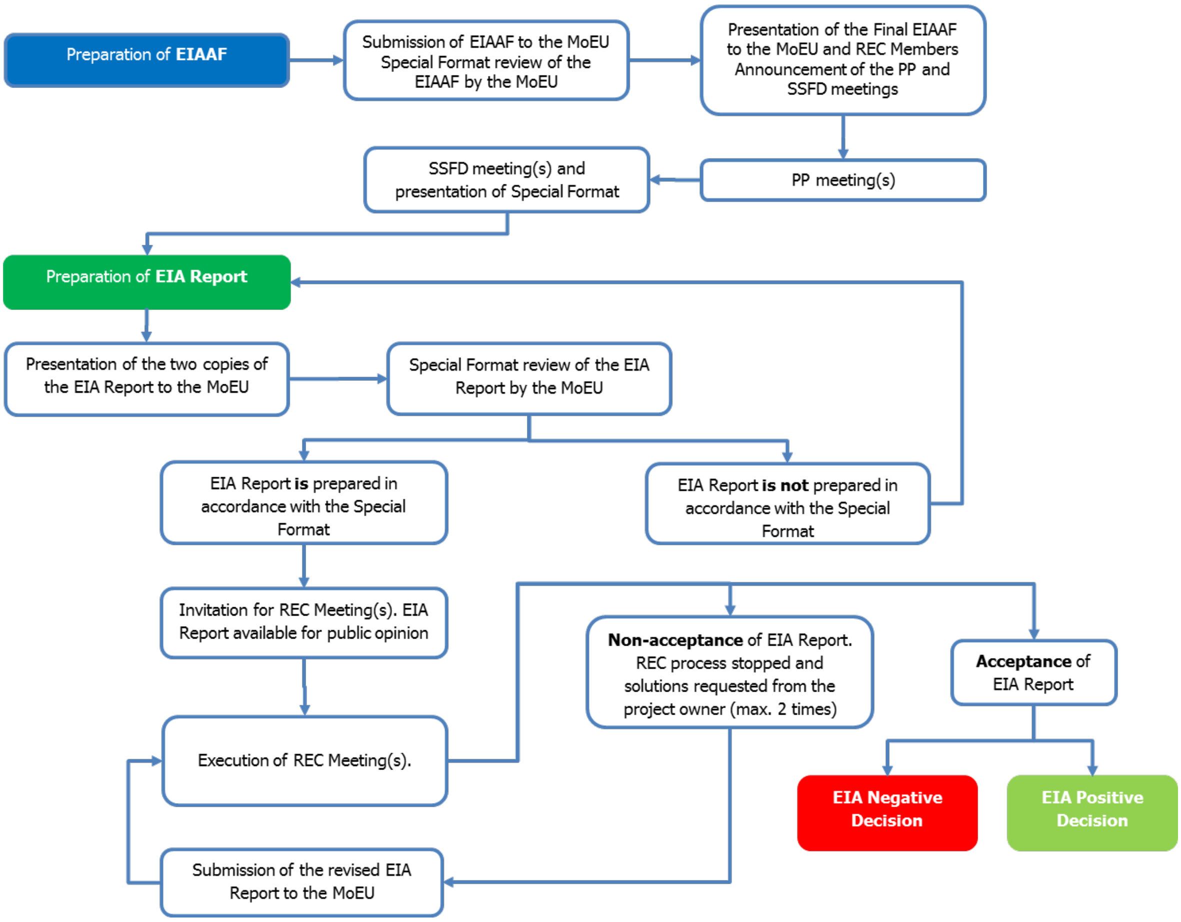


Figure 2.1: EIA Process

2.2 EIA Process for the Project

The EIA process followed for the Project is in line with the national EIA process given in **Section 2.1**. In order to provide a robust impact assessment, the Project's EIA process was structured over a series of progressive stages, as follows:

- **Screening** (**Section 2.2.1**): An initial and preliminary identification of likely potential interactions between the Project activities and environmental and social receptors;
- **Scoping** (**Section 2.2.2**): Preparation of the EIAAF which discussed the perceived required scope of the EIA to be undertaken, taking into consideration the nature of the Project, the results of the screening and applicable legislative requirements and undertaking a SSFD meeting. This stage included:
    - Desk-based studies: Review of existing environmental and social information and a gap analysis to identify areas where additional baseline information is required or needs to be verified;
    - Receptors: Identification of potential physical, biological and socio-economic receptors that may be affected by the Project; and
    - Alternatives: Assessment of the Project's technical alternatives, including alternative routes and methods.
- **Field baseline studies** (**Section 2.3**): Field surveys were conducted prior to the Screening Stage and also following on from the data gap analysis undertaken as part of the Scoping Stage. These surveys were undertaken to complement existing information and to represent the baseline conditions against which the impact assessment was to be undertaken;
- **Impact assessment** (**Section 2.4**): This stage included:
    - Impact assessment: Identification and assessment of potential impacts, including their type, nature and magnitude; and
    - Transboundary and cumulative impacts: Utilising the results of the impact assessment, specific assessments were undertaken of both the potential for impacts from the Russian and Bulgarian Sectors of the South Stream Offshore Natural Gas Pipeline to extend across Turkish national boundaries, (Transboundary Impacts, **Section 2.5.9**) and the potential for Project impacts to combine with other impacts associated with other existing or planned projects or developments and other Sectors of the South Stream Offshore Natural Gas Pipeline (Cumulative Impacts, **Section 2.5.8**).
- **Mitigation** (**Section 2.5.6**): Once all Project impacts were identified, mitigation measures to avoid or minimise potential adverse impacts and enhance potential benefits were proposed;
- **Residual impact assessment** (**Section 2.5.7**): In light of the mitigation measures to be applied, an assessment of the residual impacts, i.e., the unavoidable Project impacts resulting after mitigation measures have been applied, was undertaken;
- **Environmental and Social Management Plan (ESMP):** Development of management plans and procedures as part of the South Stream Transport Health, Safety, Security and Environment - Integrated Management System (HSSE-IMS), which capture all of the mitigation measures identified to ensure they will be practically applied as part of Project development. This is presented in **Chapter 11: Environmental and Social Management System** of this EIA Report;
- **Stakeholder Engagement**: Consultation with regulators and other stakeholders regarding the scope and content of the EIA as well input to the identification of potential Project impacts. This included the PP and SSFD meetings (**Section 2.2.2**); and
- **EIA Report Disclosure**: Submission of the EIA Report to the MoEU in line with Turkish relevant EIA regulation requirements (**Section 2.1.4**). Commencement of the review and evaluation process (**Section 2.1.5**) and notification by the MoEU of the EIA decision (**Section 2.1.6**).

2.2.1 Screening

Screening was the first stage undertaken during the Project EIA process and was done to identify potential interactions between the Project and existing physical, biological, and socio-economic receptors. There is no applicable screening stage under the Turkish EIA process; however, the process is comparable to the work conducted prior to producing and submitting the EIAAF. Undertaking screening early in the EIA process also facilitated the incorporation of environmental and social considerations in the on-going development of the Project design.

The screening process included the following key steps:

- Identification of Project activities - routine (planned) activities, non-routine but planned activities and unplanned events (accidents) were identified for the three main Project Phases: Construction and Pre-Commissioning; Operational (including Commissioning); and Decommissioning;
- Identification of likely physical, biological and socio-economic receptors based on existing knowledge of the environmental and social baseline conditions and professional judgement;
- Examination of relevant national and international legislative requirements; and
- Development of a screening matrix to illustrate the potential interactions of Project activities which are most likely to have an impact on physical, biological and socio-economic receptors.

The resultant screening matrix is presented in **Table 2.1**.

Table 2.1: Screening Matrix

Impact Receptors \ Project Activities	Construction and Pre-Commissioning Activities	Operational Activities	Decommissioning Activities
Physical			
Water Quality	✓		✓
Sediments and Geology	✓		✓
Climate / Air Quality	✓		✓
Biological			
Plankton	✓		✓
Marine Mammals	✓		✓
Seabirds	✓		✓
Fish	✓		✓
Socio-Economic			
Archaeology	✓		✓
Marine Users	✓	✓	✓

Following identification of all Project activities, the activities were then assessed to evaluate their potential to give rise to releases, emissions or interactions with the environment in order to determine those with the potential to result in an impact. A summary of the Project phases and associated activities are listed in **Table 2.2**.

Table 2.2: Project Activities

Phase	Activity
Construction and Pre-commissioning	Mobilisation of vessels to and from site and vessel movements within construction spread and use of Dynamic Positioning (DP) during pipe-lay.
	Perform pre-lay, as-laid, and as-built ROV surveys.
	Delivery of fuel, pipe and other supplies to pipe-lay vessel(s) by supply vessels. Including line up of pipe with deck pipe transfer cranes.
	Storage of fuel and other hazardous materials.
	Refuelling of vessels, plant and machinery.
	Helicopter operations for crew changes.
	Maintenance of plant and machinery.
	Vessel operations: waste generation.
	Vessel operations: Use of fresh water maker/desalination unit and vessel cooling water system. As is the case for all vessels, cooling water is the outcome of the heat of the vessel's engines, not arising from a thermal procedure and process.
	Night time working.
	Welding, weld testing and coating of pipe sections.
	Welding of recovery head to pipeline and lowering/raising of pipeline (Abandonment and Recovery Operations (if necessary due to weather or emergency conditions)).
Operation (including Commissioning)	Mobilisation of vessels to and from pipeline locations and vessel movements along pipeline (Pipeline condition survey and repairs)
	Maintenance / repair to pipelines (e.g. span correction) Pipeline condition survey and repairs
	Operation of pipeline
Decommissioning (in-situ/ leave in place option)	Pipeline cleaning by flushing with water and associated water displacement and disposal.
	Filling pipe with seawater and sealing.
	Vessel operations associated with inspection surveys.
Decommissioning (remove pipelines option)	Lifting of pipeline from the seabed.
	Vessel movements and operations with associated activities similar to those listed for the Construction and Pre-Commissioning Phase.

Note: Commissioning and pre-commissioning activities are not expected to impact any receptor in Turkey.

During the Project Phases outlined in **Table 2.2**, there is also the potential for unplanned events to occur (such as emergencies). These include:

- Spills of chemicals or fuel from vessels;
- Introduction of non-native invasive species;
- Vessel collisions; and
- Loss of containment from rupture of the pipeline.

2.2.2 Scoping

Following the Screening Stage, the Scoping process undertaken provided identification of potential environmental and social impacts of the Project. This process utilised more detailed engineering and baseline data than that which was available during the Screening Stage. The Scoping process is intended to facilitate impact identification in a consistent and robust manner.

The Scoping Stage included the preparation of the EIAAF in line with the relevant EIA Regulation. The EIAAF was submitted to the MoEU on 22 May 2013.

Stakeholder engagement was conducted in line with the national EIA requirements including one PP meeting which was held in Sinop on 2 July 2013. As the Project Area is located 110 km offshore, there were no anticipated affected communities. Sinop was selected as the location for the PP meeting as it is geographically the closest community to the Project Area.

The MoEU convened the REC for the SSFD meeting for the Project on 4 July 2013 in line with relevant Turkish EIA requirements. The SSFD meeting was conducted to discuss the Special Format for the EIA. The Special Format was provided to South Stream Transport on 23 July 2013 to which the structure of this EIA Report complies.

Views taken from the public during the PP meeting, and from other stakeholders following the SSFD Meeting, are addressed within the applicable Chapters of this EIA Report.

2.2.2.1 Desk-based Studies - Review of Existing Baseline Information

An important component of the scoping process is the definition of baseline conditions (i.e. the prevailing environmental and social characteristics against which the potential impacts of the Project can be assessed). Baseline conditions were identified primarily through the review of existing environmental and social information. The collection of existing information and available data utilised a range of sources, including:

- Statistics and reports by government agencies and other groups (e.g. NGOs and TurkStat);
- Data requested from universities, relevant stakeholders and members of the REC; and
- Scientific journals and published sources.

A significant body of information was also obtained through review of previous environmental data collected between 2009 and 2012 commissioned by OAO Gazprom (unpublished) and subsequent analysis of the collected data (Ref. 2.4).

Surveys conducted on behalf of the Project have been used for obtaining the following baseline data:

- Seabird and marine mammal observations;
- Plankton sampling;
- Hydrographical and geological remote detection measurements using;
    - Multi-beam echo sounding (echo-sounder);
    - Side scan sonar; and

   - Seabed profiler.
- Hydrochemistry, water and sediment quality; and
- Remotely operated vehicle (ROV) investigations of unknown sonar contacts and geological anomalies.

This existing baseline information was used not only for the EIAAF, but also formed the core of existing baseline information used in the impact assessment contained in this EIA Report. Where applicable, details of the sources of baseline data and key documents used are provided in **Chapter 6: Assessment of the Physical Environment, Chapter 7: Assessment of the Biological Environment** and **Chapter 8: Assessment of the Socio-Economic Environment** of this EIA Report.

2.2.2.2 Identifying Receptors

Receptors are the environmental components, people and cultural heritage assets that may be affected, adversely or beneficially, by the Project. Potential receptors were identified through both desk and field-based studies and an understanding of the likely Project impacts. Based on the review of existing information, three high-level categories of Project receptors were identified:

- Physical (i.e. non-living environmental components, including air quality, water bodies, marine sediments and geology);
- Biological (i.e. marine fauna); and
- Socio-economic (i.e. economic condition in fisheries, cultural heritage).

2.2.2.3 Alternatives Assessment and Project Optimisation

The alternatives assessment process and conclusions are further detailed in **Chapter 4: Grounds for the Route Selection and Assessment of Alternatives** of this EIA Report.

2.3 Collection of Baseline Data

The gap analysis undertaken determined where existing secondary data was considered to be insufficient or inadequate (e.g. out of date, too narrow in scope, etc.) for the purposes of this Report and led to the need to undertake a baseline field survey and study to collect additional primary data. This was undertaken in September 2012 and included a geophysical and geotechnical survey of the Project Area (Ref. 2.6). An analysis of this geophysical data was also undertaken along with a review of published literature to assess the presence of benthic habitats in the Project Area (Ref. 2.7). In addition, fish and fisheries were assessed through a review of published data and consultation with fisheries organisations (Ref. 2.8).

The details of the survey undertaken (timing, location, methods and results), together with information gathered through the desk-based data review process, are presented in **Chapter 6 Assessment of the Physical Environment, Chapter 7 Assessment of the Biological Environment** and **Chapter 8 Assessment of the Socio-Economic Environment** of this EIA Report.

2.4 Impact Assessment Methodology

The impact assessment describes what may happen if the Project is developed; using scientific information, predictive tools and expert judgement to identify the possible impacts of a Project on the environment. It is important to note that impact identification takes into account any control measures that are part of the Project design. These are referred to in this EIA Report as "design controls". Additional measures aimed at further reducing or controlling identified impacts are then proposed where necessary or as appropriate (**Section 2.5.7**). These are referred to as "mitigation measures". For the purposes of this Project, the methodology has been applied to all impacts identified as arising in the Construction and Pre-Commissioning, Operational (including Commissioning) and Decommissioning Phases.

Two different forms of impact have been assessed through the EIA process: impacts associated with planned events and those associated with unplanned (including emergency) events. Impacts from planned events are defined as those arising from a routine project activity or event (e.g. discharges of waste water from vessel operations), as well as non-routine events that are reasonably expected to occur as a result of project activities (e.g. dropped objects). Unplanned impacts are those impacts that result from events that are not anticipated to occur in the normal course of operations of the Project (e.g. vessel collision).

Following the compilation of Project baseline data and identification of Project Activities the potential impacts associated with the Project were identified and evaluated. The results of this assessment are provided in **Chapter 6: Assessment of the Physical Environment, Chapter 7: Assessment of the Biological Environment** and **Chapter 8: Assessment of the Socio-Economic Environment** of this EIA Report.

The process for assessing impacts is illustrated in **Figure 2.2** and involves an iterative methodology that considers the following:

- ***Prediction*** – What will happen to the environment as a consequence of this Project (i.e., understanding Project activities)?
- ***Evaluation*** – Will it have a beneficial or adverse effect? How big is the change expected to be? How important will it be to the affected receptors?
- ***Mitigation*** – If the impact is of concern, can anything be done to avoid, minimise, or offset the impact? Or to enhance potential benefits?
- ***Residual Impact Assessment*** – After mitigation, is the impact still of concern?

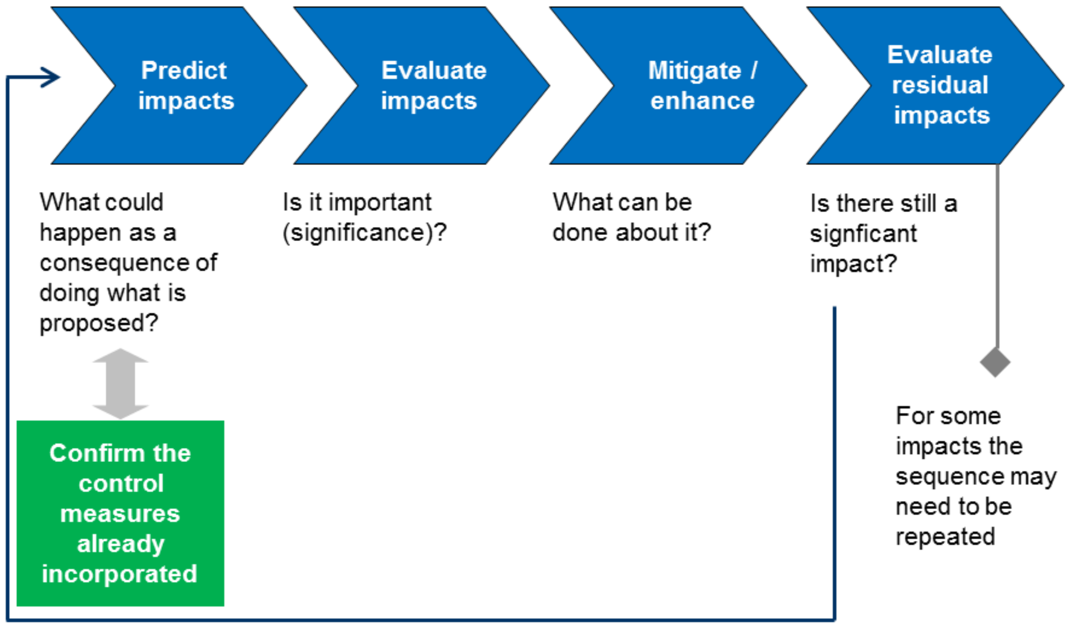


Figure 2.2: Impact Identification and Assessment Process

For some types of impact there are empirical, objective and established criteria for determining the potential impact significance (e.g. if a standard is breached). However, in other cases assessment criteria are more subjective and require professional judgement to be utilised. The criteria against which the impacts were evaluated are provided in **Section 2.5.1**.

The impact assessment methodology for these events takes into consideration an impact's nature, type and magnitude. The methodology employed complies with the requirements of the Turkish EIA Handbook (Ref. 2.5) and is informed by the previous experience of the EIA Consultant.

Whether an impact is considered to be beneficial or adverse (impact nature), and the way in which it is related to the Project (impact type, e.g. direct, indirect) are of relevance to the assessment. In particular, the degree to which an impact may be managed or modified by the mitigation measures is dependent upon the type of impact in question.

In addition to impact type and nature, the magnitude of the impact is also considered in the assessment. The magnitude of an impact is a measure of the degree of change from the baseline conditions as a result of a project activity.

The classification of impact type, nature and magnitude is given in **Table 2.3**.

Table 2.3: Impact Assessment Terminology

Term	Definition
Impact Nature	
Adverse Impact	An impact that is considered to represent a negative change from the baseline condition or introduces a new undesirable factor.
Beneficial Impact	An impact that is considered to represent an improvement on the baseline condition or introduces a new desirable factor.
Impact Type	

Direct Impact	Impacts that result from a direct interaction between a project activity and the receiving environment.
Indirect Impact	Impacts that result from other activities that may happen as a consequence of the Project.
Secondary Impact	Impacts that follow on from the primary interactions between the Project and its environment as a result of subsequent interactions within the environment.
Impact Magnitude; consisting of the following:	
Extent	The spatial extent (e.g. the area impacted) or population extent (e.g. proportion of the population affected) of an impact.
Duration	How long the impact will interact with the receiving environment.
Frequency	How often the impact will occur.

2.5 Identification of the Impacts

2.5.1 Physical Environmental Impacts

This section gives a preliminary assessment of the potential impacts of the Project and how impacts were assessed within this EIA Report.

2.5.1.1 Significance Assessment for Physical Environmental Impacts

The significance criteria used on the physical environment has been based on applicable national and international legislation, where available. The criteria are described in **Chapter 3: Statutory, Political and Administrative Framework** of this EIA Report. In the absence of applicable standards, professional judgement was used.

2.5.1.2 Impacts on Seabed Geology

Placement of the pipelines on the seabed during construction could potentially cause mobilisation of sediments. No applicable national and international legislation is available therefore the assessment in this EIA Report has been based on professional judgement: No activities causing sediment mobilisation are expected during the Operational (including Commissioning) Phase of the Project.

2.5.1.3 Impacts on Sea Water

Construction activities could potentially cause deterioration in water quality from discharges such as, waste water, macerated food wastes or accidental spills of hydrocarbons and chemicals from vessels. Impacts of the Project on the water quality during the Operational (including Commissioning) Phase are expected to be similar to those during construction but restricted to discharges from the annual use of maintenance vessels. Impacts on seawater and any proposed mitigation measures have been assessed in line with all relevant national and international legislation listed in **Chapter 3: Statutory, Political and Administrative Framework** of this EIA Report.

Estimated daily waste discharges to sea have been quantified for the typical vessels used.

2.5.1.4 Impacts on Air Quality

Construction activities will result in the release of exhaust emissions to the air from the pipe-laying, supply and support vessels and helicopters. During operation, activities will be limited to exhaust emissions from the periodic use of maintenance and repair vessels.

The emissions to air from vessels were modelled based on engine types and daily fuel usage. Air modelling is provided in **Appendix 6.A**. Impacts on air quality and any proposed mitigation measures have been assessed in line with all relevant national and international legislation listed in **Chapter 3: Statutory, Political and Administrative Framework** of this EIA Report.

2.5.1.5 Noise and Vibration

Noise and vibration emissions will be generated from engines and machinery associated with the vessels and helicopters involved in construction activities. These emissions could generate both airborne and underwater noise and vibrations. These are relevant for fish and marine mammals, as such, underwater noise modelling has been undertaken in **Appendix 7.B**. Impacts of noise and vibration and any proposed mitigation measures have been assessed in line with all relevant national legislation listed in **Chapter 3: Statutory, Political and Administrative Framework** of this EIA Report. During operation, noise generating activities will be limited to the periodic use of maintenance and repair vessels.

2.5.1.6 Impacts on Vessel Traffic

Construction activities may be associated with restrictions on marine users as a result of Project exclusion zones related to vessels involved in the Project construction. During the Operational (including Commissioning) Phase, vessel traffic will be limited to routine and occasional maintenance vessels. The impact to sea traffic will be assessed based on number of vessels used by the Project and the interaction with shipping lanes and navigation in the vicinity of the Project Area. The numbers, types and size of vessels using shipping lanes has been obtained from the relevant authority. Impacts on sea traffic and any proposed mitigation measures have been assessed in line with all relevant national legislation listed in **Chapter 3: Statutory, Political and Administrative Framework** of this EIA Report. Collision Risk Analyses has been prepared with the intent of numerical assessment and are given in **Appendix 9.A**.

2.5.1.7 Impacts on Cultural Heritage

Cultural Heritage Objects (CHO) within the Project Area could potentially be directly or indirectly impacted by pipe-laying activities during the Construction and Pre-Commissioning Phase. It is anticipated that there will be no impact on cultural heritage during the Operational (including Commissioning) Phase of the Project. Impacts on cultural heritage and any proposed mitigation measures have been assessed in line with all relevant national and international legislation listed in **Chapter 3: Statutory, Political and Administrative Framework** of this EIA Report.

2.5.2 Ecological Impacts

2.5.2.1 Significance Criteria for Ecological Impacts

The operation of construction vessels and machinery will generate noise and vibration, which could potentially impact the marine environment. The construction spread, which will include up to nine vessels at any given time, will generate underwater noise, primarily via vessel thruster use during Dynamic Positioning (DP). The impacts of underwater noise may extend outside of the Project Area and will be dependent on the activities and machinery used. The significance of underwater noise impacts will primarily depend on the occurrence of fish and marine mammals in this area. Noise could potentially impact marine mammals by causing disruption to their ability to echolocate and communicate as well as causing potential harm to fish species in the vicinity of the noise source. The impact from underwater noise on fish and marine mammals has been modelled (**Appendix 7.B**) using weighted and unweighted metric analysis of underwater sound propagation and the hearing sensitivities of marine species. It is anticipated that operational noise and vibration impacts will be limited to the periodic activities of maintenance and repair vessels.

The physical presence of the construction spread during the Construction and Pre-commissioning Phase, and of maintenance vessels during the Operational Phase, has the potential to displace marine species from the area. In addition, discharges from vessels could potentially impact water quality which in turn can impact marine ecology. Impacts on marine ecology and any proposed mitigation measures have been assessed in line with all relevant national and international legislation listed in **Chapter 3: Statutory, Political and Administrative Framework** of this EIA Report.

2.5.3 Social Impacts

2.5.3.1 Significance Criteria for Socio-Economic Impacts

Socio-economic impacts have been evaluated based on the impacts of the construction and operation activities to other marine users in the vicinity of the Project Area, such as fishing and shipping. There is potential for the construction spread to temporarily restrict access of other marine users to marine resources or shipping lanes. Impacts on fisheries and other marine users and any proposed mitigation measures have been assessed in line with all relevant national and international legislation listed in **Chapter 3: Statutory, Political and Administrative Framework** and will take into account the number and type of vessels that would potentially interact with the construction spread at different times of the year.

2.5.4 Impacts on Other Projects in the Region (TPAO Exploration Activities)

There is the potential for interaction with the TPAO and other marine resource users in the Project Area as the Project could restrict oil and gas exploration or mineral extraction activities within the Project Area. Impacts on other projects and any proposed mitigation measures takes into account the other projects' frequency, seasonality and activities and potential interaction with the Project. Detailed information has been provided in **Section 6.6** and **6.7**.

2.5.5 Impacts that may Occur as a Result of Contingencies

During all Phases of the Project there is the potential for unplanned events (such as accidents and emergencies) to occur. These events can include the accidental introduction of invasive non-native species, a spill or major leak from a vessel or rupture of the pipeline leading to loss of containment. Marine vessels entering the Black Sea have the potential to carry non-native invasive species on their hulls or in ballast water that could pose a threat to the marine habitats and species of the Black Sea. Spills or leaks have the potential to impact the entire marine environment.

Impacts as a result of unplanned events and any proposed mitigation measures have been assessed in line with all relevant national and international legislation listed in **Chapter 3: Statutory, Political and Administrative Framework** of this EIA Report.

2.5.6 Mitigation Measures and Enhancing Benefits

A mitigation hierarchy is applied to define measures to reduce potential adverse impacts and enhance the benefits of a proposed activity. In seeking to mitigate impacts, the emphasis is on demonstrating that the impact is reduced as far as practicable. The application of mitigation measures also takes into account any relevant national or international legislation.

Where an adverse impact was identified for the Project, the following hierarchy of options for mitigation was explored:

- **Avoid at source** – remove the source of the impact;
- **Abate at source** – reduce the source of the impact;
- **Attenuate** – reduce the impact after the source but before it reaches the receptor;
- **Abate at the receptor** – reduce the impact at the receptor;
- **Remedy** – repair the damage after it has occurred; and
- **Compensate or offset** – replace in a different location or with a different resource of equal value.

As part of the impact assessment process, practicable mitigation measures to reduce the significance of potential impacts were identified and incorporated into the Project. If deemed necessary, mitigation measures will be supported by monitoring activities.

2.5.7 Residual Impacts following the Implementation of Mitigation Measures

Residual impact is the remaining or mitigated impact after all avoidance, design and management measures have been taken into account. An evaluation of the level of predicted impacts that are anticipated to remain after the implementation of all proposed mitigation measures (residual impact) was undertaken where necessary using the process outlined in **Section 2.4**.

2.5.8 Cumulative Impacts

This EIA Report adopts the following definition of cumulative impacts given in the EU Guidelines (Ref. 2.8):

"Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project."

Cumulative impacts may occur as a result of interactions between any residual (i.e. post-mitigation) impacts, and the impacts of other activities or developments in the area. In other words, the cumulative impact assessment will identify the combined effects of the Project with other projects and activities that may, individually or together (i.e. cumulatively), have a significant impact. Cumulative impacts have been assessed in line with all relevant national and international legislation and guidelines. The detailed information has been given in **Chapter 10: Cumulative Impact Assessment**.

A review of past, existing or other potential works in the vicinity of a proposed Project was undertaken to identify the potential for cumulative impacts that may arise from the interaction between those works and the Project. In addition, offshore project activities conducted in the Russian and Bulgarian Sectors of the South Stream Offshore Natural Gas Pipeline have also been assessed alongside Project activities (i.e., in the Turkish Sector).

2.6 Other Issues

2.6.1 Transboundary Impacts

A transboundary impact is defined as an environmental or social impact from the Russian and Bulgarian Sectors of the South Stream Offshore Natural Gas Pipeline that can extend into the Turkish national boundaries. For the purposes of the transboundary impact assessment, the Turkish Black Sea EEZ boundaries define the transboundary impact boundaries. Any changes in baseline conditions within the Turkish EEZ arising from the Russian or Bulgarian Sectors of the Offshore Natural Gas Pipeline would be considered to be a transboundary impact.

References

Number	Section
2.1	EIA Regulation (Official Gazette No.26939 and date: 17 July 2008)
2.2	Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment
2.3	Council Directive 97/11/EC of 3 March 1997 amending Directive 85/337/EEC
2.4	Giprospetzgas (2011) Complex engineering surveys at the phase “design documentation” within the framework of the “South Stream” gas pipeline marine sector Project implementation. Technical documentation Volume 5: Environmental survey and archaeological studies. Part 3 Environmental survey, The Turkish sector. Book 3: Technical report
2.5	EIA Hand Book published by the MoEU in January 2009. Available from; http://www2.cedgm.gov.tr/cedbim/Documents/ced-el-kitabi.pdf [accessed Jan 2013]
2.6	Petergaz (2012) Complex Engineering Surveys at Design Documentation Phase as Part of South Stream Gas Pipeline marine Section. Volume 18: Integrated Report on First Phase. Part 2: Integrated Report. Book 7: Appendix 6 Catalogue of Side-Scan Sonar Targets (Ref. No. 6976.101.004.21.14.18.02.07(1))
2.7	P.P.E. Weaver, D.G. Masson, (2013). Interpretation of Seabed Survey Data for the South Stream offshore pipeline project.
2.8	EU Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions (1999). Available from; http://ec.europa.eu/environment/eia/eia-studies-and-reports/guidel.pdf [accessed August 2013]

4

Acronyms

Acronym	Definition
ACCOBAMS	Convention on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area
BOD	Biological Oxygen Demand
BUNKER	International Convention on Civil Liability for Bunker Oil Pollution Damage
CFC	Chlorofluorocarbons
CHO	Cultural Heritage Objects
Cl	Chlorine
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
E&P	Explorations and Production
EEZ	Exclusive Econmic Zone
EHS	Environmental, Health & Safety
EIA	Environmental Impact Assessment
EOP	Enhanced observing period
EP	Equator Principles
ESIA	Environmental and Social Impact Assessment
g/kWh	grams per kilowatt hour
GHG	Greenhouse Gas
GIIP	Good International Industry Practice
GT	Gross tonnage
HBFC	Hydrobromofluorocarbons
HCFC	Hydrochlorofluorocarbons
IFC	International Finance Corporation
IGA	Inter Governmental Agreement
IMO	International Maritime Organisation
IPIECA	International Petroleum Industry Environmental Conservation Association
kg	Kilogram
m	Metre

Acronym	Definition
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Maritime Environment Protection Committee
mg/l	Milligrams per litre
MoFA	Ministry of Foreign Affairs
MPN	Most probable number
NH_4	Ammonia
NO_2	Nitrogen Dioxide
NO_3	Nitrate
NOx	Nitrogen oxides
^oC	Degrees centigrade
ODS	Ozone Depleting Substances
OECD	Organisation for Economic Cooperation and Development
OPRC	International Convention on Oil Pollution Preparedness, Response and Co-operation
PCB	Polychlorinated biphenyls
PO_4	Phosphate
ppm	Parts per million
PS	Performance Standard
PVC	Polyvinyl Chloride
rpm	Revolutions per minute
SAR	International Convention on Maritime Search and Rescue
SO_2	Sulphur Dioxide
SOLAS	International Convention for the Safety of Life at Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SO_x	Sulphur Oxides
STCW	International Convention on Standards of Training, Certification and Watch keeping for Seafarers
TPAO	Turkish Petroleum Corporation
TSS	Total Suspended Solids
UNCLOS	United Nations Convention on the Law of the Sea
UNEP IE	United Nations Environment Program Industry and Environment

3 STATUTORY, POLITICAL and ADMINISTRATIVE FRAMEWORK

The purpose of this Chapter is to provide an overview of the policy, regulatory and administrative framework relevant to the Project.

Requirements relevant for the Project include those concerning:

- *International (including Inter Governmental Agreement (IGA)) Laws, Standards and Guidelines*: (e.g., the Convention on the Protection of the Black Sea against Pollution) discussed in **Section 3.1**;
- *National Laws, Standards and Guidelines*: (e.g., the EIA Regulation) discussed in **Section 3.2**;
- *Standards and Guidelines of Financing Institutions*: (e.g., International Finance Corporation Performance Standards (IFC PSs), Equator Principles (EPs)) discussed in **Section 3.3**;
- *South Stream Project Standards*: discussed in **Section 3.4**; and
- *National Corporate Requirements*: discussed in **Section 3.5**.

The Turkish national laws, standards and guidelines are applicable as the Project is located within the Turkish EEZ. The Project is subject to Turkish legal requirements within the framework described in the "Decision on the Turkish Exclusive Economic Zone" enacted as a supplement to the Decree No 86-11264 dated 5 December 1986.

The decision's relevant text is given in; *Article 2 - 2) Likewise, in the same region, Turkey has the exclusive rights and jurisdiction:*

To perform, to authorize, regulate or execute marine scientific research;

To apply the required regulations and inspections to protect and preserve the marine environment and to prevent, reduce and control the pollution of the sea.

3) The regulations regarding the use of the rights and jurisdiction explained above will be subject to this Decree and other procedures and principles enforced by Turkish Laws.

The rights of other countries are regulated by Article 3 of the Decree of the Council of Ministers. Accordingly;

Article 3 - Within the EEZ of Turkey in the Black Sea, other countries can exercise the freedom of navigation and overflight; as well as the freedom to lay submarine cables and pipelines. However, while exercising this freedom, other countries will comply with the Turkish Legislation and general practice.

In addition to national requirements, South Stream Transport is committed to implementing Good International Industry Practice (GIIP) in relation to its environmental and social performance during all Project phases.

3.1 International (including IGA) Laws, Standards and Guidelines

3.1.1 Protocol on Cooperation in the Gas Sphere

A protocol was signed between the MoFA of the Republic of Turkey and the Embassy of the Russian Federation in Ankara on 6 August 2009 (**Appendix 3-A**). This Protocol is in the process of being ratified by the Turkish Parliament. According to Article 2:

"*The Parties before 1 November 2010 shall provide all necessary conditions and permissions for unimpeded construction of a new gas pipeline across the Black Sea water area for natural gas supplies from the Russian Federation based on results of feasibility study.*

To this end, the Turkish Party, in particular, will provide, before 1 November 2009, issuance upon request of a company authorized by Open Joint-Stock Company Gazprom, of authorizations for maritime reconnaissance and environmental survey along the route of the South Stream gas pipeline for its construction within the exclusive economic zone of the Republic of Turkey."

The Ministry of Foreign Affairs (MoFA) issued the letters indicated below to the Embassy of the Russian Federation; informing the embassy of certain permitting requirements, conditions and technical requirements that should be fulfilled by the project. The official letter from the MoFA to the Embassy of the Russian Federation in Ankara, dated 28 December 2011 and referenced 3515751 (**Appendix 1.B**), stated the following: "The MoFA of the Republic of Turkey respectfully informs the Embassy of the Russian Federation that they are honoured to grant an affirmative decision regarding the permit for construction of the South Stream Offshore Natural Gas Pipeline Project within the Exclusive Economic Zone of Turkey in Black Sea."

With the official letter sent to the Embassy of the Russian Federation in Ankara, dated 15 October 2012 and referenced 2012/ESGY/4564285, the MoFA requested that the Project is executed in line with the Turkish laws listed below:

- Environmental Law, No: 2872 (Official Gazette Date: 11 August 1983 and No: 18132);
- Regulation on Water Pollution Control (Official Gazette with Date: 31 December 2004 and No: 25687);
- Regulation on Waste Collection from the Ships and Control of Wastes (Official Gazette Date: 26 December 2004 and No: 25682);
- Law Pertaining to Principles of Emergency Response and Compensation for Damages in Pollution of Marine Environment by Oil and Other Harmful Substances No. 5312 (Official Gazette Date: 11 March 2005 and No: 25752);

With the above mentioned official letters, the MoFA also requests South Stream Transport to fulfil the conditions and technical requirements listed below, within the framework of Turkish legal requirements and best practices:

- Do not cause any damage to fishery production areas, within the framework of the Law on Aquatic Products (No: 1380) and associated regulations;
- Submit precise information to the MoFA regarding vessels, equipment and crew to be employed, 6 months in advance and obtain separate permits for every activity to be implemented by the vessels;
- Provide the coordinates of the pipeline at 5-mile intervals to the MoFA;
- Notify the MoFA in writing of any CHO finds in a timely manner;
- In the event of encountering CHOs along the Project route, these objects will be treated as CHOs in accordance with article 35 of the Law on Protection of Cultural and Natural Heritages No. 2863;
- Ensure that no cables are crossed along the pipeline route. No subsea pipelines or UXO (munitions burial sites) are present that could endanger the route lying between the points

420 48 '21"N-0300 34' 37"E; 430 07 '31" N-0340 14' 08" E, 430 25'09"N-0360 13' 20"E. ITUR International underwater fiber optic cable system crosses the coordinates of 43 11.8N; 033 27.2E and 43 14.4N; 034 03.8E. The ITUR and KAFOS submarine cable systems do not interfere with the project route within the Exclusive Economic Zone of Turkey. A crossing agreement should be signed with the cable owners in the event that a cable is crossed;

- Liaise closely with the Turkish Petroleum Corporation (TPAO) regarding the potential overlapping of planned activities; and
- Coordinate with the Department of Navigation, Hydrography and Oceanography of the Turkish Naval Forces, the Turkish Coast Guard Command and the General Directorate of Marine and Inland Waters (formerly known as the Undersecreteriat of Maritime Affairs) of the Ministry of Transport, Maritime Affairs and Communication in order to ensure the safe execution of construction of the Project.

3.1.2 International Conventions and Treaties

The Republic of Turkey has ratified or accessioned several international conventions regarding environmental protection and sustainable development that are relevant for the Project. There are also some international conventions and treaties which are not signed by the Republic of Turkey but which have been adhered to on a voluntary basis by South Stream Transport. **Table 3.1** presents information on all relevant international conventions.

Table 3.1: International Treaties and Conventions for Turkey

Convention	Purpose	Status
Air Quality		
Convention on Long-Range Transboundary Air Pollution (Geneva, 1979) (Official Gazette Date: 23 March 1983)	To provide a framework for controlling and reducing transboundary air pollution.	Ratified
United Nations Framework Convention on Climate Change (1997) (Official Gazette Date: 18 December 2003)	To provide a framework for intergovernmental efforts to tackle the challenge posed by climate change. It recognizes that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases.	Accession
Convention for the Protection of the Ozone Layer (Vienna, 1985) (Official Gazette Date: 08 September 1990)	To ensure global co-operation for the protection of the Ozone Layer. Aims to reduce and eventually eliminate the emissions of manmade ozone depleting substances.	Accession
Biodiversity		
Convention on Biological Diversity (Rio, 1992) (Official Gazette Date: 03 September 1996)	The Convention promotes conservation of biological diversity and sustainable use of its components.	Ratified
Convention on the Conservation of European Wildlife and Natural Habitats (Berne, 1979) (Official Gazette Date: 12 July 1995)	To ensure conservation of wild flora and fauna species and their habitats. Special attention is given to endangered and vulnerable species, including endangered and vulnerable migratory species specified in appendices.	Accession
Convention on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS 1996)	A cooperative tool for the conservation of marine biodiversity in the Mediterranean and Black Seas. Its purpose is to reduce threats to cetaceans in Mediterranean and Black Sea waters and improve our knowledge of these animals.	Not signed
International Convention for the Protection of Birds (Paris, 1950) (Official Gazette Date: 17 December 1966)	To protect birds in the wild state, considering that in the interests of science, the protection of nature and the economy of each nation, all birds should as a matter of principle be protected.	Ratified
Marine Protection		
Convention on the Protection of the Black Sea Against Pollution (Bucharest, 1992) (Official Gazette Date: 06 March 1994)	To provide a basic framework of agreement and three specific Protocols, which are: (1) the control of land-based sources of pollution; (2) dumping of waste; and (3) joint action in the case of accidents (such as oil spills).	Ratified
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London, 1972)	To control pollution of the sea by dumping, and to encourage regional agreements supplementary to the Convention. Annexes I and II list matter prohibited or restricted to be dumped.	Not signed

Convention	Purpose	Status
International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978, Regulations for the Prevention of Pollution by Oil (as amended 1991) Annex I to VI (MARPOL 1973) (with protocol 1978- Official Gazette Date: 24 June 1990 for Annex III and IV- Official Gazette Date: 29 May 2013) (with protocol 1997- Annex I, II and V, Official Gazette Date: 16 March 2013)	The MARPOL Convention covers the prevention of pollution of the marine environment by ships from operational or accidental causes. Annex I includes regulations for the Prevention of Pollution by Oil and is mandatory. Annex II includes regulations for the Control of Pollution by Noxious Liquid Substances in Bulk. Annex III covers Harmful Substances Carried by Sea in Packaged Form. Annex IV covers the Prevention of Pollution by Sewage from Ships. Annex V includes regulations for the Prevention of Pollution by Garbage from Ships. Annex VI covers the Prevention of Air Pollution from Ships.	Annex I, II and V: Ratified ; Annex III, IV and V: Accession
The International Convention on the Control of Harmful Anti-fouling Systems on Ships, 2001	This convention aims at prohibiting the use of harmful organotins in anti-fouling paints used on ships and establishing a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems. The convention entered into force on 17 September 2008.	Not signed
International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004	The Ballast Water Management Convention, adopted in 2004, aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments. Not yet in force.	Not signed
International Convention on Civil Liability for Bunker Oil Pollution Damage (BUNKER 2001)	To ensure that adequate, prompt, and effective compensation is available to persons who suffer damage caused by spills of oil, when carried as fuel in ships' bunkers. The Convention applies to damage caused on the territory, including the territorial sea, and in exclusive economic zones of States Parties.	Not signed
United Nations Convention on the Law of the Sea (UNCLOS 1994)	To define the rights and responsibilities of nations in their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources.	Not signed
Other		
Convention on Persistent Organic Pollutants (Stockholm, 2004)	To ensure the limitation of pollution by persistent organic pollutants (POPs). It defines the substances in question, while leaving open the possibility of adding new ones, and also defines the rules governing the production, importing and exporting of those substances.	Ratified
Energy Charter Treaty (signed date: 17 December 1994) (Official Gazette Date: 6 February 2000, No. 2000/786)	This treaty provides a multilateral framework for energy cooperation and is designed to promote energy security. Ratifying countries are encouraged to promote energy efficiency and to mitigate the impacts of the use of energy on the environment.	Ratified
Maritime Safety		
International Convention for the Safety of Life at Sea (SOLAS 1974) (Official Gazette Date: 31 January 2013)	To specify minimum standards for the construction, equipment and operation of ships, compatible with their safety. Flag States are responsible for ensuring that ships under their flag comply with its requirements, and a number of certificates are prescribed in the Convention as proof that this has been done.	Accession
International Convention on Maritime Search and Rescue (SAR 1979) (Official Gazette Date: 24 March 1986)	To develop an international SAR plan, so that, no matter where an accident occurs, the rescue of persons in distress at sea will be co-ordinated by a SAR organisation and, when necessary, by co-operation between neighbouring SAR organisations.	Accession

Convention	Purpose	Status
International Convention on Standards of Training, Certification and Watch keeping for Seafarers (STCW 1978) (Official Gazette Date: 29 September 2003)	To establish basic requirements on training, certification and watch keeping for seafarers on an international level. The Convention prescribes minimum standards relating to training, certification and watch keeping for seafarers which countries are obliged to meet or exceed.	Accession
Cultural Heritage		
Convention on Protection of Underwater Cultural Heritage Objects (2001)	To pledge to preserve underwater cultural heritage for the benefit of humanity, and take action. To preserve artefacts in situ and protect them from commercial exploitation.	Not signed
European Convention for Protection of Archaeological Heritage (Valletta Treaty, 1992) (Official Gazette Date: 8 August 1999)	States that a governmental legal system is required for the protection of archaeological heritage.	Ratified
Convention Concerning the Protection of the World Cultural and Natural Heritage (Paris, 1972) (Official Gazette Date: 14 February1983)	The Convention confirms the protection and preservation of world's cultural and natural heritage.	Ratified
Unplanned Events		
International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC 1990) (Official Gazette Date: 18 September 2003)	To set requirements for all ships to carry a shipboard oil pollution emergency plan and to report incidents of pollution to coastal authorities and the convention details the actions that are then to be taken. The convention calls for the establishment of stockpiles of oil spill combating equipment, the holding of oil spill combating exercises and the development of detailed plans for dealing with pollution incidents.	Accession
Convention on the Transboundary Effects of Industrial Accidents (Helsinki, 1992)	To lay down a set of measures to protect human beings and the environment against the effects of industrial accidents, and to promote active international cooperation between the contracting parties before, during and after such accidents.	Not signed
EIA in a Transboundary Context		
Convention on EIA in a Transboundary Context (Espoo, 1991)	To promote environmentally sustainable economic development, as a preventative measure against transboundary environmental degradation. It stipulates obligations of parties to assess transboundary environmental impacts of a project in the early planning stages. It also specifies the obligation of Parties of Origin (parties under whose jurisdiction a planned activity is due to take place) to notify and consult Affected Parties (parties anticipated to be affected by transboundary impacts of a proposed activity) when a project in their territory is likely to have a significant adverse transboundary impact. Parties of origin can ask the developer to undertake further public consultation, in addition to normal ESIA requirements.	Not signed
Waste		
Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel, 1989) (Official Gazette Date: 22 June 1994)	To regulate the transboundary movements of hazardous wastes and provides obligations to its Parties to ensure that such wastes are managed and disposed of in an environmentally sound manner.	Ratified

3.2 National Laws, Standards and Guidelines

Key environmental standards and requirements, applicable to the Project can be extracted from national legislation and must be adhered to. The national legislation relevant to the Project has been split into main topic areas and is shown in **Table 3.2**.

Table 3.2: Relevant National Legislation for the Project

Topic	Relevant National Legislation
General	– Environmental Law, No: 2872 (Official Gazette Date: 11 August 1983 and No: 18132); – EIA Regulation (Published in the Official Gazette Date: 17 July 2008 and No:26939); (This regulation is abolished by the new EIA Regulation which was published in 03 October 2013, however the old regulation will be applied the Project- see Chapter 2.1); – Regulation on Permits and Licenses to be Taken Under Environmental Law (Official Gazette Date: 29 April 2009 and No: 27214); – Harbours Law, No: 618 (Official Gazette Date: 20 April 1925 and No: 95); – Decision on Turkish Economic Exclusive Zone as an annex to the Decree (Date: 5 December 1986 and No: 86-11264); – Law on Military Forbidden Zone and Security Zone, No:2565 (Official Gazette Date: 22 December 1981 and No: 17552); – Regulation on Military Forbidden Zone and Security Zone, No:2565 (Official Gazette Date: 30 April 1983 and No: 18033); – Law concerning the Destruction of Unthreatened Mines, Explosives or Suspicious Objects Seen in the Sea and Territorial Areas, (Official Gazette Date: 27 February 2000, No: 23977; – Law on Services for Navigation and Hydrography, No. 1738 (Official Gazette Date: 7 June 1973 and No: 14557); – Regulation on Inventory and Control of Chemicals (Official Gazette with Date: 26 December 2008 and No: 27092); – Regulation on Restriction on Manufacturing, Supply and Use of Some Dangerous Substances, Preparations and Articles (Official Gazette with Date: 26 December 2008 and No: 27092); – Regulation on the Classification, Packaging and Labelling of Dangerous Substances and Preparations (Official Gazette with Date: 26 December 2008 and No: 27092); and – Regulation on Compiling and Distributing of Safety Data Sheets of Dangerous Substances and Preparations (Official Gazette with Date: 26 December 2008 and No: 27092).
Water Quality and Wastes	– Regulation on Water Pollution Control (Official Gazette Date: 31 December 2004 and No: 25687); – Regulation on General Principles of Waste Management (Official Gazette Date: 05 July 2008 and No: 26927); – Regulation on the Control of Hazardous Wastes (Official Gazette Date: 14 March 2005 and No: 25755); – Regulation on Control of Solid Waste (Official Gazette Date: 14 March 1991 and No: 20814); – Regulation on Control of Waste Oils (Official Gazette Date: 30 July 2008 and No: 26952); – Regulation on the Control of Waste Batteries and Accumulators (Official Gazette Date: 31 August 2004 and No: 25569); – Regulation on the Control of Medical Wastes (Official Gazette Date: 22 July 2005 and No: 25883); – Regulation on Control of Packaging Waste (Official Gazette, Date: 24 August 2011 and No: 28035); – Regulation on Waste Collection from the Ships and Control of Wastes (Official Gazette Date: 26 December 2004 and No: 25682); – Regulation on Control of Waste Vegetable Oil (Official Gazette Date: 19 April 2005 and

Topic	Relevant National Legislation
	No: 25791); – Regulation on the Control of Pollution in Water and Its Environment due to Hazardous Substances (Official Gazette Date: 26 November 2005 and No: 26005); and – Regulation on Declaration According to the SOLAS and MARPOL Conventions (Official Gazette Date: 11 August 2006 and No: 26256).
Air Quality	– Regulation on Ozone Layer Depleting Substances (Official Gazette Date: 12 November 2008 and No: 27052); and – Regulation on the Reduction of Sulphur Content of Certain Fuels (Official Gazette Date: 6 October 2009 and No: 27368).
Noise	– Regulation on Environmental Noise Assessment and Management (Official Gazette Date: 7 March 2008 and No: 26809)
Ecology	– Law on Aquatic Products, No: 1380 (Official Gazette Date: 4 April 1971 and No: 13799) and associated Regulations; and – Regulation on Aquatic Products (Official Gazette Date: 10 March 1995 and No: 22223).
Cultural Heritage	– Law on the Conservation of Cultural and Natural Assets, No: 2863 (Official Gazette Date: 23 July 1983 and No: 18113) and associated Regulations; and – Decision of Council Ministers on The Cultural and Natural Assets Under Water that need to be Protected (Official Gazette Date 24 September 2001 and No: 24533).
Socio-Economic	– Law concerning Sea Transport on Turkey's Coasts and Performance of Industrial and Commercial Activities in Turkey's Harbours and Territorial Waters (Cabotage Law), No: 815 (Official Gazette Date: 29 April 1926 and No: 359); – Law on Aquatic Products, No: 1380 (Official Gazette Date: 4 April 1971 and No: 13799) and associated Regulations; – Regulation on Aquatic Products (Official Gazette Date: 10 March 1995 and No: 22223); – Regulation on Declaration According to the SOLAS and MARPOL Conventions (Official Gazette Date: 11 August 2006 and No: 26256); and – Sea Labour Law, No: 854 (Official Gazette Date: 29 April 1967 and No: 12586).
Unplanned Events	– Law Pertaining to Principles of Emergency Response and Compensation for Damages in Pollution of Marine Environment by Oil and Other Harmful Substances, No. 5312, (Official Gazette Date: 11 March 2005 and No: 25752); – Regulation on Control of Major Industrial Accidents (Official Gazette Date: 18 August 2010 and No:27676); and – Regulation on Pertaining to Principles of Emergency Response and Compensation for Damages in Pollution of Marine Environment by Oil and Other Harmful Substances (Official Gazette Date: 21 October 2006 and No: 26326).

3.3 Standards and Guidelines of Financing Organisations

The Project is being carried out in accordance with certain international standards and guidelines applied by International Financial Institutions, namely;

- Equator Principles III,
- OECD Common Approaches,
- International Finance Corporation Performance Standards 2012 and the IFC EHS Guidelines.

A separate Environmental and Social Impact Assessment (ESIA) will be prepared for the Project following the standards and guidelines referenced above. The ESIA will be based upon and be consistent with the findings of this EIA Report.

The IFC PS are directed towards project developers, providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations for the Project.

Similarly, the EPs are a set of ten voluntary environmental and social standards adopted by a number of global financial institutions which must be adhered to prior to the provision of project financing. Based on and in alignment with the IFC PS, the EPs focus on Project environmental and social standards and responsibilities.

OECD signatory governments have agreed a Common Approach on the environment and officially supported export credits that ensure governments consider environmental and social aspects when providing officially supported export credits.

Amongst the objectives of the Common Approaches is the promotion of coherence between policies regarding officially supported export credits and policies for the protection of the environment, including relevant international agreements and conventions, thereby contributing towards sustainable development.

However, for the purposes of this EIA Report, any requirement relating specifically to these international standards which are not relevant to the EIA process in Turkey shall not be discussed further within this document unless they are seen to have influenced either the methodology or outcome of the impact assessment.

Further details on the environmental standards to be applied in regards to the development of the Project Environmental and Social Management Plans are provided in **Chapter 11: Environmental and Social Management System** of this EIA Report.

3.4 South Stream Project Standards

Project standards are used to inform and guide the continuing development of the Project, particularly during the development of this Report and in respect of compliance with national regulatory requirements, international conventions and standards and guidelines for financing.

South Stream Transport has a Project Standards document that forms part of the Project Health, Safety, Security and Environmental – Integrated Management System (HSSE-IMS). The Project Standards are therefore subject to amendment and updating as external requirements (and the requirements of the Project) continue to evolve.

National applicable legislation is outlined in **Section 3.2** and will be adhered to by South Stream Transport and forms part of the South Stream Project Standards. In some instances where national legislation is absent, South Stream Transport will voluntarily adhere to applicable international standards and these have been outlined in **Section 3.1.2**. The most stringent standards are adopted, unless otherwise stated and justified, whether national or international. **Table 3.3** identifies the numeric Project Standards, drawn from these sources, which will be adhered to by the Project and the rationale for selection of these.

Table 3.3: Numeric Project Standards

Topic	National	International/ Lender Guidelines/ Standards		Adopted Project Standard
		IFC Performance Standards	**Other**	
Emissions of Ozone Depleting Substances (ODS)	*[Regulation on Ozone Layer Depleting Substances]* Provides guidelines on decreasing the use of ozone layer depleting substances in line with the Montreal Protocol. Pursuant to Article 14, the use of any substances listed in Article 5 of the regulation is prohibited, with the exception of laboratory and obligatory uses. Annex 6 of the regulation provides "Substances of Under Control" Annex 7 provides "Forbidden Substances for Usage" No relevant numeric standards.	*[IFC General EHS Guidelines]* No relevant numeric standard (Although 'no new systems or processes should be installed using chlorofluorocarbons (CFCs), halons, 1, 1, 1-trichloroethane, carbon tetrachloride, methyl bromide or Hydrobromofluorocarbons (HBFCs')). Hydrochlorofluorocarbons (HCFCs) should only be considered as interim / bridging alternatives as determined by the host country commitments and regulations. *[IFC EHS Shipping Guidelines]* Avoid installation of fire fighting or refrigeration systems containing CFCs, in accordance with applicable phase-out requirements; (Refer to MARPOL Annex VI- Regulation 12) Recover ODS during maintenance activities and prevent deliberate venting of ODS to the atmosphere.	*[MARPOL 73/78 Annex VI, Regulation 12]* Any deliberate emissions of ozone-depleting substances shall be prohibited. New installations which contain ozone-depleting substances shall be prohibited on all ships, except that new installations containing HCFCs are permitted until 1 January 2020. (July 2010 update) Each vessel of 400 gross tonnage (GT) and above should have an ODS record book and list of equipment containing ODS, including record of the mass (kg) of substance in use, lost, removed, supplied and recharged.	*All apply* – the use of ODS shall be avoided.
Greenhouse gas (GHG)emissions	No relevant numeric standards.	*[IFC Performance Standards]* Considers any project that produces or is expected to produce more than 25,000 tonnes	*[EPIII]* EPIII requires public reporting of GHG emission levels for projects emitting over 100,000 tonnes CO_2 annually during	*[IFC Performance Standards]* Considers any project that produces or is expected to produce more than 25,000 tonnes

Topic	National	International/ Lender Guidelines/ Standards		Adopted Project Standard
		IFC Performance Standards	Other	
		CO_2 equivalent annually, to be significant and therefore requires them to quantify emissions.	operational phase. *[OECD Common Approaches]* OECD Common Approaches requires reporting of annual emissions only when emissions exceed threshold during the operations phase. Projects emitting over 25,000 tonnes of CO_2 are encouraged to report publicly.	CO_2 equivalent annually, to be significant and therefore requires them to quantify emissions.
Ship engine emissions	No relevant numeric standards.	*[IFC EHS Guidelines for Shipping]* Refers to MARPOL 73/78	*[MARPOL 73/78 Annex VI]* [Regulation 13] Nitrogen oxide (NO_x) limits: 17.0 grams per kilowatt per hour (g/kWh) when n(*) is less than 130 revolutions per minute (rpm); 45.0 x n-0.2 g/kWh when n is 130 or more but less than 2000 rpm; 9.8 g/kWh when n is 2000 rpm or more. [Regulation 14] The sulphur content of any fuel oil used on board ships shall not exceed the following limits: - 4.5% prior to Jan 2012 - 3.5% after Jan2012 -0.5% after Jan 2020 Alternatively, a scrubber (or similar) may be used to ensure the equivalent Sulphur oxides (SOx) emissions are met. (*) n = rated engine speed (crankshaft revolutions per minute).	*[MARPOL 73/78 Annex VI]* [Regulation 13] NOx limits: 17.0 g/kWh when n is less than 130 rpm; 45.0 x n-0.2 g/kWh when n is 130 or more but less than 2000 rpm; 9.8 g/kWh when n is 2000 rpm or more.
Shipboard incinerator emissions	No relevant numeric standards.	*[IFC EHS Guidelines for Shipping]*	*[MARPOL Annex VI Regulation 16]* Incineration of Annex I, II and III cargo	*[MARPOL Annex VI Regulation 16]*

Topic	National	International/ Lender Guidelines/ Standards		Adopted Project Standard
		IFC Performance Standards	Other	
		IFC specifies a combustion temperature of >850°C and other operational controls. Use of flue gas cleaning devices that comply with MARPOL Annex VI and Article 5 and Annex C of the Stockholm Convention on Persistent Organic Pollutants, Section V.	residues, of Polychlorinated biphenyls (PCBs),of garbage containing more than traces of heavy metals and of refined petroleum products containing halogen compounds is always prohibited. On-board incineration outside an incinerator is prohibited except that sewage sludge and sludge oil from oil separators may be incinerated in the main or auxiliary power plants and boilers when the ship is not in ports, harbours and estuaries. Incineration of polyvinyl chlorides (PVC's) is prohibited except in shipboard incinerators type approved according to resolutions Marine Environmental Protection Committee (MEPC) 59(33) or MEPC 76(40). A combustion temperature of >850 ^{0}C is required.	Incineration of Annex I, II and III cargo residues, of PCBs, of garbage containing more than traces of heavy metals and of refined petroleum products containing halogen compounds is always prohibited. On-board incineration outside an incinerator is prohibited except that sewage sludge and sludge oil from oil separators may be incinerated in the main or auxiliary power plants and boilers when the ship is not in ports, harbours and estuaries. Incineration of PVC's is prohibited except in shipboard incinerators type approved according to resolutions MEPC 59(33) or MEPC 76(40). A combustion temperature of >850 ^{0}C is required.
Sulphur content of fuel oil (in marine vessels)	*[Regulation on the Reduction of Sulphur Content of Certain Fuels]* Article 5 – (1) a) Middle distillate fuels,b) Group I marine gasoline, with sulphur content higher than 0,1% by mass;cannot be used. Article 6- (1) All required measures are implemented to avoid the use of marine fuels with sulphur content higher than 1,5% by mass in the SOx Emission Control Areas within the maritime domains and pollution	*[IFC EHS Guidelines for Shipping]* Refer to MARPOL 73/78	*[MARPOL Annex VI]* [Regulation 14] The sulphur content of any fuel oil used on board ships shall not exceed the following limits: - 4.5% prior to Jan 2012 - 3.5% after Jan2012 - 0.5% after Jan 2020	In accordance with the opinion letter (date/no: January 31 2014/866, Appendix 5-A) of the Ministry of Transportation, Maritime Affairs and Communication, General Directorate of Marine and Inland Waters, sulphur rate will be applied as 3.5% as per MARPOL 73/78, Annex VI. As indicated by the same opinion letter, in case of an exigency for the vessels to use Turkish ports, the vessels cannot use marine

Topic	National	International/ Lender Guidelines/ Standards		Adopted Project Standard
		IFC Performance Standards	Other	
	control areas of the Republic Turkey. This provision is applicable for all ships regardless of flags, including the vessels which started navigating outside the marine domain of the Republic of Turkey. (2) Vessels under Turkish Flag cannot use marine fuels with sulphur content higher than 1,5% by mass in the SOx Emission Control Areas defined by MARPOL Agreement – Annex VI" of International Maritime Organization (IMO). (3) Any passenger ships regularly operating cannot use marine fuels with sulphur content higher than 1,5% by mass within the maritime domains and pollution control areas of the Republic Turkey. This provision is applicable for all ships regardless of flags, including the vessels which started navigating outside the marine domain of the Republic of Turkey. (4) As a condition for the entry to the ports of our country, all vessels regardless of their flags are obliged to keep regular and accurate logbook records including their fuel bunkering operations. (5) Judgment of the first clause; a) Vessels under Turkish Flag; b) SOx Emission Control Areas within the pollution control areas of			diesel with sulphur content exceeding 0.1% by mass as per the Regulation on Reduction of Sulphur Rate in Some Types of Fuel Oils.

Topic	National	International/ Lender Guidelines/ Standards		Adopted Project Standard
		IFC Performance Standards	Other	
	the Republic Turkey. This provision is applicable for all ships regardless of flags, including the vessels which started navigating outside the marine domain of the Republic of Turkey.			
Water Discharge to sea from ships: Oily waste	*[Water Pollution Control Regulation]* Article 23 – All sorts of marine and coastal water usages and discharges which generate the contaminant factors set forth in Article 6 of this Regulation are completely forbidden or subject to permitting. The prohibitive provisions on the direct discharges and waste drainages into the territorial waters of Turkey without permission also include the indirect external effects on the waters which Turkey has economic right to use. In such circumstances, the Administration shall take the necessary measures against those who cause current or potential effects. Accordingly; a) It is prohibited to discharge or dispose substances, whether they are originated in Turkey or from abroad, which are banned or restricted (subject to permits) into the waters described above or the nearby waters which may affect these waters without getting the necessary permissions. b) It is prohibited for the ships cruising on the seas which fall within the sovereignty of Turkey or for the airplanes which fly over	*[IFC EHS Guidelines for Shipping]* All bilge water and sludge should be discharged to port reception facilities, except where ships are equipped with certified oily water separators, which may discharge treated water to sea in accordance with MARPOL 73/78 provisions. Outside special areas, and whilst en route, vessels can discharge an oil content of <15 parts per million (ppm) (without dilution). Note. Conditions apply and reference should be made to MARPOL 73/78	*[MARPOL 73/78, Annex I]* Any discharge into the sea of oil or oily mixtures from ships shall be prohibited unless the oil content of the effluent without dilution is <15 ppm and the oily mixture is processed through oil filtering equipment.	MARPOL provisions for special waters apply; specifically Annex I (Oil), Black sea is considered special area.

Topic	National	International/ Lender Guidelines/ Standards		Adopted Project Standard
		IFC Performance Standards	Other	
	these seas to discharge into these seas garbage, petroleum and petroleum derivatives and bilge, dirty ballast, sludge, slope, oil and similar domestic or industrial wastewaters contaminated with these. Wastes originating from ships shall be given to licensed waste reception facilities and/or licensed waste reception ships. Domestic wastewater discharges of all ships are subject to the provisions of Annex-IV of the International Convention for the Prevention of Pollution from Ships published in the Official Gazette dated 24/6/1990 and numbered as 20558. Discharge of wastewaters from ships is prohibited in bays and gulfs designated as sensitive areas, even if the ships are equipped with a treatment device. c) In order to prevent the coastal waters used for recreational purposes from being polluted, the septic tanks built on or near the sand strips of the shores must be leak proof and must be discharged into a wastewater treatment facility or a sewer system. d) The operators processing, loading/unloading, storing petroleum and its derivatives are obligated to prepare emergency response plans and make and keep available all sorts of equipment and materials by considering the possibility of discharge of petroleum into water			

Topic	National	International/ Lender Guidelines/ Standards		Adopted Project Standard
		IFC Performance Standards	Other	
	environments due to accidents or unexpected conditions. e) Except for the circumstances that constitute an immediate fire hazard following an accident, it is prohibited to precipitate the petroleum contamination dispersed in water environment or dilute it by using a chemical dispersant, without obtaining the positive opinion of the Ministry. f) It is prohibited to discharge to sea and coastal waters with the purpose of disposing all types of construction and demolition wastes, debris, treatment and process waste sludges or similar wastes.			
Water discharge to sea from ships: temperature	*[Regulation on Aquatic Products]* Annex-5: Temperature: Wastewaters to be discharged into fisheries production areas that cause temperature variation in the receiving environment more than 2^0C in seas and inland waters; and 0.5^0C in one-hour measurements cannot be discharged.			
Water Discharge to sea from ships: **Sewage water (domestic wastewater)**	*[Regulation on Aquatic Products]* Annex-5: List of Hazardous Materials that are forbidden to be discharged into Inland Waters and Areas of Production in Seas; and Acceptable Values for Receiving Environments. C- Colour: Wastes that block at least	*[IFC EHS Guidelines for Shipping]* Ships should comply with effluent standards for oil / grease and sewage as described in Annex I and IV of MARPOL.	*[MARPOL 73/78 Annex I]* In case of discharge into the sea, the oil content of effluent without dilution must not exceed 15 parts per million. [MARPOL 73/78 Annex IV] applies restrictions on sewage treatment	Most stringent combination of MARPOL and Turkish standards.

Topic	National	International/ Lender Guidelines/ Standards		Adopted Project Standard
		IFC Performance Standards	Other	
	10% of light transmission in 5 metres (m) water depth cannot be discharged into the water. E-pH: Wastes that cause the pH value fall out of allowable range between 6.5 and 8.5 cannot be discharged. F- Oxygen: Wastes that decrease the dissolved oxygen level in the water below 6.0 mg/l cannot be discharged G- Suspended Solids: Wastes that increase the suspended solid amount in the water over 30 mg/l cannot be discharged. H- Sludge: Process sludge and sewage sludge cannot be discharged. I- Radioactive substances: radioactive contaminated wastes cannot be discharged under any circumstances.		facilities and when/where treated sewage can be discharged Standards for sewage treatment to be achieved under testing are: Total Suspended Solids (TSS): 35mg/l (above TSS content of flushing water) Coliform: 100/100ml Biological Oxygen Demand (BOD): 25mg/l Chemical Oxygen Demand (COD): 125mg/l pH: 6 – 8.5	
Waste Disposal from Ships including bilge sludge	No relevant numeric standards.	*[IFC EHS Guidelines for Shipping]* Application of MARPOL 73/78 Annex I. All bilge sludge should be discharged to port reception facilities, except where ships are equipped with certified oily water separators, which may discharge treated water to sea in accordance with MARPOL 73/78 provisions (see Seaside Water discharge from ships: Sewage water).	*[MARPOL 73/78. Annex I]* Ship wastes will be shipped to shore. No overboard discharge except food wastes in line with MARPOL 73/78. (resolution MEPC.201(62)) which entered into force on 1 January 2013) As far as possible from shore but at least >12 nautical miles from the nearest land	MARPOL 73/78. Annex I applies Ship wastes will be shipped to shore. No overboard discharge except food wastes in line with MARPOL 73/78. (resolution MEPC.201(62)) which entered into force on 1 January 2013) As far as possible from shore but at least >12 nautical miles from the nearest land.

Topic	National	International/ Lender Guidelines/ Standards		Adopted Project Standard
		IFC Performance Standards	Other	
Waste incineration offshore	No relevant numeric standards.		*[MARPOL 73/78. Annex VI]* Shipboard incineration of the following substances is prohibited: Certain cargo residues, PCBs, garbage containing heavy metals, halogens, and sewage sludge not generated on board the ship, and exhaust gas cleaning system residues. According to the Technical Code (Regulation 13 Annex VI MARPOL 73/78) is forbidden to burn a waste in an incinerator within ports, harbors and estuaries. Ashes from burning of a waste cannot be dumped in Special Areas (Black Sea).	MARPOL 73/78, Annex VI
Food waste disposal from ships	No relevant numeric standards.	*[IFC EHS Guidelines for Shipping]* Application of MARPOL 73/78. *[IFC EHS Offshore Oil & Gas Guidelines]* Organic (food) waste should, as a minimum, be macerated to acceptable levels and discharged to sea, in compliance with MARPOL 73/78	*[MARPOL 73/78 Annex V Regulation 13]* Disposal into the sea of food wastes shall be made as far as practicable from land, but in any case not less than 12 nautical miles from the nearest land.	[MARPOL 73/78 Annex V Regulation 13] Black Sea classify as a special area according to MARPOL Annex V. Most stringent standard will be applied.

3.5 National Institutional Requirements

There are currently no national institutional requirements to be adopted by the Project.

3.6 Other Issues

There are no other issues to be discussed for this chapter.

Acronyms

Acronym	Definition
%	Percentage
bcm	Billion cubic metres
CS	Compressor Station
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EU	European Union
FSU	Former Soviet Union
ITUR	Italy-Turkey-Ukraine-Russia
KAFOS	Karadeniz Fiber Optik Sistemi
km	Kilometres
LNG	Liquefied Natural Gas
m	Metres
mtoe	Million tonnes of oil equivalent
UXO	Unexploded Ordinance

4 GROUNDS FOR THE ROUTE SELECTION AND ASSESSMENT OF THE ALTERNATIVES

The Turkish Sector of the South Stream Offshore Natural Gas Pipeline (the Project) is part of the South Stream Offshore Natural Gas Pipeline that crosses the Black Sea, which in itself is part of the larger South Stream Pipeline System. The objective of the South Stream Pipeline System is to develop a new gas supply route via the Black Sea that provides a safe and reliable means to export Russian gas to the countries of Central and South-Eastern Europe.

It is important to recognise that the South Stream Offshore Natural Gas Pipeline (and therefore the Project) is inextricably linked to downstream components of the entire South Stream Pipeline System (and the upstream Unified Gas Supply System of Russia). Consequently, the Offshore Natural Gas Pipeline and the Project (Turkish Sector), which forms part of it, are significantly influenced by the route selection for the broader Pipeline System.

Accordingly this Chapter briefly refers to the consideration of alternatives and decisions taken by Gazprom and that have to some extent predefined the Project design i.e. broad location of landfall facilities in Russia and Bulgaria (determined by decisions made for the Pipeline System) and the routing of the pipeline through the Black Sea.

The objective of this Chapter is to outline how the Project represents a design, that is technically and financially feasible whilst minimising overall environmental and social impacts. The assessment of impacts that will arise as the result of the Project is contained in **Chapter 6,7** and **9** of this EIA Report.

Technical and routing alternatives have been analysed in the context of the engineering, environmental and social optimisations that have been carried out throughout the Feasibility and Development (including Front End Engineering and Design) Phases of the Project, and are described in this Chapter.

The analysis of alternatives described in this Chapter is structured to follow a ‘narrowing approach’ involving a series of logical steps, starting with consideration of high-level alternatives and design decisions related to the overall South Stream Offshore Natural Gas Pipeline (e.g. the ‘no project’ alternative) followed by a description of more detailed Project specific alternatives considered as part of the Front End Engineering and Design (FEED) process (e.g. routing decisions). Using this commonly adopted approach, the analysis of alternatives considers alternatives in the following sequence:

- The “No Project” alternative;
- Alternative transportation options (pipeline or vessel); and
- The offshore routing.

4.1 "No-Project" Alternative

The "no project" alternative for the purposes of this Report is the situation where the overall South Stream Offshore Natural Gas Pipeline does not proceed.

Under the 'no project' alternative for the overall Pipeline there are no negative or positive environmental or social impacts in Turkey, on land or in Turkish waters, as there is no construction or operation of the overall Pipeline (and therefore the Project) through the Turkish EEZ.

4.2 Gas Transportation Methods

Based on the premise that gas will be exported via a new route across the Black Sea, consideration can be given to offshore transportation of gas by means other than by pipelines. This relates to the overall South Stream Offshore Natural Gas Pipeline and not just the Project. The main alternative to pipelines for transporting natural gas from Russia to the countries of Central and South-Eastern European via the Black Sea is the liquefaction of natural gas at a Black Sea port in Russia, and transportation of Liquefied Natural Gas (LNG) using LNG Carriers to either:

- A port on the Western Black Sea coast; or
- A port in southern Europe beyond the Bosphrous Strait and Dardanelles Strait.

The following factors were considered in the assessment of these alternatives.

Liquefaction and transportation of LNG to gas markets is usually undertaken for 'stranded gas' deposits where the source of gas is so distant and isolated from its markets as to make transportation by pipeline uneconomic. Considering that Gazprom operates the largest gas pipeline network in the world, it is more practical and efficient for Gazprom to bring gas to Europe by pipelines.

Liquefaction would require the construction of a liquefaction plant on the Russian coastline. The onshore environmental impacts associated with the construction and operation of an LNG plant would be greater than those of a pipeline system. This alternative would require the presence of an unloading jetty or offshore buoy and a regasification plant on the shores of a receiving country. In view of the extent of land required and the potential environmental and social impacts associated with such facilities, the development of a regasification plant on the coastal areas of the Western Black Sea was considered undesirable.

Transportation of LNG would require approximately 600 to 700 full LNG carrier movements per year to export 63 bcm of natural gas per year. This would equate to approximately two full LNG carrier movements per day passing through the Turkish Straits, which include the densely populated areas adjacent to the Bosphorus Strait, Istanbul. In view of the hazardous nature of the cargo, the existing high density of maritime traffic through the Turkish Straits and the population density around the Bosphorus Strait this number of vessels movements would potentially increase the safety risk in the Turkish Straits, in particular the Bosphorus Strait.On the basis of the above the LNG alternative is not considered further.

4.3 Route Alternatives

4.3.1 Alternative Route Options

Whereas this EIA Report is concerned with the Turkish Sector of the South Stream Offshore Natural Gas Pipeline i.e., the Project, the routing alternatives across the Turkish EEZ were heavily dependent on decisions taken for other elements of the South Stream Offshore Natural Gas Pipeline and more broadly the wider South Stream Pipeline System. The discussion of routing alternatives below therefore considers options for the Black Sea crossing before subsequent consideration of route alignments through the Turkish EEZ.

Following the selection of a landfall near Anapa, the four alternatives originating from Beregovaya were discarded from futher consideration. The remaining four offshore pipeline routes were assessed for crossing the Black Sea from the Anapa landfall site (**Table 4.1**). **Figure 4.1** shows the route alternatives.

Table 4.1: Offshore Pipeline Route Alternative

	Landfall (Russia)	Landfall (S. Europe)	Transit Exclusive Economic Zones (EEZs)	Total Offshore Route Length (km)	Length in Turkish Sector (km)
1	Anapa	Varna	Russia, Turkey, Bulgaria	940.3	520
2	Anapa	Varna	Russia, Ukraine, Romania, Bulgaria	928.4	N/A
3	Anapa	Constanta	Russia, Ukraine, Bulgaria	933.2	N/A
4	Anapa	Constanta	Russia, Turkey, Bulgaria, Romania	931.3	449

Of these four corridors, two cross the Turkish EEZ (Options 1 and 4) and two cross the Ukrainian EEZ (Options 2 and 3). Options 2 and 3 could not be surveyed within the timeframe required and were therefore discarded from further consideration. Subsequently, further technical investigations were performed for Options 1 and 4. Various alternative shore crossing areas were assessed on the Black Sea coast of southern Europe, in Bulgaria and Romania.

This assessment identified two preferred shore crossing areas; one near the Bulgarian port of Varna and one near the Romanian port of Constanta. Bulgaria was then selected as the preferred onshore transit country of the Black Sea Coastal states for the South Stream Pipeline System, resulting in the selection of Option 1 as the preferred offshore pipeline route.

4.3.2 Alternative Route Options in the Turkish EEZ

Following selection of the optimal continental slope crossing locations in the Russian and Bulgarian EEZs, it was necessary to address environmental and technical considerations for the preferred offshore route along the abyssal plain (deep-water part of the seabed) within the Turkish EEZ. This investigation formed part of the wider South Stream Offshore Natural Gas Pipeline survey of the abyssal plain, which also included areas in the Bulgarian and Russian EEZs.

The required locations for the continental slope crossing in the Bulgarian and Russian EEZs constrain where the pipeline in the Turkish EEZ can be laid as it has to join these two continental slope crossings.

Option 1 was subsequently subject to route optimisation with consideration of a direct route across the Turkish EEZ (Option 1a) rather than the original deviation to the south. The deviation to the south in Option 1 had been included to avoid the potential impacts of the southern edge of the Danube Delta sediment fan[1], however following further engineering investigation it was concluded that due to the relatively low relief and inactive depositional nature of the outer submarine fan, the effects associated with deposition of sediment in the Danube Delta fan system were minor.

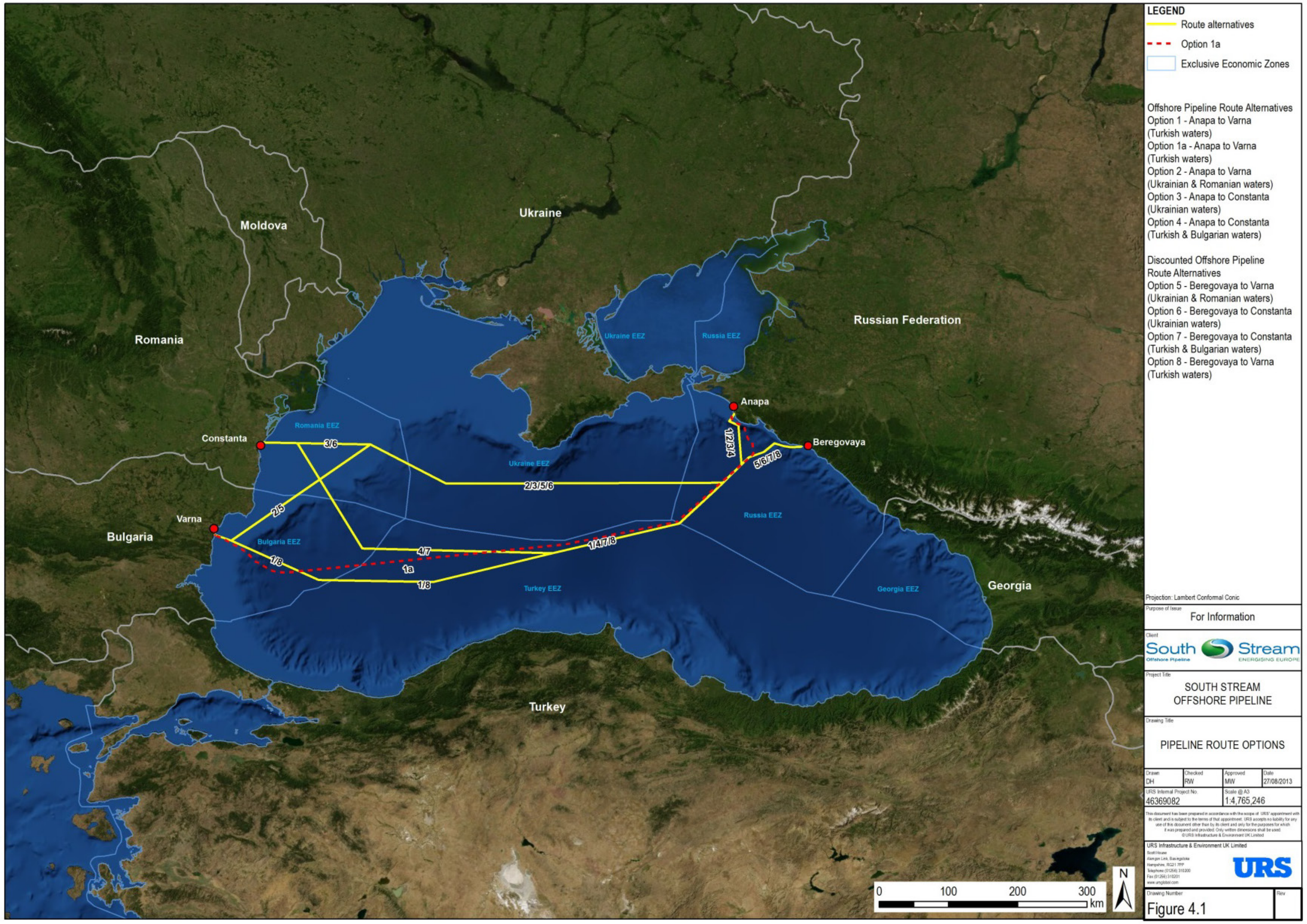
The direct route shown as Option 1a on in **Figure 4.1**, whereby the pipeline passes through the southern end of the Danube Fan, was therefore adopted and subjected to further consideration of environmental and cultural heritage sensitivities (see **Chapters 6:** (Assessment of the Physical Environment)**, Chapter 7: (**Assessment of the Biological Environment) **and Chapter 8:** (Assessment of Socio-Economic Environment) of this EIA Report).

One of the key reasons for selecting the preferred option (Option 1a) is that it is shorter than the alternative routes.It reduces the total offshore length of the pipeline route by approximately 20 km per pipeline, and the length of the Turkish sector by approximately 50 km per pipeline thereby minimising the Project footprint.

In summary, the selection process for the offshore route of the South Stream Offshore Natural Gas Pipeline was largely constrained by engineering and environmental factors in Russian or Bulgarian waters. The landfall options and continental slope crossing significantly influenced where the EEZ border crossing with Turkey would be and as such, also determined where the pipeline could run in the Turkish EEZ and thus dictated the location of the Project.

[1] A sediment fan is a fan- or cone-shaped deposit of sediment crossed and built up by streams. The Danube fan system is a relict sedimentary feature in the north-western part of the bottom of the Black Sea.

Figure 4.1: Pipeline Route Options



4.4 Issues to be Considered for Route Selection

The pipeline route has been defined based on engineering studies performed after offshore surveys were executed within the preferred option corridor (Option 1a). Potential constraints analysed and taken into account for the selection of the pipeline route are indicated below.

4.4.1 Abyssal Plain

The final route alignment was selected on the basis of geophysical, environmental and cultural heritage surveys. The entire corridor was mapped and the geological, bathymetric and cultural features were recorded for further analysis.

Specifically, a thorough review (Ref. 4.1 - 4.2) of the seabed features was carried out to determine the presence of features of biological importance such as microbial mats and cultural heritage objects. The findings of this review are summarised below.

The water depth in the Turkish EEZ is in excess of 2,000 m. Given the high hydrogen sulphide (H_2S) concentrations and the anoxic conditions, it is considered that benthic communities within the abyssal plain of the Black Sea are unlikely to exist or are limited to chemosynthetic communities (microbial mats of bacteria feeding on H_2S or methane).

The eastern part of the abyssal plain (within the Turkish EEZ) is the deepest and is essentially flat. The western part has more irregular topography, resulting from a complex of channel levee systems that crosses the area. This forms an elevated ridge that rises about 50 m above the main abyssal plain and represents the distal part of the Danube Fan (Ref 4.2).

The deepest, eastern part of the abyssal plain lacks any large-scale features. In the western part of the abyssal plain, the seafloor rises gently onto the flank of the channel levee area. Six channels crossing the pipeline can be identified in bathymetry data within the channel levee complex. Most of these have rather indistinct signatures on sidescan sonar data and are clearly partly buried.

They can thus be inferred to be inactive (not subject to sediment flows, turbidity currents, moving through the canyon). More information on the geological features of the route corridor are given in **Section 6.2** of this EIA Report.

Geophysical and cultural heritage field surveys conducted in 2011 and 2012 (Ref. 4.3 and 4.4) discovered a total of 76 potential Cultural Heritage Objects (CHO) within 1 km on either side of the centreline of the route corridor. In 2012, these targets, as well as other sonar anomalies underwent visual inspection via ROV as part of a primarily geotechnical survey of the preferred corridor.

Based on their size (greater than 5 m long), shape, elevation from the seabed, and acoustic reflectivity in the sonar images the objects were preliminarily screened so as to identify potential CHOs. Such CHOss could include metal or wooden shipwrecks, associated shipwreck debris, or similar anthropogenic structures (e.g., aircraft remains). Only two objects were preliminarily identified as CHOs within 150 m of any of the initial pipeline routes. The pipelines have since been re-routed to avoid these known CHOs by a minimum of 150 m. More information on CHOs observed during surveys is provided in **Section 6.10** and **6.11** of this EIA Report.

4.4.2 Sea Traffic

The Black Sea is an important transport route for the countries located on its shores. Through data collected on shipping traffic over the route corridor it was understood that marine transport in the Turkish EEZ is not considered to be a significant constraint in relation to route selection.

4.4.3 Deep Sea Cable systems

Three international and regional cables run through the Turkish EEZ; the Italy-Turkey-Ukraine-Russia (ITUR) cable system, operated by Rostelecom, the Karadeniz Fiber Optik Sistemi (KAFOS) cable system, operated by Vivacom and the Caucasus Cable System (CCS) operated by Caucasus Online. None of these cross the route corridor within the Turkish EEZ therefore, they were not considered in the route selection.

According to the letter sent by the Turkey Ministry of Foreign Affairs to the Russian Federation Embassy in Ankara on 15^{th} October 2012 (**Appendix 5.A**) and based on the following coorindates; 42^{0} 48’ 21”N- 030^{0} 34’ 37”E; 43^{0} 07’ 31”N- 034^{0} 14’ 08”E; 43^{0} 25’ 09”N- 036^{0} 13’ 20”E no pipelines or UXO sites are located within this area. The ITUR (International Underwater Fiber Optic Cable System) within the coordinates of 43^{0} 11,8N; 033^{0} 27,2E and 43^{0} 14,4N; 034^{0} 03,8E, and the KAFOS cable do not intersect with the Project route. If any future cable system iintersects the project, crossing agreements will need to be made with the owner of the system.

4.4.4 Existing Offshore Pipelines

No existing offshore pipeline cross the route corridor, therefore offshore pipelines were not considered in the route selection.

4.4.5 Drilling Areas and Exploration Blocks

During the route selection, TPAO exploration licenses where known to be crossed by the route corridor. The Project will engage with TPAO prior to and during construction with regard to schedules and work progress reports to coordinate planned activities in the Turkish EEZ. More information on the potential interaction with TPAO areas is given in **Section 6.7** of this EIA Report.

4.4.6 Military Areas and Areas of Unexploded Explosive Ordnance

It is understood that there are no permanently designated military training areas in the route corridor, with the exception of an area adjacent to the Bulgarian EEZ that is used for firing training exercises. The precise location of this area has not been disclosed. The Project will engage with the relevant Turkish authorities before and during construction to ensure to avoid interference with any military exercises undertaken in the Turkish EEZ during construction. No items of unexploded ordnance (UXO) have been identified from the offshore surveys conducted to date along the route corridor. A dedicated UXO survey will be performed at selected locations prior to the construction activities.

4.5 Other Issues

There are no other issues to be discussed in relation to this Chapter.

References

Number	Section
4.1	PeterGaz (2010). Feasibility Study for the Offshore Section of the "South Stream" Project Pipeline, Volume 17 of the Environmental Impact Assessment (Russian Sector), Second Part of the Environmental Impact Assessment on Alternative Route Options for Pipeline (land area), Archive number: 6976.101.003.11.14.17.02-1 (replacement for 6976.101.003.11.14.17.02, St. Petersburg 2010, by Giprospecgaz.
4.2	P.P.E. Weaver, D.G. Masson (2013). Interpretation of Seabed Survey Data for the South Stream offshore pipeline project.
4.3	PeterGaz (2011). Complex Engineering Surveys at the Phase 'Design Documentation' within the Framework of the South Stream Gas Pipeline Marine Sector Project Implementation. Volume 5 Environmental Survey and Archaeological Studies. Part 5 Archaeological Studies. Book 2 Determination of objects with cultural heritage features along the route. Development and coordination of the found objects survey programme. Visual examination of cultural heritage objects information and report (Ref. No. 6976.101.004.21.14.05.05.02 Vol 05.05.02).
4.4	PeterGaz (2012). Complex Engineering Surveys at Design Documentation Phase as Part of South Stream Gas Pipeline marine Section. Volume 18: Integrated Report on First Phase. Part 2: Integrated Report. Book 7: Appendix 6 Catalogue of Side-Scan Sonar Targets (Ref. No. 6976.101.004.21.14.18.02.07(1)).

5 PUBLIC (STAKEHOLDER) ENGAGEMENT

This Chapter sets out the EIA public engagement process that was undertaken for the Project. This includes the commencement of the public engagement process, the identification of Project (stakeholder) groups and communicating with stakeholders. It also covers the Public Participation (PP) meeting and how comments were received from stakeholders and addressed.

The public engagement process for the EIA is led by the MoEU and PDoEU. The public engagement approach for this Project has been influenced by the fact that the Turkish Sector of the Project is located at least 110 km offshore from the Turkish coast and that there are no landfall facilities in Turkey. Therefore, the impact on local communities is considered to be extremely low.

However, public engagement is a requirement of the EIA process, to enable stakeholders who may have an interest in, or who are affected by the Project, to participate in the process and comment on the Project. The views of the public help inform the MoEU's format determination process. Throughout the EIA process stakeholders have an opportunity to raise any issues or concerns they might have about the Project and provide input regarding potential Project impacts and mitigation measures. Throughout the EIA process stakeholders have an opportunity to raise any issues or concerns they might have about the Project. These have been considered in the development of the EIA Report. The EIA Application File Opinion Letters from Commission Members are given in **Appendix 5.A**.

5.1 Commencement of the Public (Stakeholder) Engagement Process

The MoEU found it appropriate to hold a PP meeting along the Turkish Black Sea coastline, in Sinop, the closest land point to the Project.

Following the MoEU's evaluation of the EIA Application File (EIAAF) and the selection of Sinop as the PP meeting location, copies of the EIAAF were sent to the Review and Evaluation Committee (REC) members and the Sinop Provincial Directorate of Environment and Urbanisation (PDoEU).

The public engagement process officially commenced on 12 June 2013, when the following announcement was published by the Sinop PDoEU on their website:

"*Announcement of the Ministry of Environment and Urbanisation, Sinop Provincial Directorate of Environment and Urbanisation:*

The EIA Application File submitted to our Ministry for the "South Stream Offshore Pipeline Project – Turkish Sector" proposed to be realised by South Stream Transport B.V. in the EEZ of Turkey in the Black Sea has been approved and the EIA Process has commenced:

- *Those who would like to study the Application File may view it at the headquarters of the Ministry or the Provincial Directorate of Environment and Urbanisation.*
- *You are welcome to submit your inquiries, views and recommendations about the project to our Provincial Directorate or Ministry until the Environmental Impact Assessment process is completed.*

This is an announcement for our People."

The EIAAF was also published on the website of the MoEU[1] and the PDEU[2] in Sinop.

5.2 Identifying Project Groups (Stakeholders)

Under the Turkish relevant EIA Regulation (Official Gazette Date: 17 July 2008 and No: 26939), the stakeholder identification process should ensure that the public and any other interested stakeholders are informed about the Project, via the MoEU website and the Public Participation meeting. The MoEU is responsible for identifying all relevant government organisations to be part of the REC for the Project. The MoEU can also invite NGOs to participate in the REC, particularly for projects which are considered to have high environmental or social impacts. However, given the relatively limited impacts anticipated for this Project, the MoEU did not see the need to directly engage specific NGOs.

The general public is a key stakeholder in the EIA process. Members of the public can submit comments on the Project in person during the Public Participation meeting and also have the opportunity to comment on the EIAAF and EIA Report which is hosted on the websites of the MoEU and Sinop PDEU (see **Section 5.4** for further information).

5.2.1 Communication with the Stakeholders

A public announcement with details of the PP meeting was published in national and local newspapers on 21 June 2013, which satisfied the legal requirement to advertise the PP meeting at least 10 days in advance of it taking place. The public announcement included details of the meeting such as the date, venue, meeting content, contact details of the project owner and as well as the details of a shuttle bus to transport people from Sinop town centre to the venue.

The public announcement was released in two newspapers:

- Hürriyet - a national paper (circulation: around 375,000); and
- Bizim Karadeniz - a local newspaper published and distributed daily in Sinop (circulation: around 1,000).

A copy of the newspaper announcement published in both newspapers is provided in **Figure 5.1**. The PP meeting announcement was also posted on a wall at the entrance of the venue.

[1] Available from http://www.csb.gov.tr/db/ced/editordosya/karadenizTRmayis2013.pdf
[2] Available from http://www.csb.gov.tr/iller/sinop/index.php?Sayfa=duyurudetay&Id=2642

T.C.
ÇEVRE VE ŞEHİRCİLİK
BAKANLIĞI

T.C.
ÇEVRE ve ŞEHİRCİLİK BAKANLIĞI
DUYURU

South Stream Transport B.V. tarafından;
Türkiye Karadeniz Münhasır Ekonomik Bölgesi'nde
"Güney Akım Açık Deniz Doğal Gaz Boru Hattı"
projesinin yapılması planlanmaktadır.

Söz konusu proje için Çevresel Etki Değerlendirmesi (ÇED) Yönetmeliğinin 9. Maddesi gereğince aşağıda belirtilen tarih ve saatte faaliyetle ilgili, Halkı bilgilendirmek, görüş ve önerilerini almak için
"Halkın Katılımı Toplantısı"
yapılacaktır.

Halkımıza saygı ile duyurulur.

Toplantı Yeri : VİRA Otel- Sinop
Toplantı Yerinin Adresi : Enver Bahadır Cad. No:18 Karakum SİNOP
Toplantı Tarihi : 02 Temmuz 2013
Toplantı Saati :10:00

Toplantı yerine ulaşım için Sinop Valilik binası önünden 9:30'da servis kalkacaktır.

Proje Sahibi : South Stream Transport B.V.
Tel : 0031 -20- 262 45 00
Faks : 0031 -20- 524 12 37

ÇED Raporunu Hazırlayan Kuruluş:
ELC Group Mühendislik ve Müşavirlik A.Ş.

Tel : (0216) 465 9130
Faks : (0216) 465 9139

Figure 5.1: The Newspaper Announcement for the Public Participation Meeting

REPUBLIC OF TURKEY

MINISTRY OF ENVIRONMENT AND URBANISATION

ANNOUNCEMENT

"South Stream Offshore Natural Gas Pipeline" Project

is planned to be carried through

in the Turkish Exclusive Economic Zone in the Black Sea

by South Stream Transport B.V.

For the above-mentioned project, in line with the 9th Article of the EIA Regulation, a **Public Participation Meeting** will be held on the date/hour/place specified below, to inform the public about the project, and to receive people's views/comments and recommendations

Posted for the kind information of our public.

Meeting Venue	**:** Vira Hotel – Sinop
Address of the Meeting Venue	**:** EnverBahadır cad. No: 18 Karakum - SİNOP
Date of the Meeting	**:** July 2, 2013
Time of the Meeting	**:** 10:00

Vehicles for transportation to the meeting venue will be available in front of Sinop Provincial Governorate building at 09.30.

Project owner: South Stream Transport B.V.

Tel: 0031-20-262 45 00

Fax: 0031-20-524 12 37.

EIA Report Prepared by

ELC Group Mühendislikve Müşavirlik A.Ş.

Tel (0216) 465 91 30

Fax (0216) 465 91 39

The Newspaper Announcement for the Public Participation Meeting [English translation]

5.2.2 Monitoring Stakeholders

As part of the Turkish EIA process, stakeholders are given the opportunity to provide feedback on the Project. Feedback from stakeholders is typically monitored by the MoEU, which receives and reviews all comments, requests or complaints that were raised during the PP meeting or that were submitted to the MoEU or PDoEU throughout the consultation period.

5.3 Public Participation Meeting

Following the public announcement period, a PP meeting was held in Sinop on 2 July 2013 at 10.00 at the Vira Hotel, under the chairmanship of the PDoEU and with the participation of representatives of the MoEU and the Project owner (South Stream Transport). The meeting venue was decided by the MoEU in consultation with the officials at the PDoEU, taking into account the meeting room size and accessibility to interested stakeholders in Sinop and the Region.

The purpose of the PP meeting was to inform the public about the Project and seek feedback from stakeholders. A shuttle bus service was organised to transport stakeholders from the centre of Sinop to the venue, from 09.30 am until 10.15 am. Details of this service were included in the public newspaper announcement.

A number of public officials from the PDoEU with an interest in the Project attended the meeting. However, the public turnout to the meeting was low with two members of the public attending. The low turnout can be attributed to the distance of the Project from the Turkish coastline (minimum 110 km) and the relatively limited impacts envisaged, resulting in relatively low levels of interest among the general public and NGOs. Photos from the meeting are provided in **Figure 5.2**.

The meeting was opened by the Head of the EIA Department of the PDoEU who also chaired the meeting. A 45-minute slide presentation of the Project was delivered with information on: the South Stream Offshore Natural Gas Pipeline (including the Turkish Sector specifically), the EIA and ESIA process, initial baseline information, a preliminary identification of impacts, potential mitigation measures, some preliminary conclusions and the ‘next steps’ in the EIA process. Project information was also distributed to stakeholders at the meeting.

Public officials and stakeholders communicated their views and recommendations following the presentation when the floor was opened to questions. Questions related to whether sufficient marine baseline surveys had been undertaken along the pipeline route, how risks of unplanned events would be managed and whether all the commitments in the EIA Report would be fulfilled by the Project owner. The Project owner and the institution that prepared the EIA Report provided answers to the questions raised in the meeting/ Questions and answers were recorded in the meeting minutes by the PDoEU.

The questions and comments raised in the meeting are summarised in **Table 5.1** with an explanation on how they have been addressed in this EIA Report.

Table 5.1: Comments and Questions raised during the Public Participation Meeting

Comment / Question raised during the Public Participation Meeting	How has this been addressed in EIA Report
Will there be maintenance facilities along the 470 km pipeline and how will incidents (unplanned events) be responded to?	There will be no maintenance facilities along the pipeline route. Response to incidents will be managed from onshore facilities and procedures are detailed in the Emergency Response Plan (**Chapter 11**).
Will all the commitments in the EIA Report be fulfilled by the Project Owner?	SSTTBV is dedicated to fulfil the commitments of the EIA Report. These commitments are detailed throughout the EIA Report. The management and monitoring of environmental and social impacts and requisite commitments is presented in **Chapter 11**.
What type of surveys have been conducted along the pipeline route?	Surveys were conducted along the pipeline route including environmental, metocean, geophysical, hydrophysical, seismological, hydrographical, geotechnical and engineering survey work. Details of these surveys can be found in **Chapters 6** and **7**.

Figure 5.2: Photos from Public Participation Meeting in Sinop

5.4 Methods of Receiving the Stakeholder Comments

As part of the Turkish EIA process, stakeholders are given the opportunity to provide feedback in a number of ways:

- Direct feedback during the PP Meeting;
- Via e-mail correspondence; and
- Via postal correspondence.

All questions, comments and recommendations raised are collected by the MoEU for consideration with regard to the scope and contents (i.e., the Special Format) of the EIA Report and for the EIA Report itself. This EIA Report is available online on the MoEU's website for public comment and review and can be found here http://www.csb.gov.tr.

5.5 Other Issues

There are no other issues to be discussed under this chapter.

6. ASSESSMENT OF THE PHYSICAL ENVIRONMENT

This Chapter provides information on the physical environment of the Black Sea Region in general, and the Project Area (which is defined in **Chapter 1 General Features of the Project** of this EIA Report) in particular. The potential impacts on the physical environment associated with the Project's construction, operation and decommissioning are identified and where appropriate, mitigation measures are suggested to reduce or eliminate the identified impacts. The assessment described here has been based on the methods described in **Chapter 2 Environmental Impact Assessment Approach** of this EIA Report. The reports that have been prepared on behalf of South Stream by experts and certified organisations and include field survey work. The results derived on the field work have been used in the section and other relevant parts of the EIA with the approval of South Stream Transport B.V. The data are in line with literature survey results.

The Black Sea is one of the largest enclosed seas in the world with an approximate surface area of 420,000 km^2, a maximum water depth greater than 2,200 m, and a total water volume of 534,000 km^3 (Ref. 6.1). It is bordered by Europe, Anatolia and the Caucasus and is ultimately connected to the Mediterranean and the Aegean Seas via the Turkish straits; consisting of the Bosphorus Strait and the Strait of Dardanelles (see **Figure 6.1**).

Figure 6.1: The Black Sea and Surrounding Area

The formation of the Black Sea is important in understanding its present physical conditions. Major crust movements led to mountain-building in the Miocene Period (5 to 7 million years ago) and the formation of the Alps, the Carpathians, the Balkan Mountains and the Caucasus Mountains. This caused the Tethys Sea (a vast oceanic basin extending from west to east across Southern Europe and Central Asia) to shrink in size and become divided into a number of brackish basins. One of these basins, the Sarmatic Sea, included the modern Black Sea, the Azov Sea, the Caspian Sea and the Aral Sea. By the late Miocene and early Pliocene Period (3-5 million years ago) a link to the ocean from this sea was again established causing salinity to increase and an influx of marine species. Later in the Pliocene Period (1.5 - 3 million years ago) the connection to the ocean was again severed, and the salty sea was replaced by the almost freshwater Pontian Sea-Lake (Ref. 6.2).

From the Pontian stage onwards, the Caspian Sea was separated from the Black Sea and the Azov Sea although temporary links between the seas were formed intermittently during this period. The salinity and species composition of the developing Black Sea continued to change together with its outline with the onset of the Quaternary Period and the Northern Hemisphere Glaciation. When the ice began to melt in the late Mindel (Elsterian) Glaciations (around 400,000 to 500,000 year ago), the Sea-Lake became filled with melt waters and turned into the Paleoeuxinian basin, the outline of which resembled the modern Black Sea and the Azov Sea. In the north-east, this basin was connected to the Caspian Sea through the Kumo-Manych depression, and in the south-west to the Sea of Marmara through the Bosphorus. At the time, the Sea of Marmara was isolated from the Mediterranean and also had reduced salinity (Ref. 6.2).

The Riss-Wurm Interglacial Period (100,000-150,000 years ago) represented a new phase in the history of the Black Sea. The future Black Sea became connected to the Mediterranean and Atlantic following the opening of the Dardanelles for the first time since the formation of the Tethys Sea. Some 18,000-20,000 years ago, coinciding with the end of the last Wurm Glaciation; the sea was filled with melting waters. Once again it lost its connection to the ocean and its salinity was greatly reduced. About 7,000 years ago, (although some experts believe that it was earlier, about 5,000 years ago) a connection to the Mediterranean Sea was established through the Istanbul Straits. A gradual increase in salinity in the Black Sea followed and it is believed that within 1,000-1,500 years the salinity of the sea became sufficient to support a large number of Mediterranean marine species (Ref. 6.2).

6.1 Meteorological and Climatic Conditions

6.1.1. Climatic Conditions of the Black Sea and Black Sea Region

The climate of the Black Sea can be divided into three sub-climatic regions: coastal, highland and inland. In winter, the Black Sea region is under the influence of low pressure air systems from the west and high pressure air systems carried from the north-east. In summer, the region is under the influence of high pressure air systems carried from the south and the low pressure air systems carried from the west.

The Black Sea region experiences generally mild summers and winters. Weather fronts can rapidly advance across the Black Sea from west to east and, as a result, climatic conditions in the south-east region of the Black Sea can change rapidly. The Caucasus Mountains of Georgia tend to prevent cold fronts from Siberia from reaching the Black Sea region. Similarly, the Pontic Mountains of Turkey also tend to prevent cold fronts from entering the region from the Anatolian Plain (to the south) during the winter months (Ref. 6.3).

Wind patterns are generally cyclic; the cold winter winds from the north-east blowing strongly as storms are replaced by milder winds with low humidity from May to September. In the northern and southern ends of the Black Sea, the temperatures can differentiate to a great extent from central temperatures (Ref. 6.4).

6.1.1.1. Pressure

The atmospheric pressure regime over the Black Sea is influenced by the Azores and Asian anti-cyclones. These are defined by the wintertime cyclonic activity over the Mediterranean Sea and by the summertime thermal depression over North Africa and Asia. Seasonal changes in air and sea surface temperatures additionally affect pressure. Cyclones may cause rapid and periodic changes in atmospheric pressure. The annual trends of atmospheric pressure are presented in **Figure 6.2**. During the winter, the general pressure background is elevated and is rather similar over the entire Black Sea. Pressure increases rapidly in August and September and lasts until January after which the pressure begins to decrease. During the period from May to October, mean pressure values over the western part of the sea are higher than those over the east. In other months, low pressure is generally observed over the central part of the Black Sea. The variability of the atmospheric pressure throughout the year is the highest in the north of the Black Sea and the lowest in the south-east (Ref. 6.5).

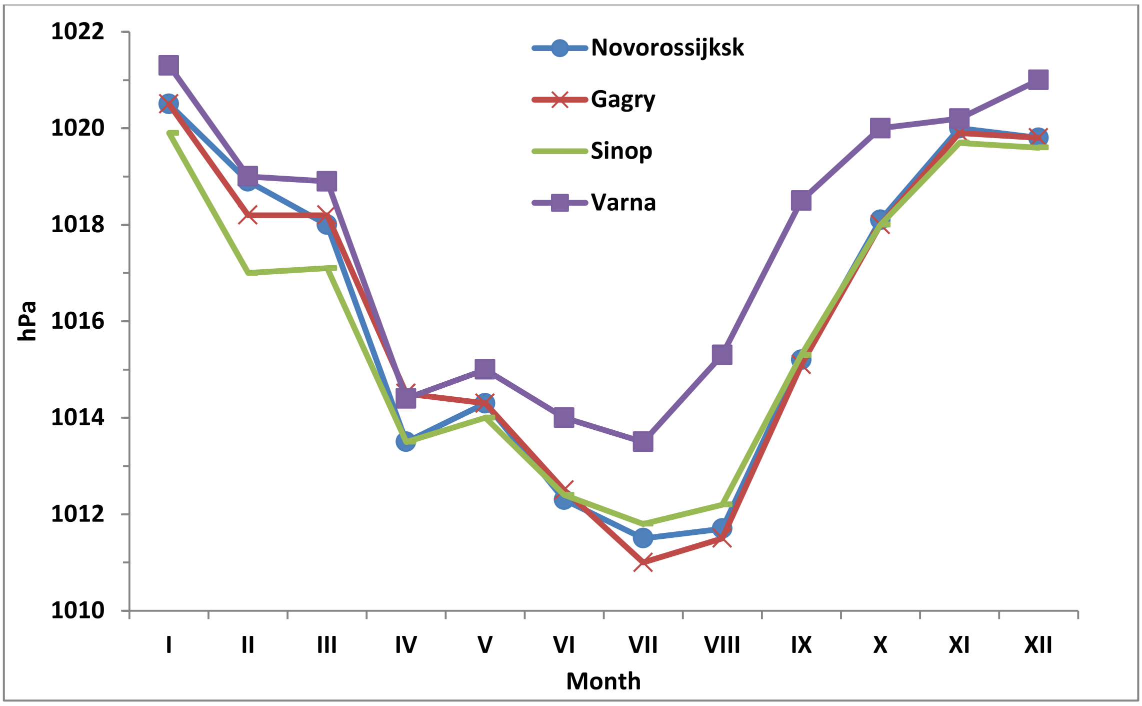


Figure 6.2: Mean Monthly Atmosphere Pressure at Hydro-Meteorological Stations, in hectopascals (hPa)

6.1.1.2. Temperature

The mean annual air temperature over the Black Sea ranges from 10 ^{0}C in the north-west to 14–15 ^{0}C in the south-east. From August to March, air temperatures over the open sea are higher than the coasts and annual variability is greater in coastal regions. The greatest annual temperature variations are characteristic of the north-western part of the Black Sea, while the central and south-eastern parts feature the least variations (Ref. 6.5).

The highest temperatures are noted in the south-east and south-west of the Black Sea. The lowest mean monthly temperature (down to average values of -1 to -2 ^{0}C), are generally observed in February in the north-west; the highest values (up to 24 ^{0}C) are generally observed in August off the Caucasian coast (**Figure 6.3- 6.4** and **Table 6.1**).The differences in the annual temperature trends over the Black Sea range from -2 ^{0}C in the northwest to 7.5 ^{0}C in the southeast (**Figure 6.5**). On the whole, negative temperatures occur over the entire Black Sea;

they are mostly noted in January and February with the highest recurrences over the north-western and north-eastern parts of the sea. Temperatures from 0 to -5 ^{0}C are generally observed for between 6 to 10 days per month. The number of days with negative air temperatures may reach 22 to 26 in January and February and 13 to 15 in December and March (Ref. 6.6).

The warmest regions are the Caucasian and Anatolian coasts of the Black Sea. In these regions air temperatures rarely drop below 0 ^{0}C. The number of such days is around 5 to 8 in January and February, 1 to 2 in December, and 13 to 15 in March. In these regions, mean daily temperatures below -5 ^{0}C are noted on average once per 10 to 20 years (Ref. 6.6).

On the coast, mean air temperatures below -10 ^{0}C are not regularly observed. These temperatures may be observed during 7 to 14 days in January and February, 5 to 8 days in December, and 2 to 3 days in March only in the northwest and northeast. Large temperature increases are possible, which is caused by the warm air advection from the south. The period when mean daily air temperatures of 20^{0}C and higher are experienced is shortest in the northwest where it lasts from the end of June to the beginning of September. Its average duration in this region is 70 to 80 days; toward the southeast its duration increases to 100 to 110 days per year. Over the majority of the Black Sea coast, mean daily temperatures higher than 30 ^{0}C are possible in the summer (Ref. 6.5).

The number of days with a mean daily temperature from 20 to 25 ^{0}C is highest in July and August and, on average, comprises 20 days per month (up to 25 days per month on the Anatolian and the southern part of the Caucasian coasts). A mean daily temperature higher than 25 ^{0}C is observed over 3 to 9 days per month in the north of the Black Sea coast, 10 to 11 days on the southern coast of the Crimea, and 2 to 7 days in the southern part of the Caucasian coast. At mean daily temperatures of 30 ^{0}C and higher, the maximum air temperature values may reach 35 to 40 ^{0}C (Ref. 6.5).

Over the entire Black Sea, the daily variability of air temperature in the winter is greater than those in the summer, except for the eastern region, where it is greatest in the autumn. Daily variations increase from the southeast to the northwest. The inter-daily temperature variability generally decreases from the north to the south; in the winter it is 2 to 3 times greater than the summer. On average, cooling is more intensive than warming: inter-daily decreases in temperatures may reach 10 to 15 ^{0}C, while temperature rises rarely exceed 10 ^{0}C.

Table 6.1: Monthly Average Temperature (^{0}C) for Coast of the Black Sea Region (Years: 1960-2012)

Months	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Average Temperature (°C)	3,0	3,8	6,6	11,1	15,4	19,3	21,9	21,9	18,4	14,0	9,0	5,3

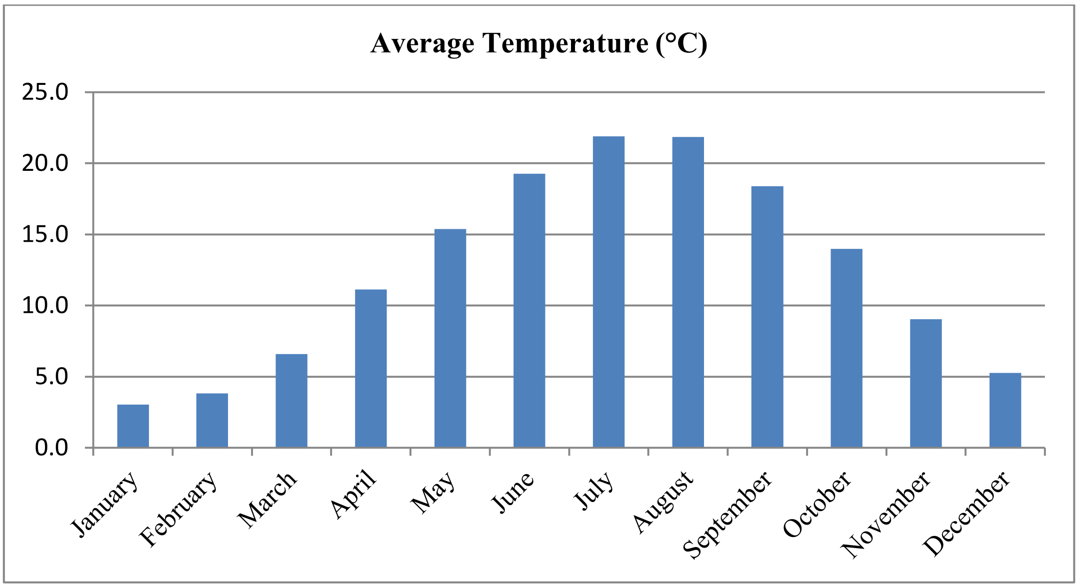


Figure 6.3: Monthly Average Temperature (^{0}C) for Coast of the Black Sea Region (Years:1960-2012) (Ref. 6.35)

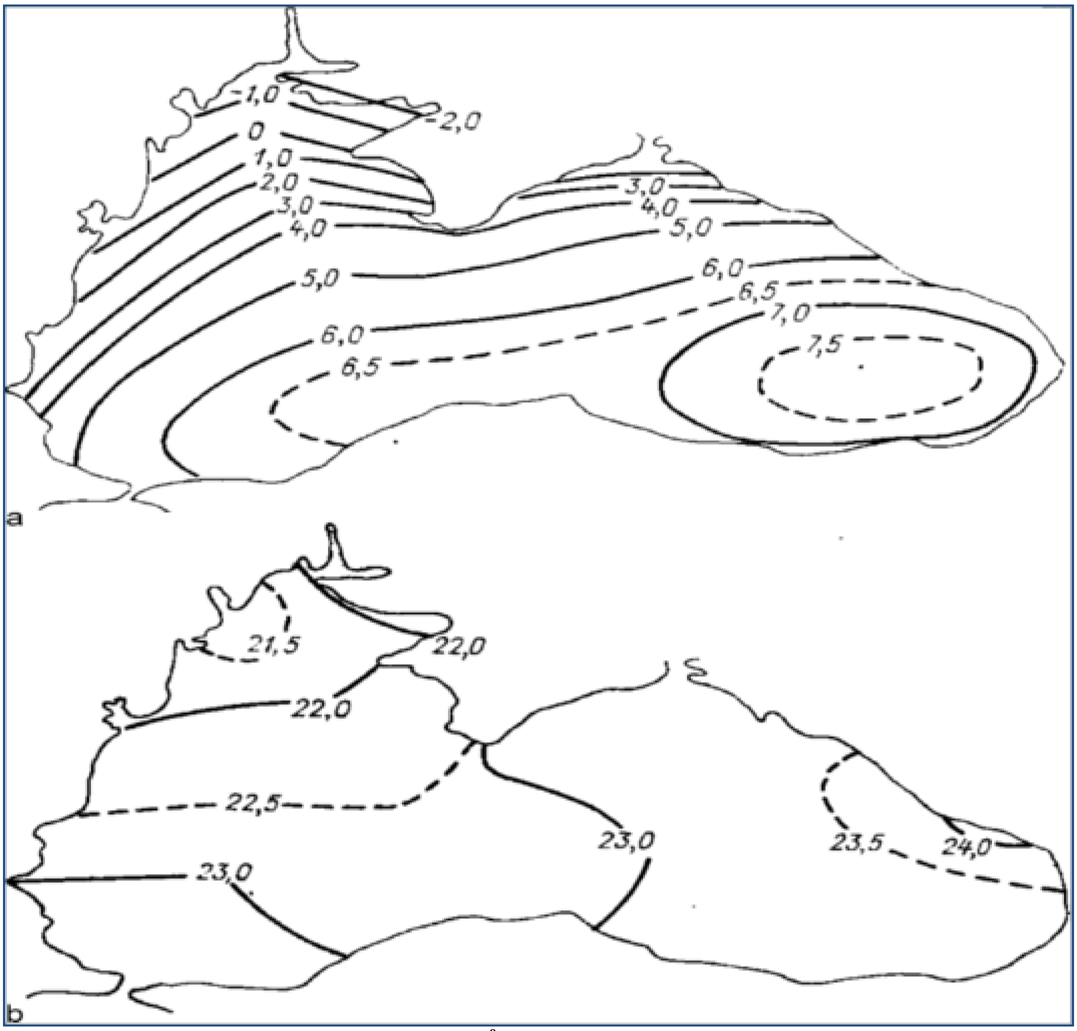


Figure 6.4: Mean Air Temperature (^{0}C) in the Black Sea during February (a) and in August (b)

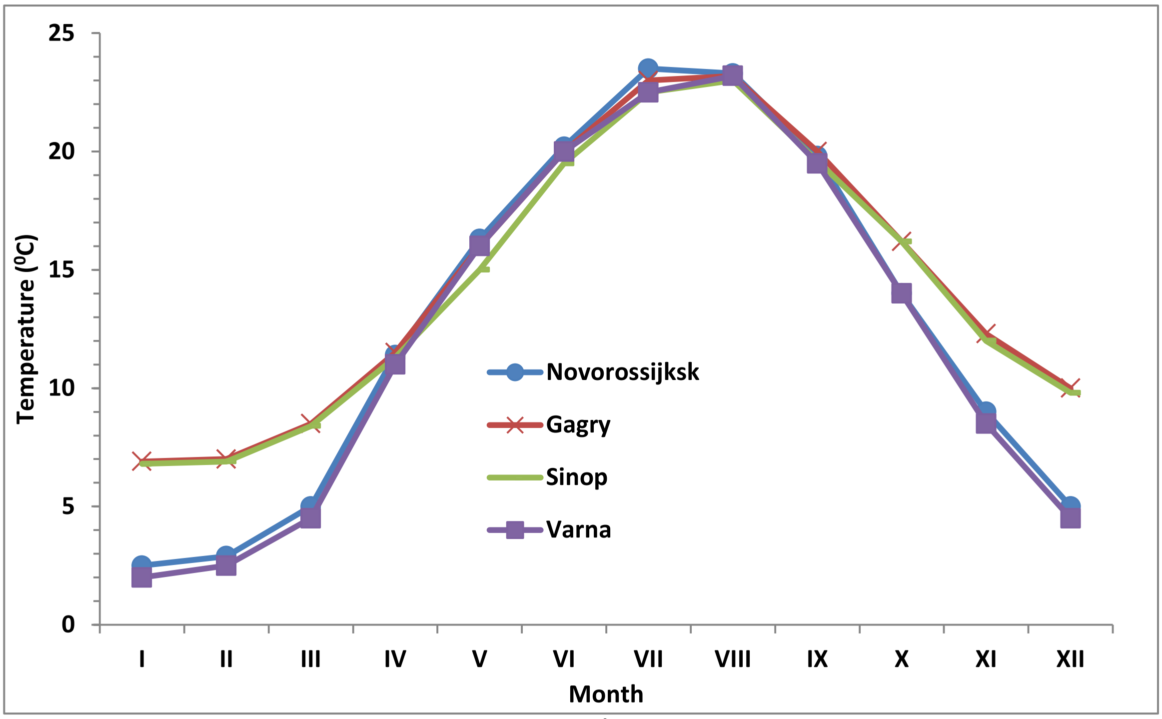


Figure 6.5: Mean Monthly Temperature (^{0}C)

6.1.1.3. Precipitation

Atmospheric precipitation over the Black Sea is mostly related to the cyclonic activity. Convective processes play a noticeable role within the nearshore and along the coastline. Throughout the year, the precipitation amount increases from 380 to 420 mm/year in the northwest to up to 1,500 to 2,500mm/year in the southeast (**Figure 6.6**). In the southeast, the annual number of days with precipitation is 100 to 170, while on the north-western and Crimean coasts it equals 100 to 125 days. The intensity of precipitation is greater in the summer. In the winter, especially on the northern coast, precipitation may take the form of snowfall. On average, during the winter there are 25 to 40 days with a snow cover on the north-western coast, 15 to 25 days in the Crimea (on its southern coast, this is no greater than 15 days), 14 to 17 days in the northeast, and less than 15 days in the southeast (Ref. 6.5).

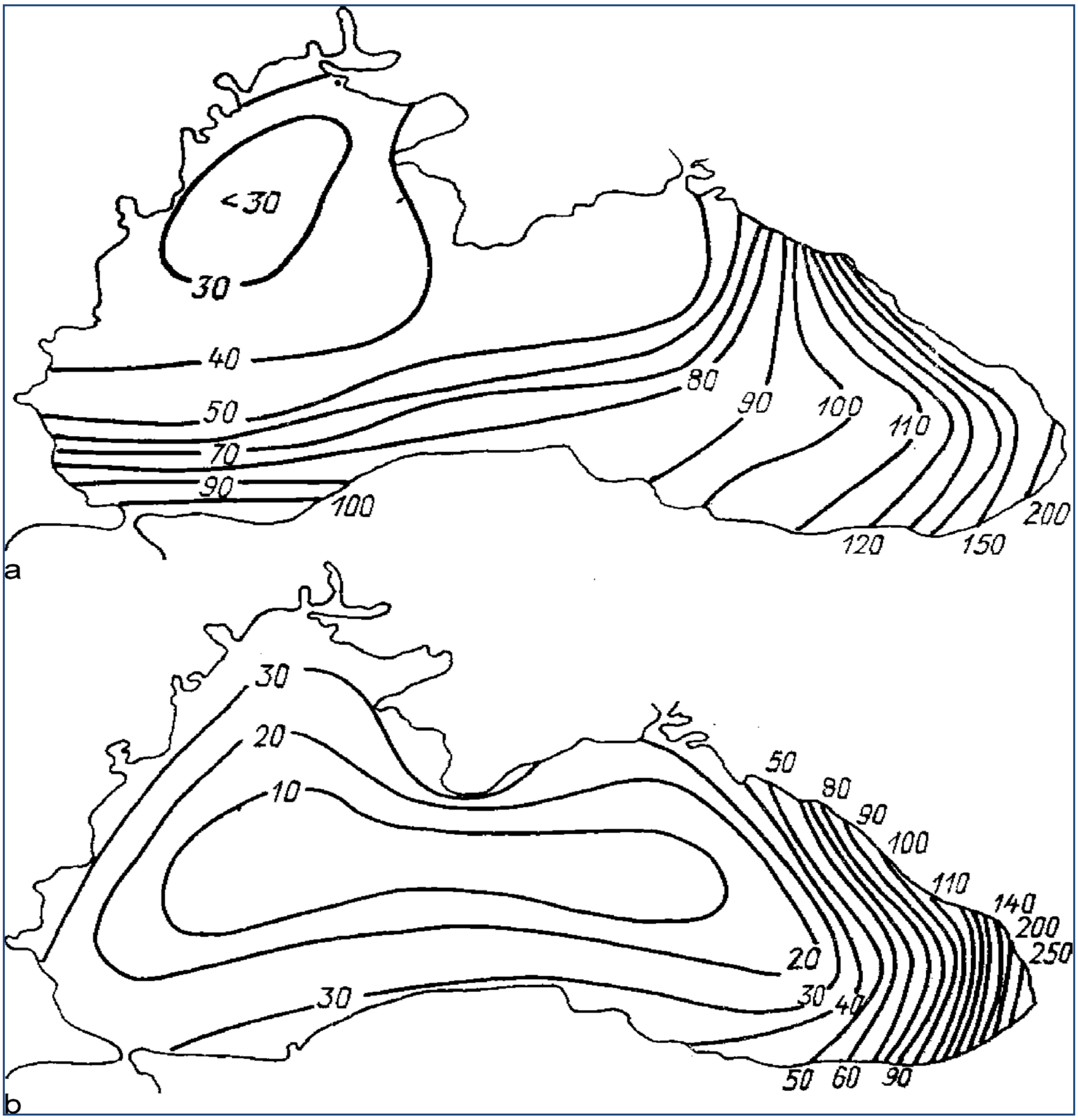
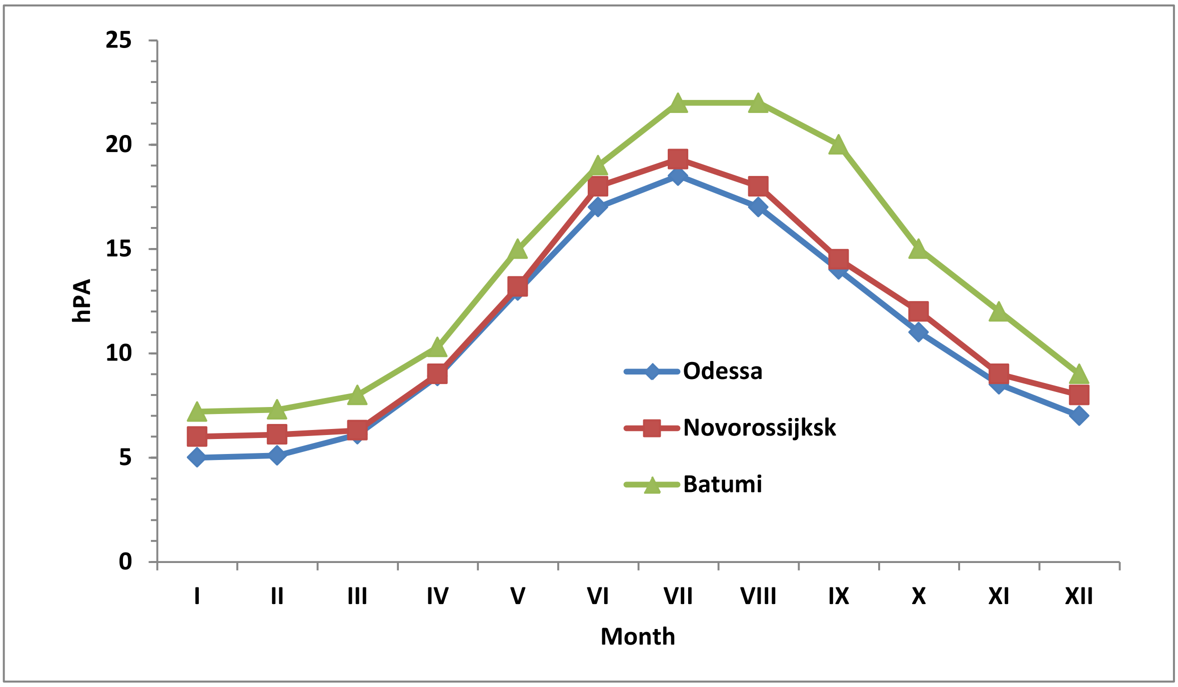


Figure 6.6: Mean monthly precipitation, mm/month, in the Black Sea during February (a) and August (b)

6.1.1.4. Humidity

The moisture content (humidity) regime over the Black Sea is determined by the interaction between the air and sea surface. In coastal regions, the daily variations in the moisture content are additionally affected by wind circulation. The daytime breeze supplies humid air from the sea to the land. In contrast, night time breezes deliver dry air to the sea surface. The intra-annual changes in humidity follow the annual trend of air temperatures over the sea. The lowest values are observed in January and February, while the highest are recorded in July and August. The lowest values of the humidity are noted in the northwest (4.7 to 20 hPa on the coast and 5.0 to 21.0 hPa over the sea). The moisture content grows in a south-easterly direction (7.2 to 23.4 hPa on the coast and 8.0 to 24.0 hPa over the sea) (Ref. 6.6).

The annual trend of the relative humidity over the majority of the Black Sea shows its maximum values in the coldest part of the year and the lowest values in the warmest (**Figure 6.5**). The humid subtropical areas of the eastern coast are characterised by a distinct regime where the highest values are observed in the summer and the intra-annual variations are not significant (**Figure 6.7**). The lowest values of the relative moisture content are characteristic of the north-western areas of the Black Sea, while the highest values are recorded to the southeast and southwest. On the contrary, in the winter, the humidity increases from the southeast to the northwest (Ref. 6.5).



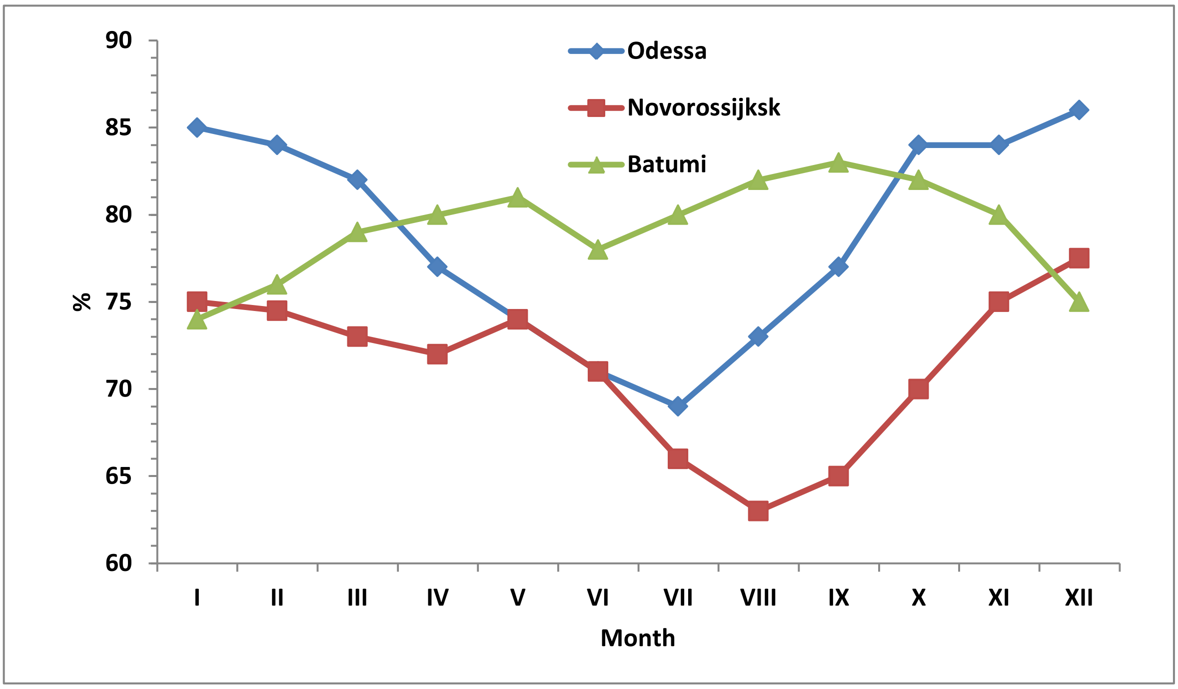


Figure 6.7: Annual Trends of a) the Partial pressure of Water Vapour (hPa) and b) the Relative Moisture Content (%)

6.1.1.5. Evaporation

Evaporation rates in the Black Sea region tend to follow the opposite pattern to precipitation rates, with the greatest rates occurring in the north and northwest and lowest rates occurring in the south and southeast. Over the entire Black Sea basin, precipitation and runoff exceed evaporation. As a result, the Black Sea is a dilution basin with an excess of freshwater flow that ultimately exits the basin towards the Aegean Sea through the Bosphorus and Dardanelles Straits (Ref. 6.5).

6.1.1.6. Wind

The atmospheric circulation represents the most important process that defines the movements of air masses over the Black Sea. The climates in the western and eastern parts located at the same latitude differ in their thermal regimes and moisture contents. Winter is warmer and precipitation is higher over the western part (Ref. 6.7).

In the north, the Black Sea is within the south-eastern periphery of a vast anticyclone centred over Europe and Scandinavia. Within the north-easterly synoptic process in the Black Sea region, the centre of the anticyclone is located over the western regions of the European part of Russia.

Owing to the advection of cold air from the north and northeast, the cyclonic activity over the south-eastern part of the Black Sea is intensified. The passage of cyclones over the southern part of the Black Sea is accompanied by strong easterly and north-easterly winds, especially in the northeast and off the western coast of the Crimea. The southeast is usually dominated by weak and moderate winds of differing directions. For the easterly type of processes, it is characteristic of the anticyclone to be centred over the central regions of the European part of Russia. Meanwhile, the cyclonic activity also develops over the Mediterranean Sea and Turkey. This results in a significant strengthening of easterly winds over the southern regions of the Black Sea.

The northerly, north-easterly, and easterly processes noticeably dominate in the winter and generally throughout the entire year. The south-easterly processes are related to the high-pressure area located over the east of the European part of Russia and Kazakhstan. The cyclonic activity over the central part of European Russia leads to the development of westerly winds over the Black Sea (Ref. 6.7).

Over the open sea, the wind speed is greater than that on Black Sea coasts throughout the year. In all the months, the highest wind speeds are noted in the north except for the south-eastern coasts of the Crimean Peninsula. The lowest values are observed in the south-east. According to the data of meteorological stations, weak winds with speeds less than 5m/s dominate throughout the year over the major part of the coasts. The number of days with strong winds (>15m/s) is the greatest on the north-eastern and south-western coasts (34–35 days per year). The least number of such days (20–22 days per year) are characteristic of the southern coast of the Crimea and the south-eastern regions of the Caucasian coast. On average, the mean annual wind speed over the sea increases from the south to the north and is around 4–6m/s. The highest wind speed over the open sea likely to occur once per 100 years is 40m/s. The annual trend of the wind speed is characterised by increases in winter and decreases in the summer for the majority of the Black Sea (**Figure 6.8**).

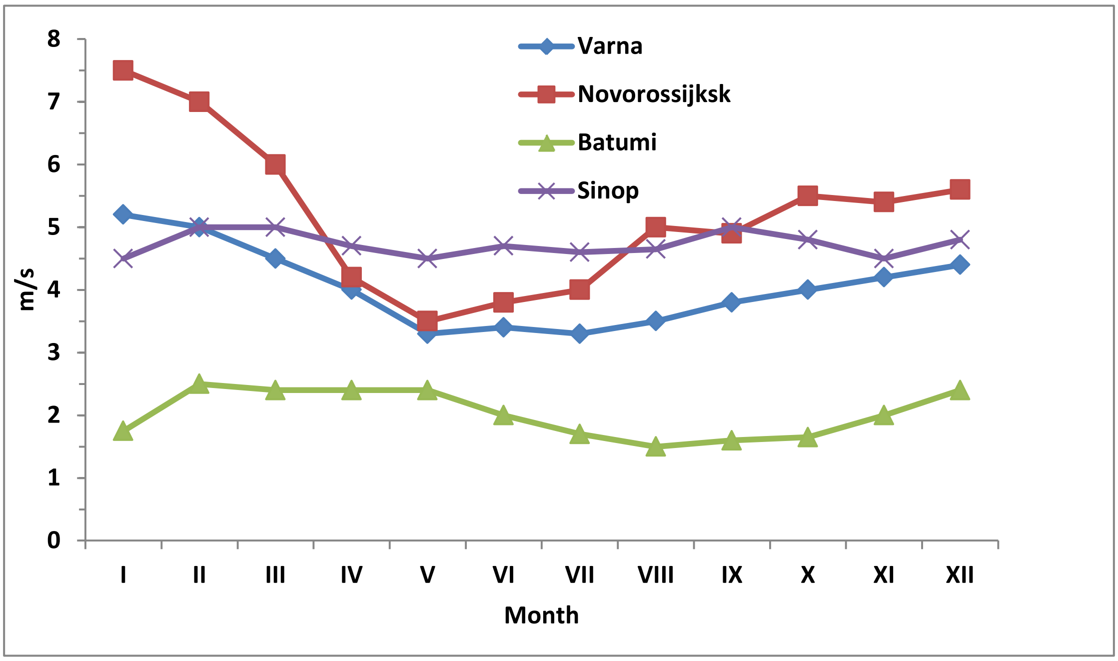


Figure 6.8:Mean monthly wind speed, m/s

6.1.1.7. Fog

The south-eastern Black Sea region has some of the poorest visibility conditions along the Turkish Black Sea coastline based on the review of the meteorological station data along the Black Sea Coast line. High levels of humidity and a generally wet climate can lead to significant fog formation, particularly during the spring. Fog in this region is typically advection fog, caused by warm, moist sea breezes passing over the cooler land surface resulting in condensation and fog formation in the coastal region. Upper slope fogs are also common along the entire coastline of the Black Sea.

6.1.2. General and Local Climatic Conditions of the Project Area

The Project runs through the Turkish EEZ without the use of any landfall facilities in Turkey. There are no records that have been collected by the Turkish State Meteorological Service along the Project Area. Meteorological models and literature surveys were, used to identify the meteorological characteristics. In addition the data from the two nearest meteorological stations to the Project Area (Samsun and Sinop), were used to characterise climatic characteristics of the Project Area. These stations were the Samsun Regional Meteorological Station No: 17030 and the Sinop Regional Meteorological Station No: 17026, located at 230 km and 135 km respectively form the Project Area. The Black Sea Meteorological Atlas, prepared by the Turkish Naval Force in 1991 which includes the meteorological conditions of the Black Sea was also used to inform this section (Ref. 6.8).

Meteorological modelling was one of the tools used to identify the meteorological features of the Project Area. The second version of the Climate Forecast System (CFS), i.e. software developed by National Climatic Data Centre (NCDC), was used to generate high resolution historical data in the Project Area.

Three locations along the route were simulated for this EIA Report. The locations were chosen as: the endpoints (boundaries of the EEZ) and the midpoint. The point coordinates are in **Table 6.2**:

Table 6.2: Coordinates of the Points where Meteorological Data were simulated

Point No	Location	Coordinates
1	Eastern Endpoint (Russian EEZ Border)	30°35'57.6"E, 42°49'16.9"N
2	Mid	36°16'23.8"E, 43°24'0.6"N
3	Western Endpoint (Bulgarian EEZ Border)	33°24'0.20"E, 43° 9'25.44"N

6.1.2.1. Pressure

The modelling results predict the annual average atmospheric pressure along the Project Area to be 1017.41 hPa, 1017.58 hPa, and 1017.25 hPa at the Eastern, Mid and Western points, respectively. The atmospheric pressure values along the Project Area are given in **Table 6.3** and **Figure 6.9**.

Table 6.3: Atmospheric Pressure Values along the Project Area

Parameter	Region	Jan.	Feb.	March	April	May	June	July	August	Sep.	Oct.	Nov.	Dec.	Annual
Average. Atmospheric Pressure (hPa)	East	2021	1021	1017	1012	1013	1021	1012	1014	1020	1021	1017	1020	1017.41
	Mid	1023	1024	1014	1013	1014	1019	1011	1014	1016	1026	1017	1020	1017.58
	West	1021	1024	1015	1013	1015	1012	1011	1015	1017	1018	1022	1024	1017.25

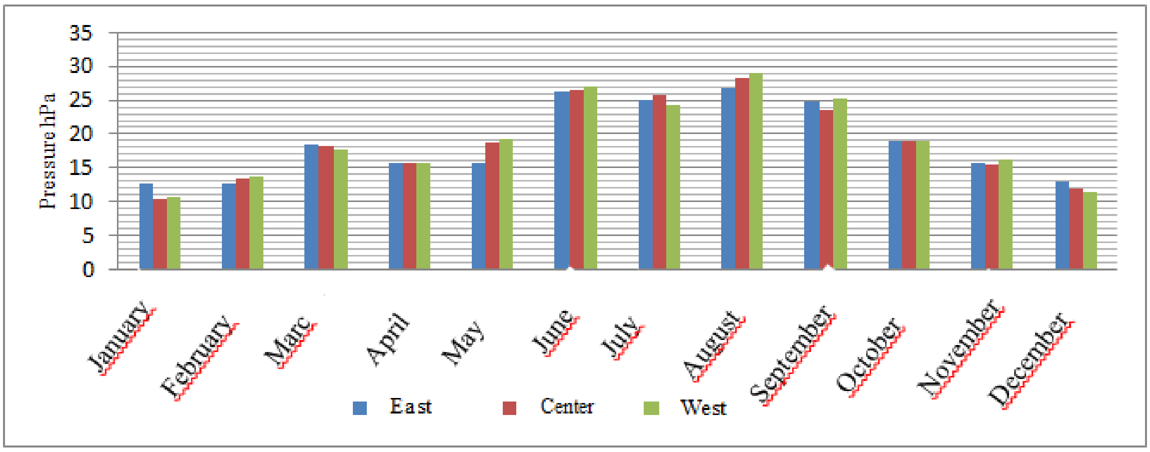


Figure 6.9: Graphical Representation of the Average Atmospheric Pressure Values along the Project Area

6.1.2.2. Temperature

The meteorological modelling results predict the annual average temperature to be 15.61 ^{0}C, 15.47^{0}C and 15.65 ^{0}C at the Eastern, Mid and Western points, respectively. The average temperature values along the Project Area are given in **Table 6.4** and **Figure 6.10**.

Table 6.4: Average Temperature Values along the Project Area

Parameter	Region	Jan.	Feb.	March	April	May	June	July	August	Sep.	Oct.	Nov.	Dec.	Annual
Average. Temperatures (^0C)	**East**	6.1	6.4	8.3	13.1	17.5	21.0	24.7	24.2	21.6	17.7	13.0	13.8	15.61
	Mid	5.5	6.7	8.7	13.2	17.4	20.3	25.1	24.2	21.0	17.6	12.7	13.3	15.47
	West	5.7	6.1	9.0	13.5	17.4	20.7	24.7	25.0	21.4	18.1	12.9	13.3	15.65

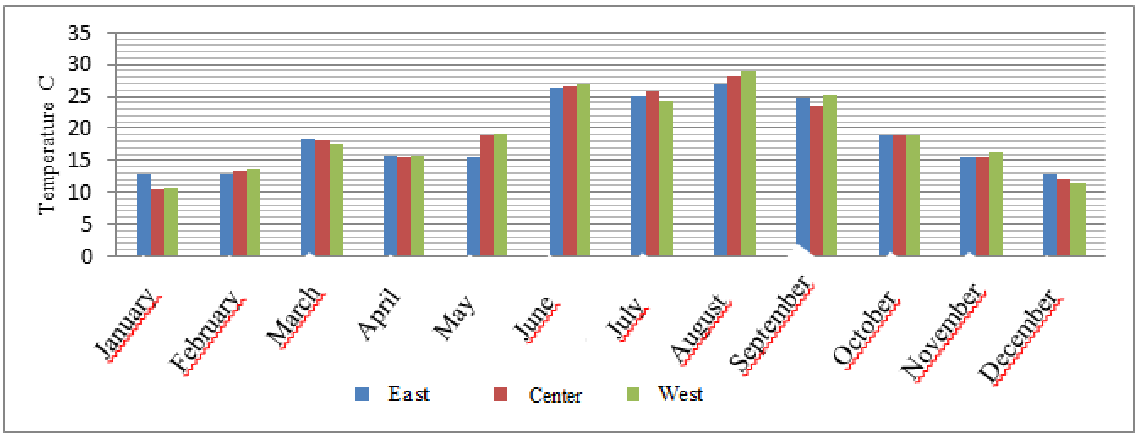


Figure 6.10: Graphic Representation of Average Temperature Values along the Project Area

6.1.2.3. Precipitation

The meteorological modelling predicts that the monthly average precipitation amount to be 18.82 mm, 18.9 mm, and19.07 mm at the Eastern, Mid and Western points, respectively of the Project Area. The average precipitation values along the Project Area are given in **Table 6.5** and **Figure 6.11**.

Table 6.5: Average Precipitation Values along the Project Area

Parameter	Region	Jan.	Feb.	March	April	May	June	July	August	Sep.	Oct.	Nov.	Dec.	Annual
Average. Precipitation (kgm^2)	**East**	12.7	12.8	18.5	15.8	15.6	26.3	25.1	26.9	24.8	18.9	15.6	12.9	18.82
	Mid	10.5	13.4	18.2	15.6	18.8	26.5	25.8	28.2	23.4	18.9	15.5	12.0	18.9
	West	10.7	13.6	17.6	15.8	19.2	27.0	24.2	29.1	25.2	18.9	16.2	11.4	19.07

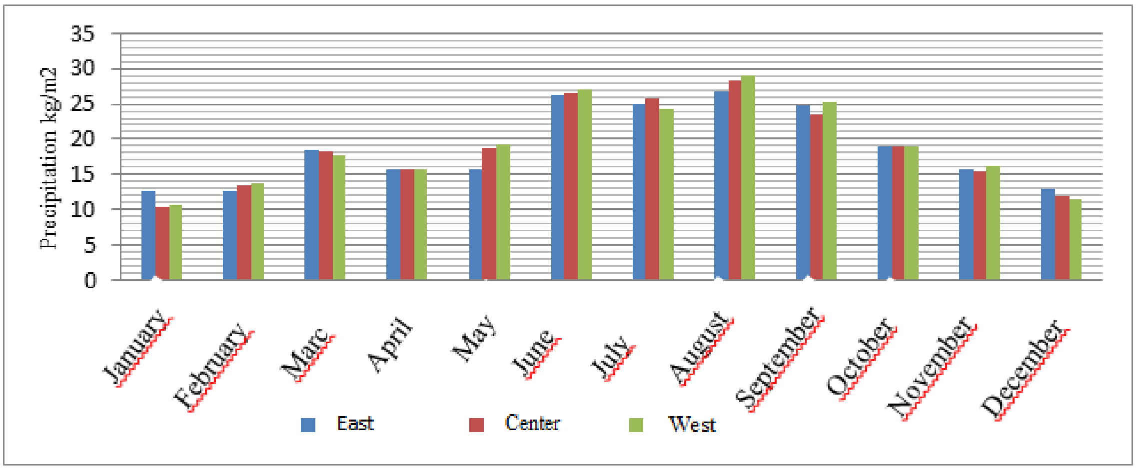


Figure 6.11: Graphic Representation of Total Precipitation Values along the Project Area

6.1.2.4. Humidity

The CFS Model data did not include the relative humidity parameter; these values were obtained from Samsun and Sinop Meteorology Stations which are most likely to represent the conditions in the Project Area. The annual average humidity rate is 73.3% and 74.3% according to the monitoring records of Samsun and Sinop Meteorological Stations, respectively. Minimum humidity rate, on the other hand, is 10% for Samsun and 4% for Sinop, both rates recorded in February. Samsun and Sinop Meteorological Stations, humidity rates are given in **Table 6.6** and **Figure 6.12** and **6.13**.

Table 6.6: Samsun and Sinop Meteorological Stations, Humidity Rates

Parameter	Station	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Average Humidity (%)	Samsun	67	69.5	75	79	80.2	75.8	73.4	73.3	74.8	75.4	69.9	66.2	73.29
	Sinop	71	71.7	74.4	76.6	78.4	76	76.2	75.2	74.9	74.7	72.3	70.5	74.325
Minimum Humidity (%)	Samsun	6	2	5	14	20	27	20	36	18	5	10	5	2
	Sinop	21	4	9	14	17	24	26	23	24	9	13	15	4

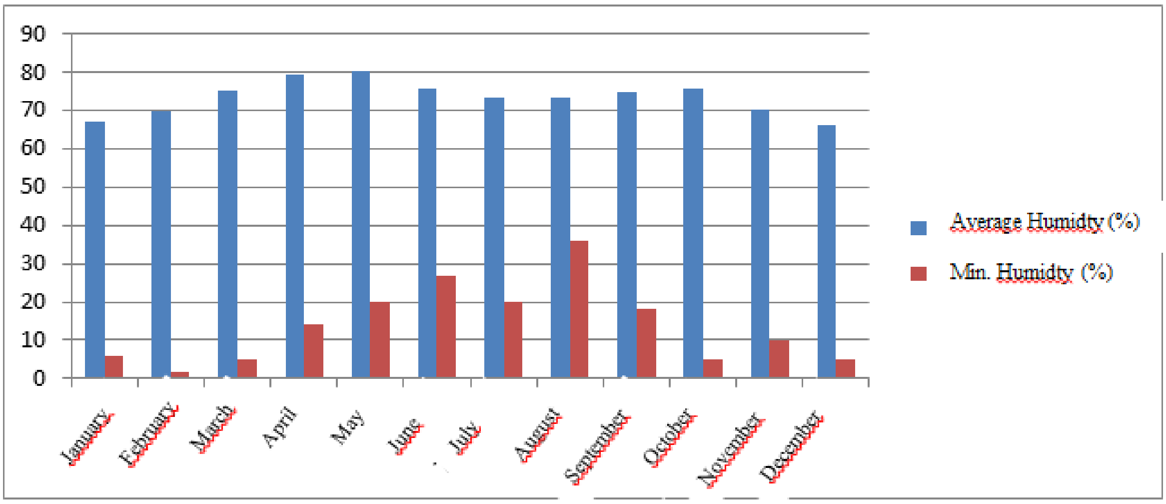


Figure 6.12: Graphic Representation of Humidity Rates from Samsun Meteorological Station

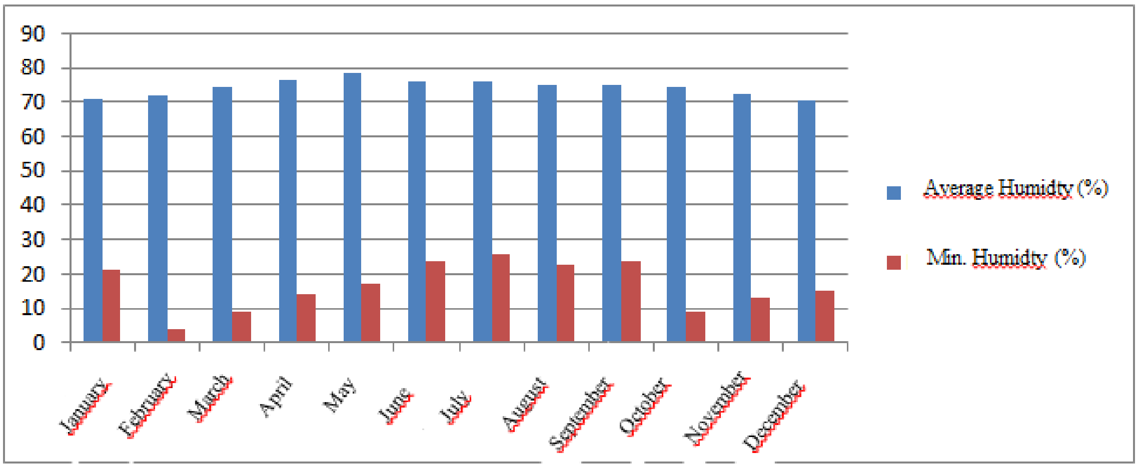


Figure 6.13: Graphic Representation of Humidity Rates from Sinop Meteorological Station

6.1.2.5. Evaporation

The CFS Model data do not include an evaporation parameter; these values were obtained from Samsun and Sinop Meteorology Stations which are most likely to represent the Project Area. The total average open surface evaporation rate is 858 mm and 787 mm, as per the data of Samsun and Sinop Meteorological Stations, respectively. Maximum open surface evaporation has been measured as 11.8 mm in February and November for Samsun Province and as 12.5 mm in July for Sinop Province. Surface evaporation rates received from Samsun and Sinop Meteorological Stations are given in **Table 6.7** and **Figure 6.14** and **6.15**.

Table 6.7: Surface Evaporation Rates received from Samsun and Sinop Meteorological Stations

Parameter	Station	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Average Open Surface Evaporation (mm)	Samsun	19	16.2	16.2	65.3	88.8	120.4	152.9	145.7	98.3	66.9	43.4	24.9	858
	Sinop	2.5	0.5	1.4	63.6	96.3	124.6	154.5	140.1	96.4	63.6	33.5	10.2	787.2
Maximum Open Surface Evaporation (mm)	Samsun	9.5	11.8	7.3	11	8.6	11	10	10.2	9	8.6	11.8	10	11.8
	Sinop	2.3	4	4	6.2	7.7	8	12.5	9.1	6.5	6.4	12.1	3.2	12.5

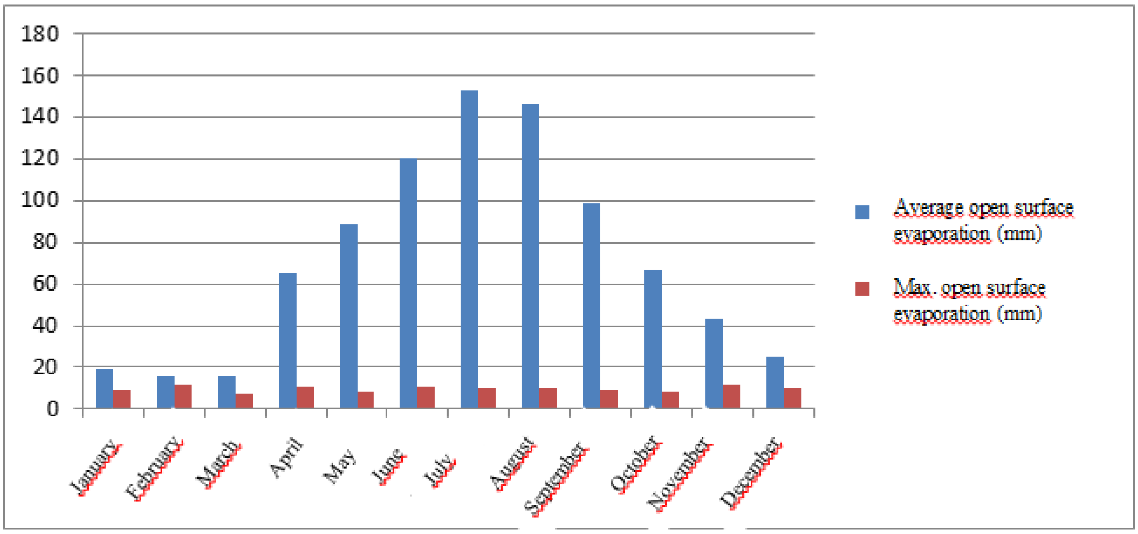


Figure 6.14: Graphic Representation of Surface Evaporation Values of Samsun Meteorological Station

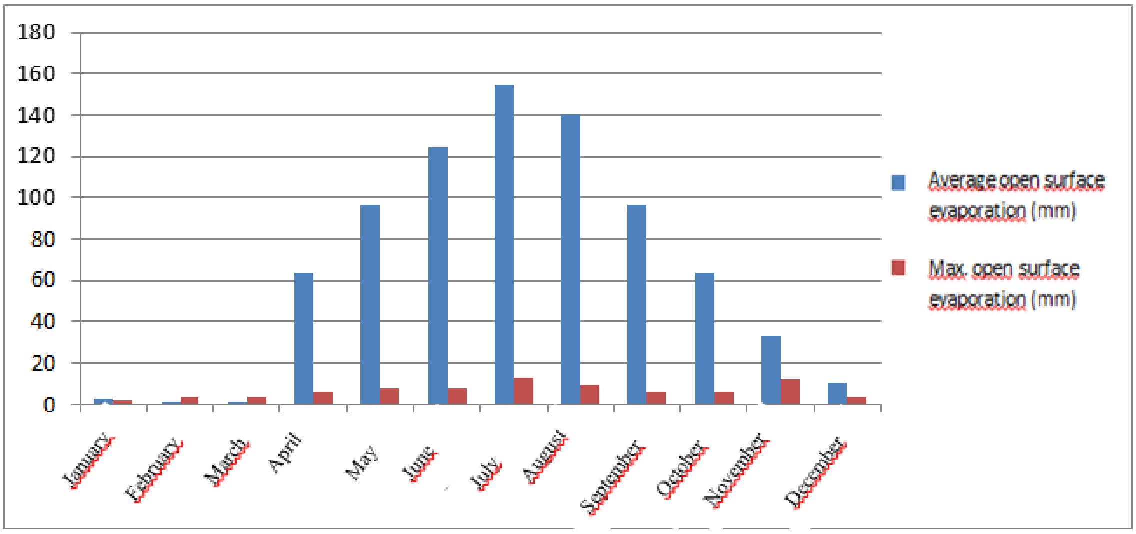


Figure 6.15: Graphic Representation of Surface Evaporation Values of Sinop Meteorological Station

6.1.2.6. Wind

Long-Term wind frequency data information was obtained from the Black Sea Meteorological Atlas prepared by Turkish Naval Force (Ref. 6.8). Wind blowing frequencies in all directions on the Eastern, Mid and Western Points of the Project Area are given in **Table 6.8, Table 6.9** and **Table 6.10**.

Table 6.8: Wind frequency data on the Eastern Point of the Project Area (%)*

Direction	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
N	12	5	6	5	14	15	21	23	15	15	12	17	13,3
NE	18	9	22	2	19	12	19	17	22	20	21	17	16,5
E	12	13	3	16	9	10	3	8	16	7	5	7	9,08
SE	7	12	10	17	8	5	10	4	3	4	8	8	8
S	12	20	10	8	2	6	5	2	8	5	6	15	8,25
SW	6	15	20	20	19	17	3	9	7	17	17	15	13,75
W	20	10	10	21	16	7	18	20	7	11	17	10	13,91
NW	6	6	11	4	6	18	21	17	15	7	8	7	10,5
Tranquil	7	10	8	7	7	10	0	0	7	14	6	4	6.71

Table 6.9: Wind blowing frequencies on the Mid-Point of the Project Area (%)*

Direction	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
N	9	3	10	3	4	17	13	22	3	3	11	5	8.58
NE	13	18	20	15	30	14	20	30	20	35	15	19	20.75
E	20	18	20	18	17	9	9	12	13	22	9	19	15.50
SE	2	5	9	6	8	3	8	3	8	2	4	13	5.92
S	13	6	5	9	5	4	6	2	8	5	10	11	7.00

Direction	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
SW	13	17	14	15	6	20	14	4	9	7	16	21	13.00
W	17	17	12	19	18	22	7	11	14	3	16	6	13.50
NW	10	10	7	4	10	8	20	16	19	5	12	6	10.58
Tranquil	3	6	3	11	2	3	3	0	6	18	7	0	5.17

Table 6.10: Wind blowing frequencies on the Western Point of the Project Area (%)*

Direction	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
N	10	8	12	2	10	10	12	16	13	16	13	8	10.83
NE	27	18	25	20	22	27	40	28	34	28	23	17	25.75
E	16	21	10	19	17	20	12	17	20	17	17	13	16.58
SE	2	3	10	7	3	6	1	1	3	3	4	12	4.58
S	10	18	8	6	8	7	2	2	2	7	9	15	7.83
SW	15	12	8	16	14	4	3	8	6	7	5	12	9.17
W	4	9	10	17	8	8	12	12	6	5	12	4	8.92
NW	15	6	9	4	7	13	12	4	8	6	11	15	9.17
Tranquil	1	5	8	9	11	5	6	12	8	11	6	4	7.17

The monitoring records of the Turkish Naval Forces (Ref. 6.8) show that the prevailing wind direction for Eastern point is NE (North East) and second degree prevailing wind direction is W (West). The prevailing wind direction for the Midpoint is NE (North East) and second degree prevailing wind direction is E (East) and the prevailing wind direction for Western point is NE (North East) and second degree prevailing wind direction is E (East). Relevant data has been shown in **Figures 6.16 – 6.24** and **Tables 6.11 – 6.13**.

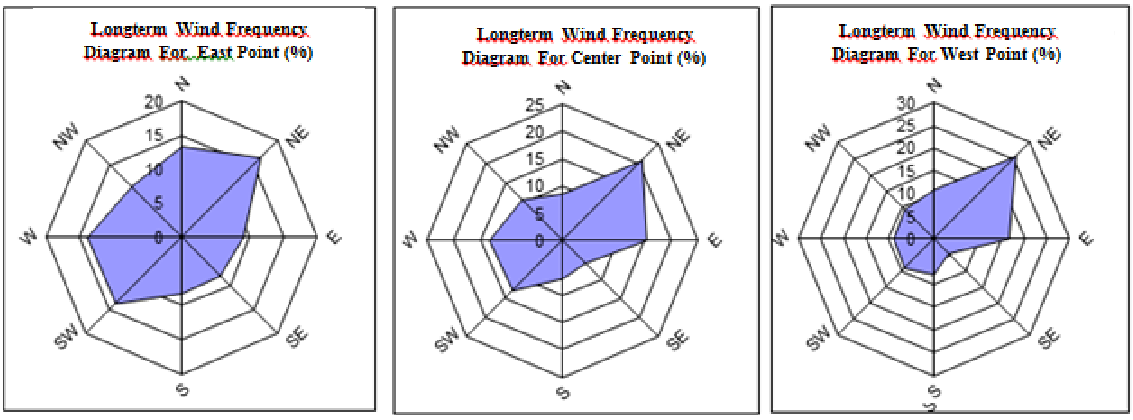


Figure 6.16: Diagram of Long-TermWind Blowing Directional Frequencies

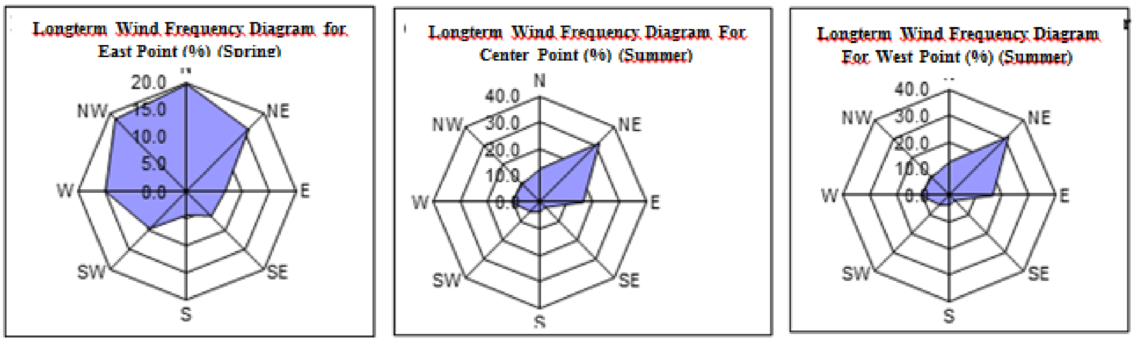


Figure 6.17: Diagram of Long-Term Wind Blowing Frequencies for Spring along the Project Area

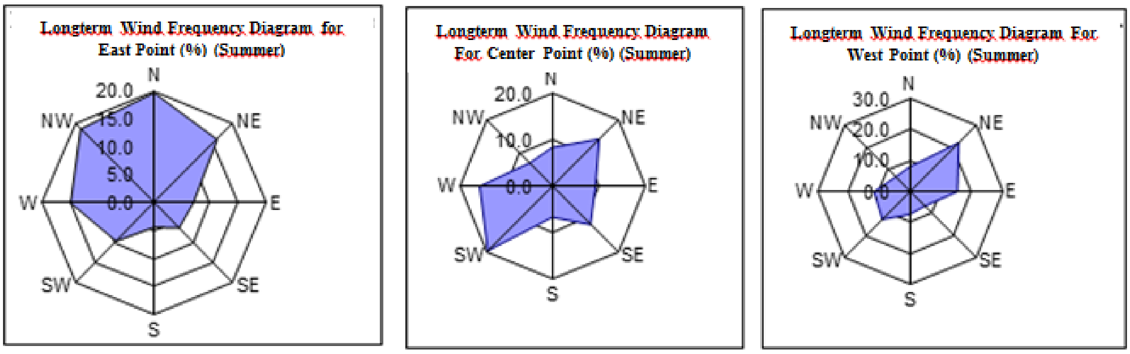


Figure 6.18: Diagram of Long-Term Wind Blowing Frequencies for Summer along the Project Area

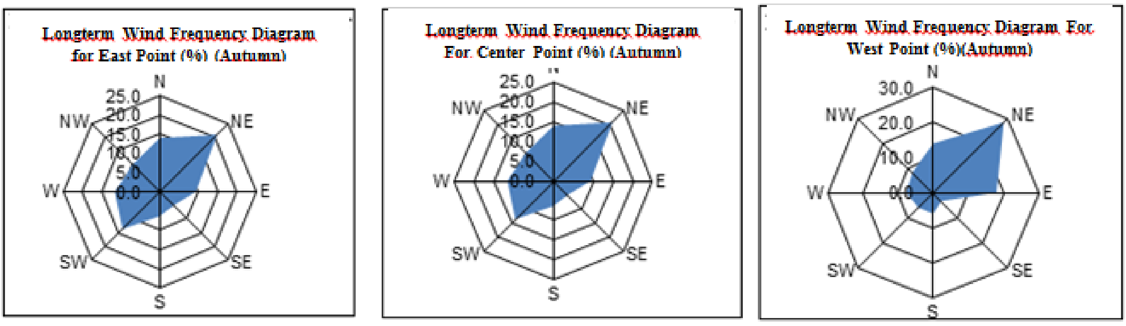


Figure 6.19: Diagram of Long-Term Wind Blowing Frequencies for Autumn along the Project Area

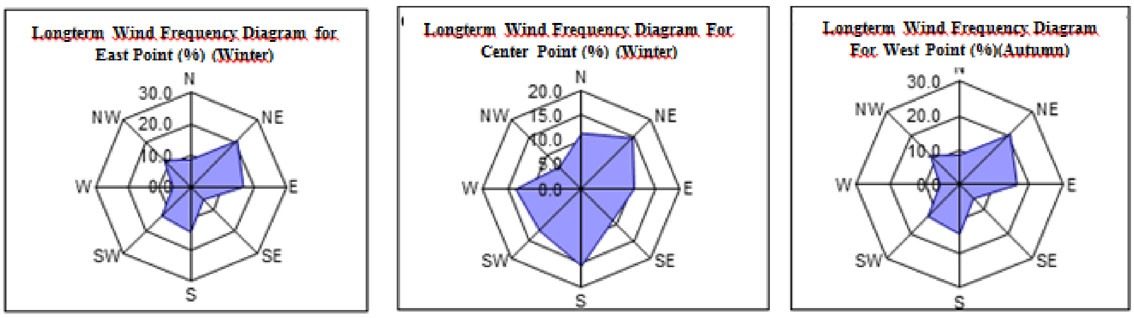


Figure 6.20: Diagram of Long-Term Wind Blowing Frequencies for Winter along the Project Area

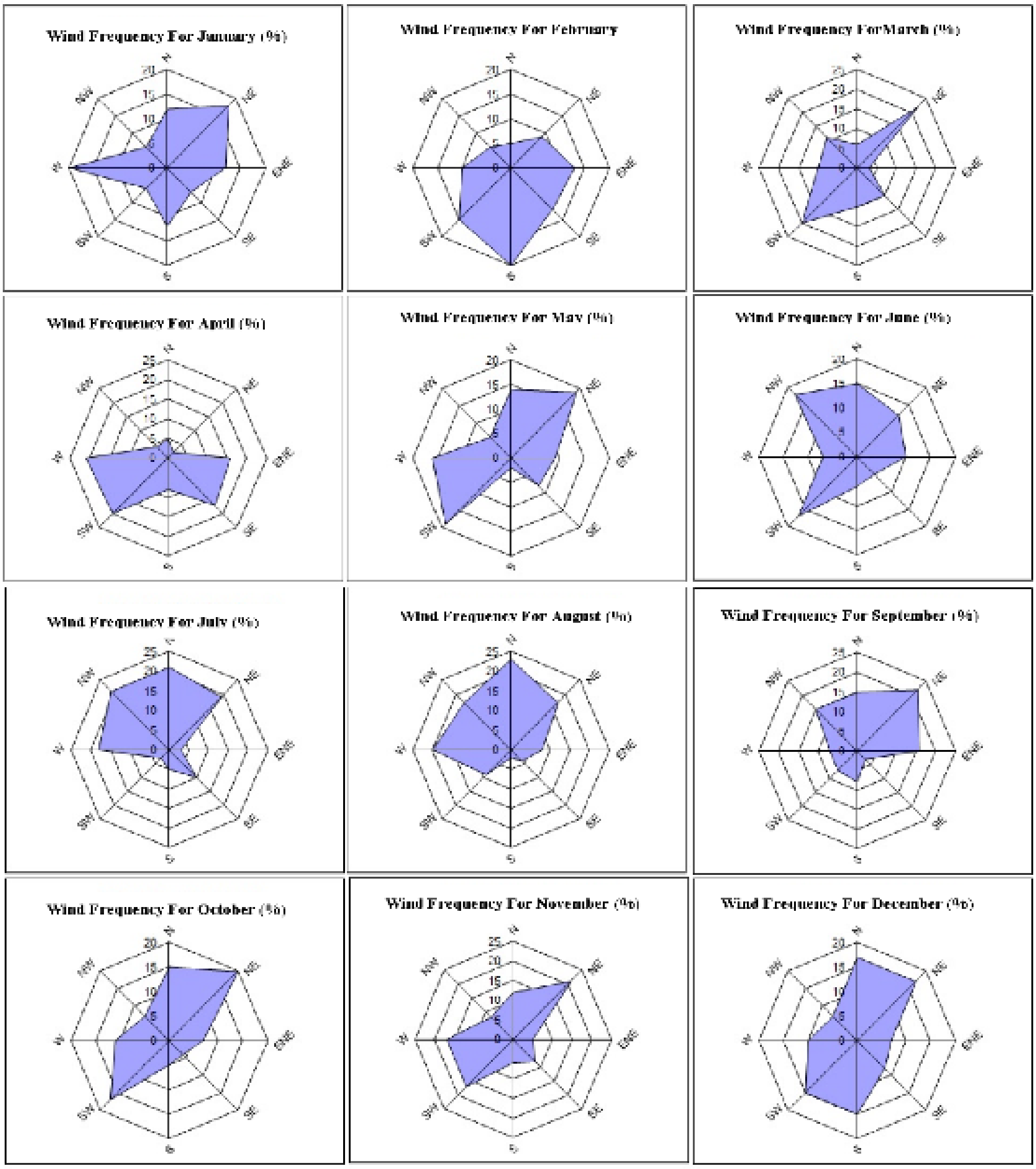


Figure 6.21: Eastern Point - Wind Rose Diagrams for Long-Term on monthly basis

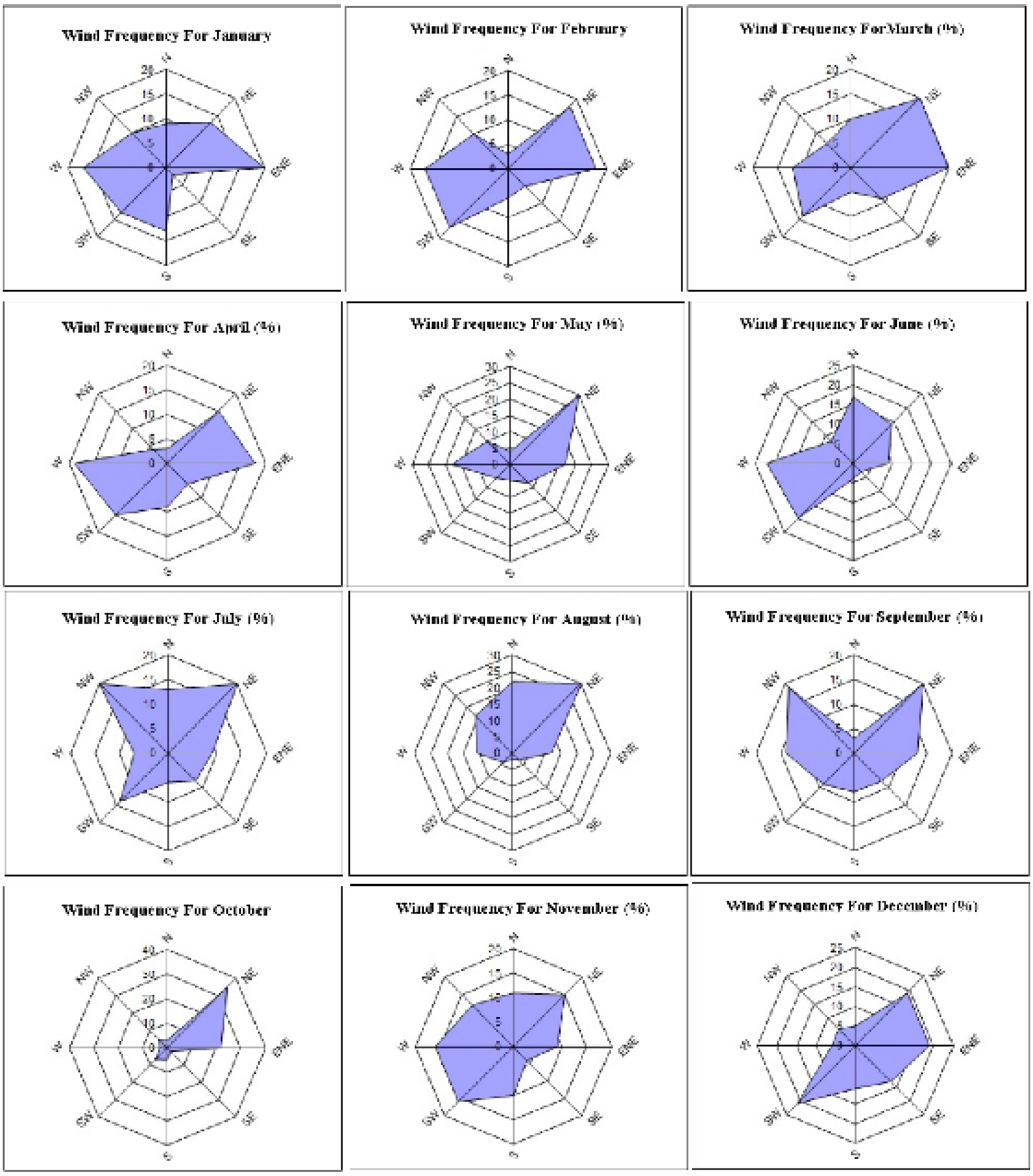


Figure 6.22: Mid-Point - Wind Rose Diagrams for Long-Term on monthly basis

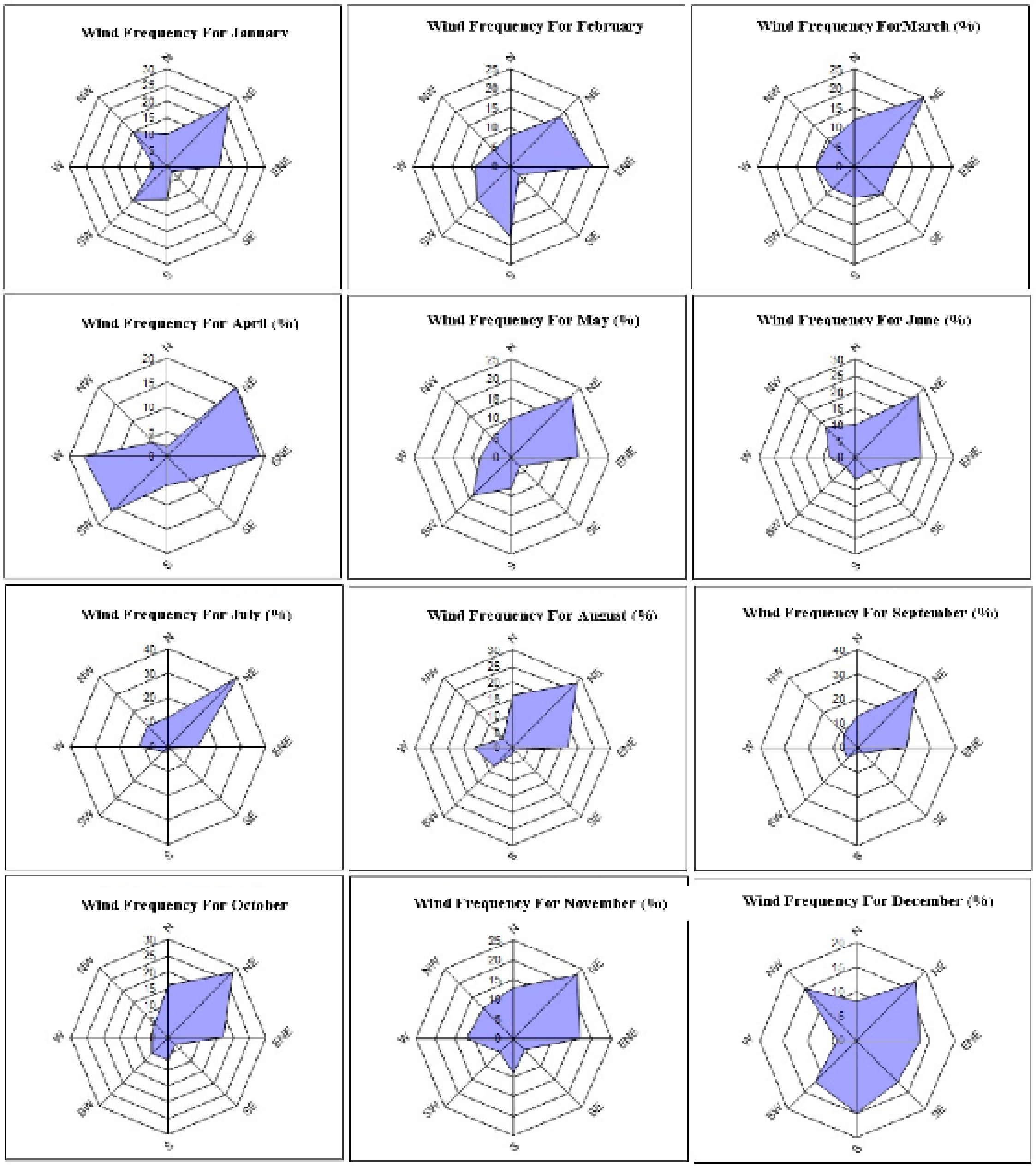


Figure 6.23: Western Point - Wind Rose Diagrams for Long-Term) on monthly basis

The average wind speed values in all Directions for multiple years: According to the Black Sea Meteorological Atlas prepared by Turkish Naval Force; the average wind speeds for all directions are shown in **Tables 6.11- 6.13** and also a diagram of the long term average wind speeds for all wind directions are given in **Figure 6.24**.

Table 6.11: Long Term (Multiple years) Average Wind Speeds for all Wind Directions at the Eastern Point along the Project Area

Direction	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
N	15	14	11	17	6	11	15	16	15	9	18	16	13,58
NE	22	9	19	10	13	7	11	14	12	12	13	17	13.25
E	19	14	9	11	14	10	5	9	11	6	9	21	11.50

Direction	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
SE	9	18	13	11	5	6	9	8	9	12	9	18	10.58
S	16	14	10	10	5	9	6	2	11	3	16	11	9.41
SW	16	12	13	11	6	9	10	8	3	7	11	18	10.33
W	13	10	13	11	9	12	11	10	6	7	10	8	10.00
NW	22	12	13	22	5	11	10	10	10	9	14	19	13,08

Table 6.12: Long Term (Multiple years) Average Wind Speeds for all Wind Directions at the Midpoint along the Project Area

Direction	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
N	15	16	16	13	12	10	9	6	10	11	23	14	12.92
NE	15	17	15	13	8	11	11	11	13	13	13	16	13.00
E	16	11	10	10	11	9	8	10	12	11	11	12	10.92
SE	9	10	7	10	24	9	4	11	8	8	9	11	10.00
S	13	12	10	6	7	11	3	11	8	6	14	15	9.67
SW	14	11	7	13	9	7	17	4	9	7	11	14	10.25
W	15	11	8	10	9	9	8	4	10	9	12	8	9.42
NW	17	11	11	13	10	9	10	9	14	10	20	14	12.33

Table 6.13: Long Term (Multiple years) Average Wind Speeds for all Wind Directions at the Western Point along the Project Area

Direction	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
N	15	14	11	17	6	11	15	16	15	9	18	16	13.58
NE	22	9	19	10	13	7	11	14	12	12	13	17	13.25
E	19	14	9	11	14	10	5	9	11	6	9	21	11.50
SE	9	18	13	11	5	6	9	8	9	12	9	18	10.58
S	16	14	10	10	5	9	6	2	11	3	16	11	9.41
SW	16	12	13	11	6	9	10	8	3	7	11	18	10.33
W	13	10	13	11	9	12	11	10	6	7	10	8	10,00
NW	22	12	13	22	5	11	10	10	10	9	14	19	13.08

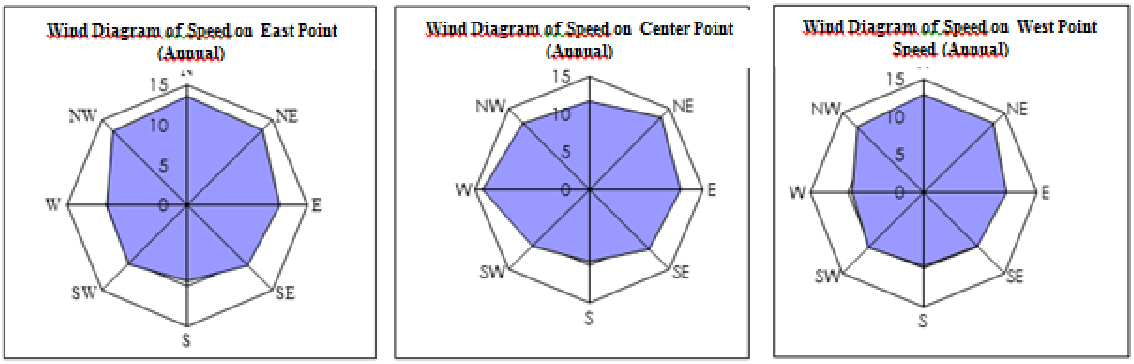


Figure 6.24: Diagram of Long Term Average Wind Speeds for all Wind Directions

6.1.2.7. Fog

Due to the prevailing atmospheric conditions towards the centre of the Black Sea, the occurrence of fog is far less common than what is observed on or near to the Black Sea coastline of Turkey.

6.1.3. Meteorological and Climatic Impacts on Local and Regional Climatic Conditions which may arise during the Works and Procedures within the scope of the Project and Measures to Control and Mitigate these Impacts (Construction, Operation and Decommissioning)

The potential meteorological and climatic impacts have been assessed based on the anticipated activities related to the Construction, Operational and Decommissioning Phases of the Project. Detailed information on the Project phases are given in **Section 1.5** of this EIA Report. A list of the activities associated with the Project phases is given in **Table 6.14**.

Table 6.14: Project Phases and Activities

Phase	Activity	Impact
Construction	Mobilisation of vessels to and from site and vessel movements within construction spread.	Deterioration of air quality from the release of emissions from vessel engines.
	Helicopter operations for crew changes.	Deterioration of air quality from the release of emissions from helicopter engines.
Operation	Mobilisation of vessels to and from pipeline locations and vessel movements along pipeline (Pipeline condition survey)	Deterioration of air quality from the release of emissions from vessel engines.
Decommissioning (Pipeline left in situ)	Vessel operations associated with inspection surveys.	Deterioration of air quality from the release of emissions from inspection survey vessel engines.
Decommissioning (Pipeline removed from seabed)	Vessel operations associated with the removal of the pipeline.	Deterioration of air quality from the release of emissions from vessel engines and equipment.

The assessment of impacts on air quality has been conducted in line with **Chapter 2 Environmental Impact Assessment Approach** of this EIA Report. An assessment of impacts compared to relevant national standards is given in **Chapter 9 Assessment of Project Activities** of this EIA Report.

Table 6.15 lists the controls which have been built into the design to limit potential impacts on air quality.

Table 6.15: Design controls

Design Controls	Receptor
Use of modern, fuel efficient vessels and equipment, where possible.	Air Quality
Compliance with relevant provisions of MARPOL 73/78 (as described in Section 9.7 of this EIA Report) relating to ODSs, emissions to air from engines and waste incineration, fuel oil specification, and discharges of waste waters and wastes.	
Regular maintenance checks of engines and equipment.	

6.1.3.1. Impacts from Construction

Emissions from construction activities could contribute to localised and temporary air quality deterioration. The major part of the emissions will be produced by the fuel combustion in the vessels' engines. The resulting primary pollutants will be Nitrogen Oxides (NO_X), Carbon Monoxide (CO), Sulphur Oxides (SO_X) and Particulate Matter (PM). Given the limited quantities of wastes anticipated, the fact that any on board incineration would be in compliance with MARPOL 73/78 and IMO Specification, and the large distance between offshore vessels and sensitive receptors, incinerator emissions have been scoped out of this EIA Report.

The Project's emissions of NO_2, CO, SO_2 and PM_{10} have been modelled and, in the absence of limit values applicable to the central Black Sea, compared to the limit values set by the Regulation on Assessment and Management of Air Quality (RAMAQ) issued in the Official gazette dated 06.06.2008. Air Modelling Report is given in **Appendix 6.A** and results are detailed in **Chapter 9 Assessment of Project Activities** of this EIA Report.

The maximum modelled Project's contribution for NO2, CO, SO2 and PM10 during construction was all less than 9 % of the applicable standards within the Project Area.

Furthermore, the modelled distribution of Project's contribution for these pollutants shows that values on the Turkish coastline are below 3 % of the applicable standards.

Based on the above, the Project's design controls are considered sufficient to minimise impacts on air quality from construction activities. As such, no mitigation is proposed.

6.1.3.2. Impacts from Operation

Emissions from activities associated with the operation phase could contribute to localised and temporary air quality deterioration. They will be limited to emissions from vessel mobilisation required by the periodic inspections and maintenance of the pipelines and will be much lower than the emissions from construction activities. During operation, the Project's contribution within the Project Area and along the Turkish coastline, for NO_2, CO, SO_2 and PM_{10} will therefore be substantially below the above referenced limit values.

Based on the above, the Project's design controls are considered sufficient to minimise impacts on air quality from operation. As such, no mitigation is proposed.

6.1.3.3. Impact from Decommissioning

At the time of writing this EIA Report, the strategy for decommissioning is unknown. If the pipelines are to be left in situ, emissions would be limited to those of the inspection survey vessels. If the pipelines are removed from the seabed, emissions from decommissioning activities are expected to be similar to those from the construction activities described in **Section 6.1.3.1** of this EIA Report.

6.1.3.4. Impacts from Emergency Situations

In the event of an emergency event such as a fire on-board, air quality could potentially be impacted. Emergency situations will be managed in line with the Project's Emergency Response Plan.

Fires on-board are covered by this document which includes provisions regarding fire detection and fire-fighting systems. Good baseline air quality, distance offshore and meteorological conditions in the Project Area (as discussed in **Section 6.1.2**) suggest that airborne pollutants are expected to be rapidly dispersed. Impacts associated with a fire on-board are likely to be local, reversible, short-term and are not expected to reach any receptor on the Turkish coastline (this is discussed further in **Section 9.8**). In the event of a loss of pipeline containment, impacts are likely to be minimal because as the gas travels approximately 2,000 m to surface waters it will become dispersed across a wider area by water movement.

6.1.3.5. Mitigation Measures

At this point, there are no mitigation measures envisioned to be undertaken since the modelling results show that the ambient air quality limits will not be exceeded during the construction phase and operation phases.

6.2 Geological Characteristics of the Black Sea

6.2.1. General Geological Features of the Black Sea

6.2.1.1. Sedimentation

The Black Sea watershed drainage area is about 1,864,000 km^2 (**Figure 6.25**) which is made of the Russian Platform area (85%) and the high mountain areas (15%) (Ref. 6.9). The Danube is the most important river draining into the Black Sea, which together with the Dnester, Bug, Dneper, and Don which drain the Russian Platform areas have low discharge velocities. In the southwest, south and east, the Black Sea is surrounded by mountainous regions (Balkan, Pontic, and Caucasus mountains) which have numerous small, but extremely erosive, rivers. This sediment budget of the Black Sea can be seen from **Figure 6.25**.

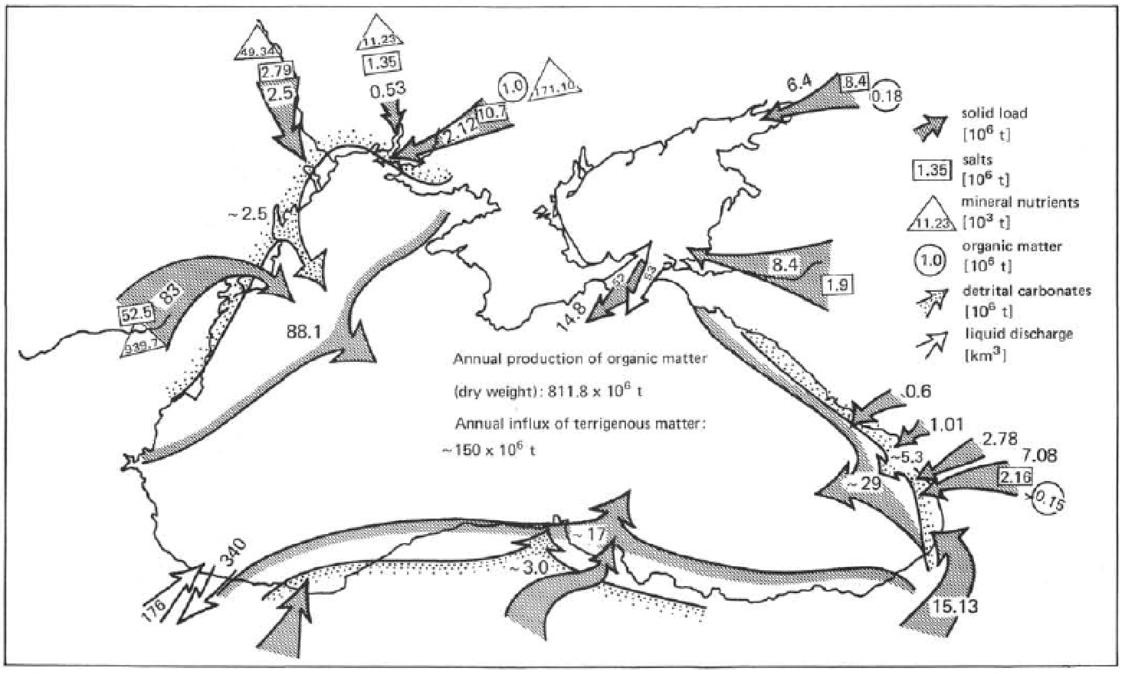


Figure 6.25: Supply of Sedimentary Material to Black Sea Basin on an Annual Basis (Ref 9 from Shimkus and Trimonis, 1974) [URS to replace with higher quality image]

The sediment pattern in the near shore zone of the Black Sea is reported to be governed by surface and long shore bottom currents and wave action (Ref. 6.9). In the deep basin, the sediment pattern is controlled by an isolated cyclonic current system and bottom morphology.

Large quantities of detritus from the rivers which feed into the Black Sea are deposited and trapped on the broad western shelf, whereas the terrigenous (sediments derived from the erosion of rocks on land) material derived from Pontic and Caucasus mountains, and Crimean peninsula crosses the narrow shelf and enters the deep basin, often in the form of turbidite (sedimentary rock composed of layered particles that grade upward from coarser to finer sizes) deposits.

Textural analyses of cores from the western and eastern basins reflect these differences in the shelf morphology. A rather uniform sedimentation pattern of mainly fine-grained material predominates in the western basin, whereas abundant turbidites and silty material in the cores off the eastern coast indicate high variability in the sedimentation pattern (Ref. 6.9).

Recent sedimentation in the Black Sea is governed by the deposition of terrigenous allochthonous (a large rock which has been moved from its original site of formation, usually by low angle thrust faulting) material of low carbonate content and the production of large quantities of biogenic carbonate material (in the form of microscopic calcite plate plankton forming chalk and limestone deposits known as coccolithophorids).

The highest clay and carbonate content is in central area of the western and eastern basins. Because the biogenic constituents are composed of clay-sized calcite, the total carbonate content, as well as the amount of the >2 micrometre (μm) fraction, increase simultaneously with the coccolithophorids portion. **Figure 6.26** shows the compositional types of the sediments found in the Black Sea.

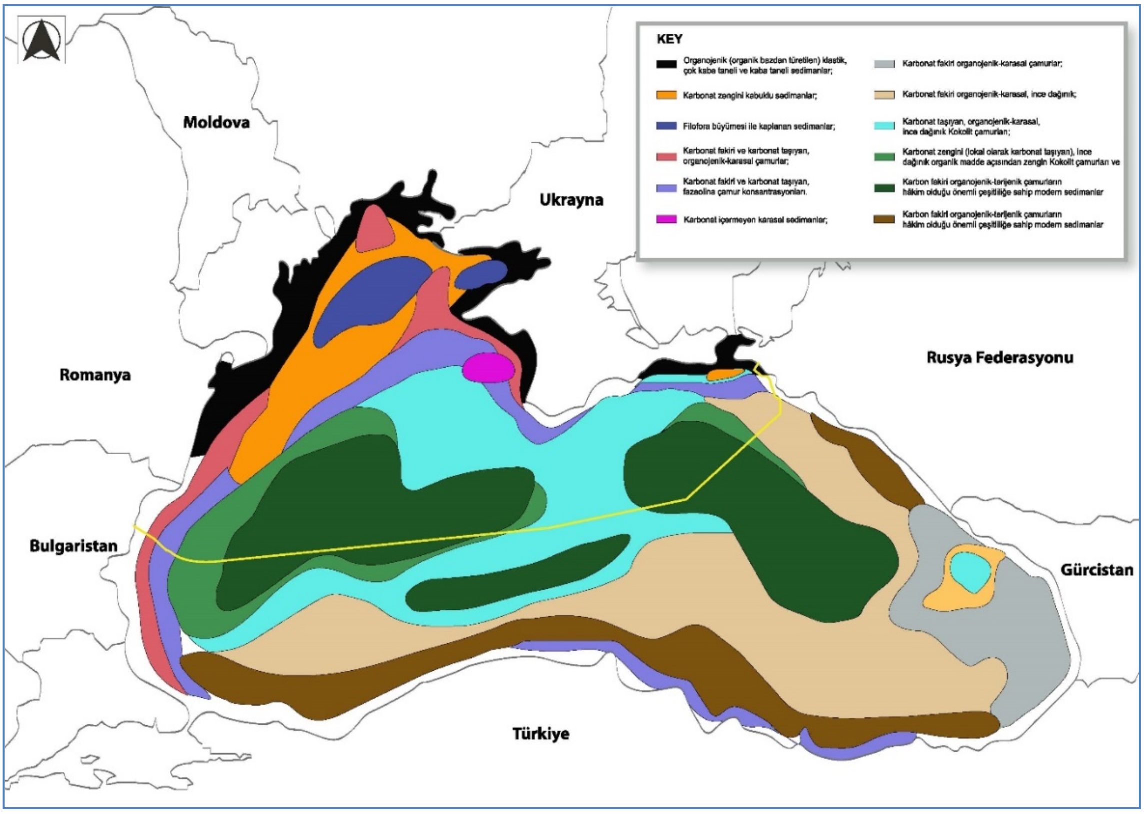


Figure 6.26: Generic Types of Modern Black Sea Sediments (Ref. 6.10)

The sediments can be divided into shallow and deep water sediments compositional-genetic type classification. The shallow water sediments are:

1) Organogenic (derived from organic base)-clastic, very coarse-grained and coarse-grained sediments;
2) Carbonate-rich shelly sediments;
3) Sediments covered by overgrowth of Phyllophora;
4) Carbonate-poor and carbonate-bearing, organogenic-terrigenousmuds;
5) Carbonate-poor and carbonate-bearing phaseolina muds concretions.

Deep-water sediments (based on Figure 6.26 numbering):

6) Carbonate-free terrigenous sediments;
7) Carbonate-poor organogenic- terrigenous muds;
8) Carbonate-poor, organogenic-terrigenous, finely dispersed;
9) Carbonate-bearing, organogenic-terrigenous, finely dispersed Coccolith muds;
10) Carbonate-rich (locally carbonate-bearing), finely dispersed Coccolith muds rich in organic matter; and
11) Modern sediments of considerable diversity with predominance of carbon-poor organogenic-terrigenic muds.

Stratigraphic studies (**Figure 6.27**) based on piston cores revealed three distinct sediment units which can be correlated over most of the Black Sea. The top unit (Unit 1), which is about 30 cm thick, consists of alternating white carbonate and dark lutite layers (fine-grained, sedimentary rocks, which are composed of silt-size sediment, clay-size sediment, or a mixture of both). The white layers consist almost entirely of coccoliths. Unit 2 is a dark brown jelly-like sapropel (unconsolidated sedimentary deposit rich in bituminous substances) having as much as 50% organic matter. Thin layers of inorganically precipitated aragonite (carbonate mineral) often occur within this unit. Unit 3 is an alternating sequence of dark and light lutites consisting of clastic material with a low content of carbonate and organic matter.

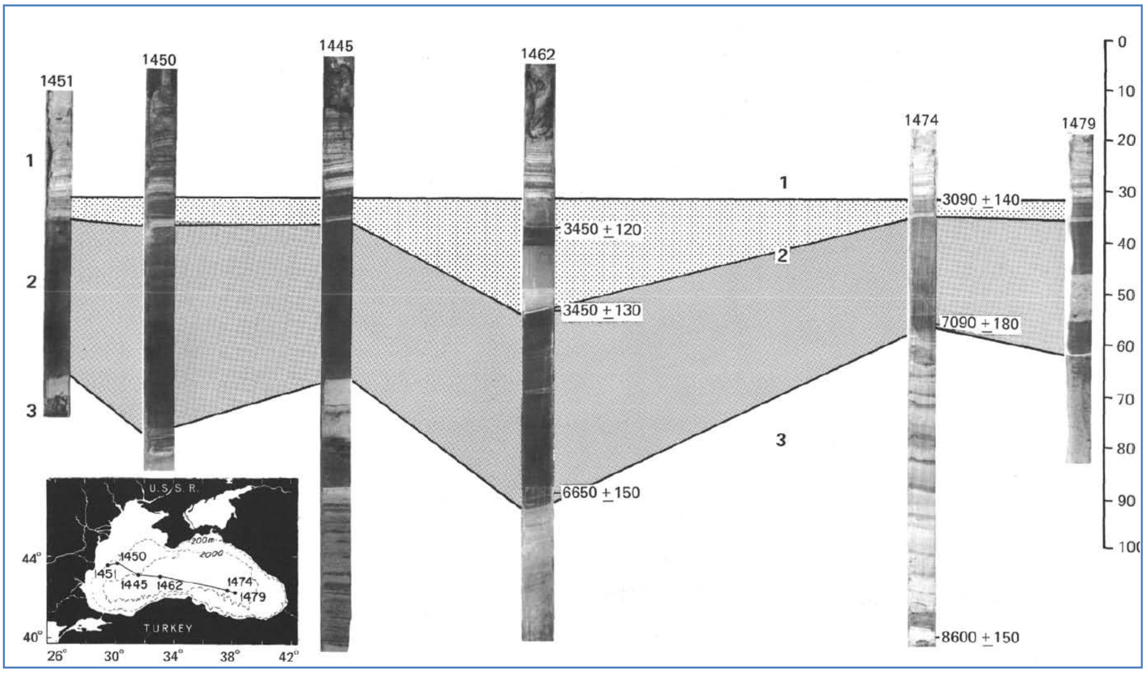


Figure 6.27: Sediment Profile of Some Cores (Ref. 6.11) Numbers show the depth ranges

Drilling explorations were conducted by the Woods Hole Oceanographic Institution in the Black Sea in 1974 in order to obtain a Pleistocene stratigraphic section (Ref. 6.12). Late Cenozoic sediments were recovered by drilling and continuous coring at three sites shown in **Figure 6.28**. A considerable thickness of Pleistocene strata was obtained at Site 379 without reaching their base. Two boreholes were drilled on the continental slope at depths of 2,115 and 1,750 m near the Bosphorus Strait.

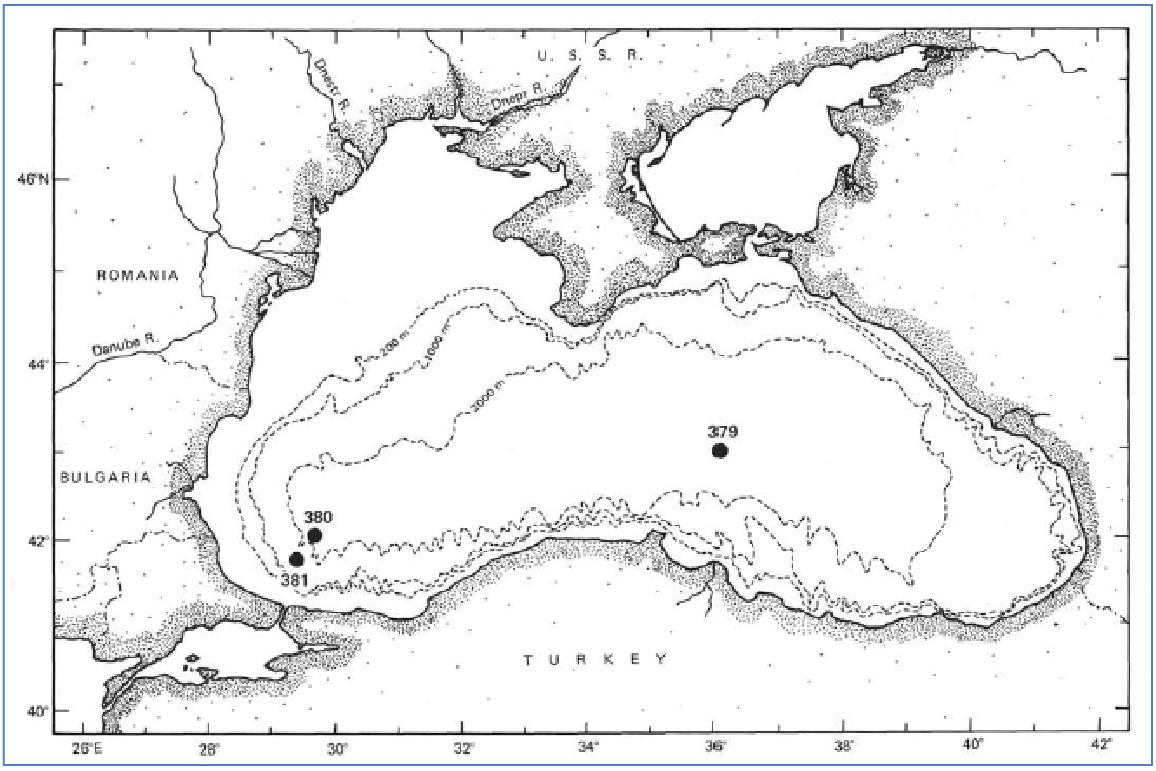


Figure 6.28: Drilling Locations (Ref. 6.12)

Pleistocene sediments at all three sites were mainly represented by terrigenous muds, silts, and fine sandy interbeds. The sedimentation conditions in the basin at this time were closely connected with the climatic fluctuations (**Figure 6.29**).

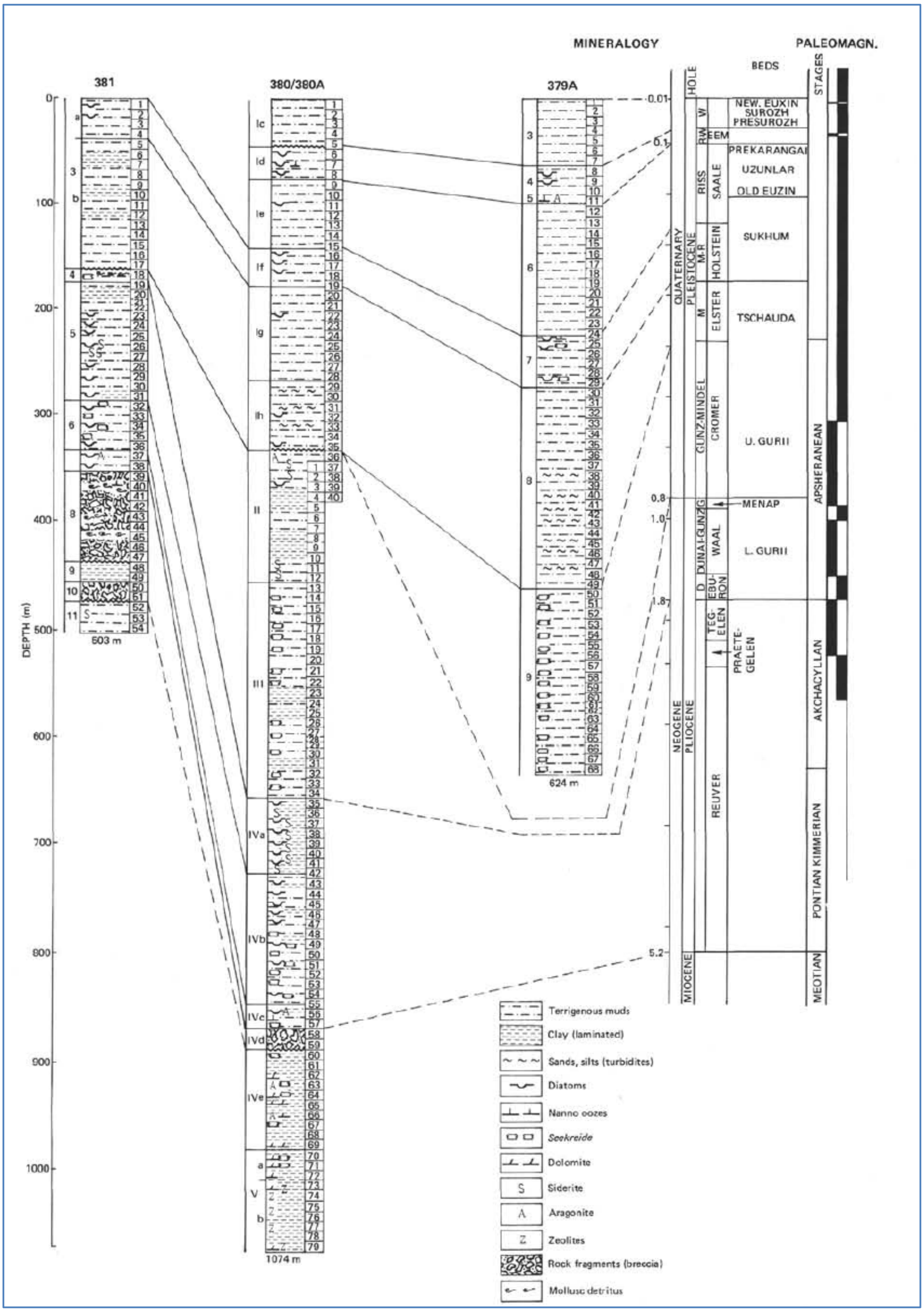


Figure 6.29: The cross section from the boreholes (Ref. 6.12)

6.2.1.2. Bathymetry

The bathymetry of the Black Sea generally parallels the topography of the adjoining land mass as shown in **Figure 6.30-6.31**. The Black Sea basin can be divided into four physiographic provinces (Ref. 6.13):

- Shelf: around 29.9% of the total area of the sea in water depths of around 0-110 m (max-160 m);
- Basin slope: around 27.3%, in water depths of 110 to 1,500 m;
- Basin apron: around 30.6%, at around 1,500 m depth); and
- Abyssal plain: around 12.2%, in water depths of over 1,500 m.

Black Sea bathymetry is characterised by a relatively narrow coastal shelf running along the perimeter of a very deep and relatively flat interior basin. The northwest area is the only area with a coastal shelf of any significant extent. Here the alluvial discharge planes of the Danube, Dnieper, Dniester, and Yuzhny (South) Bug Rivers extend a considerable distance offshore.

Near the Caucasian and Anatolian coasts the shelf is only a narrow intermittent strip. The shelf along the Crimean, the Caucasian and Anatolian coasts predominantly consists of an abrasion type of relief, with Meso- Cenozoic folded formations that have been heavily eroded in places.

Underwater valleys and canyons make the even, flat relief of the shelf more complex. Well defined underwater canyons belonging to rivers such as the Yeşilırmak, the Kızılırmak and the Karasu can be found near the Anatolian shore (Ref. 6.14).

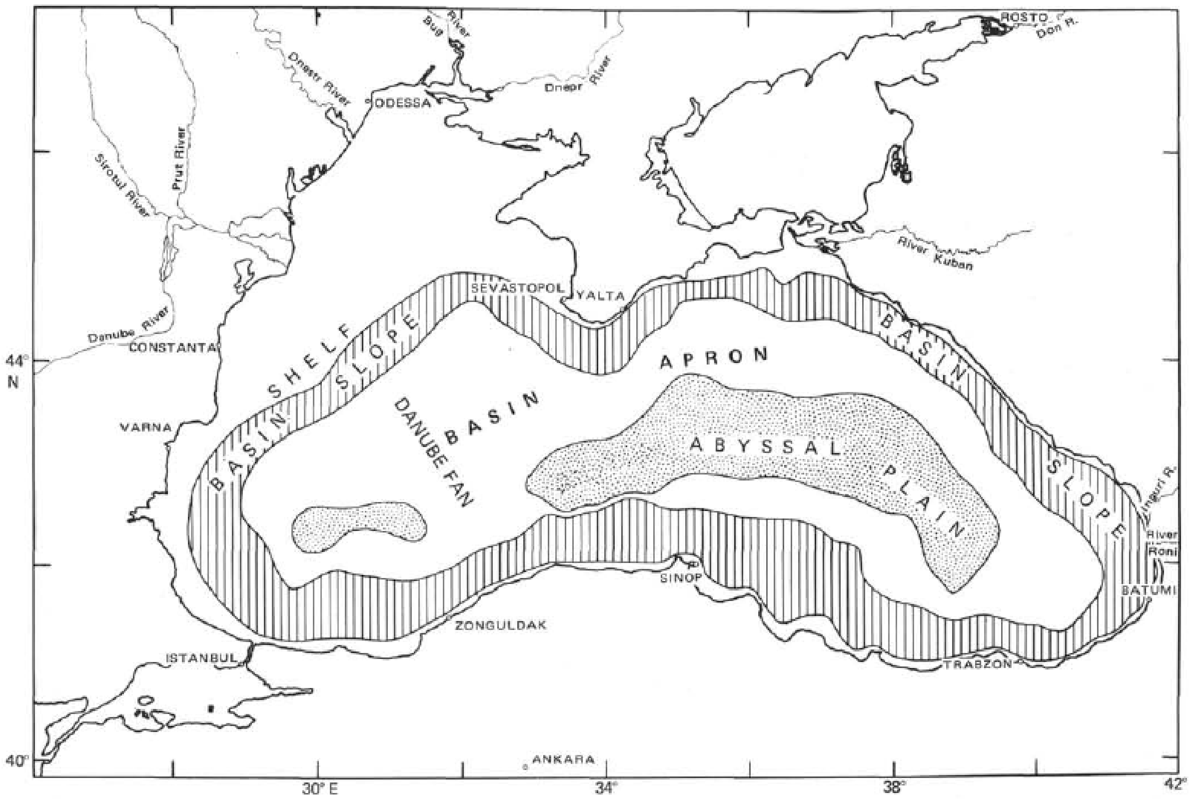


Figure 6.30: Main Physiographic Features of the Black Sea (Ref. 6.15)

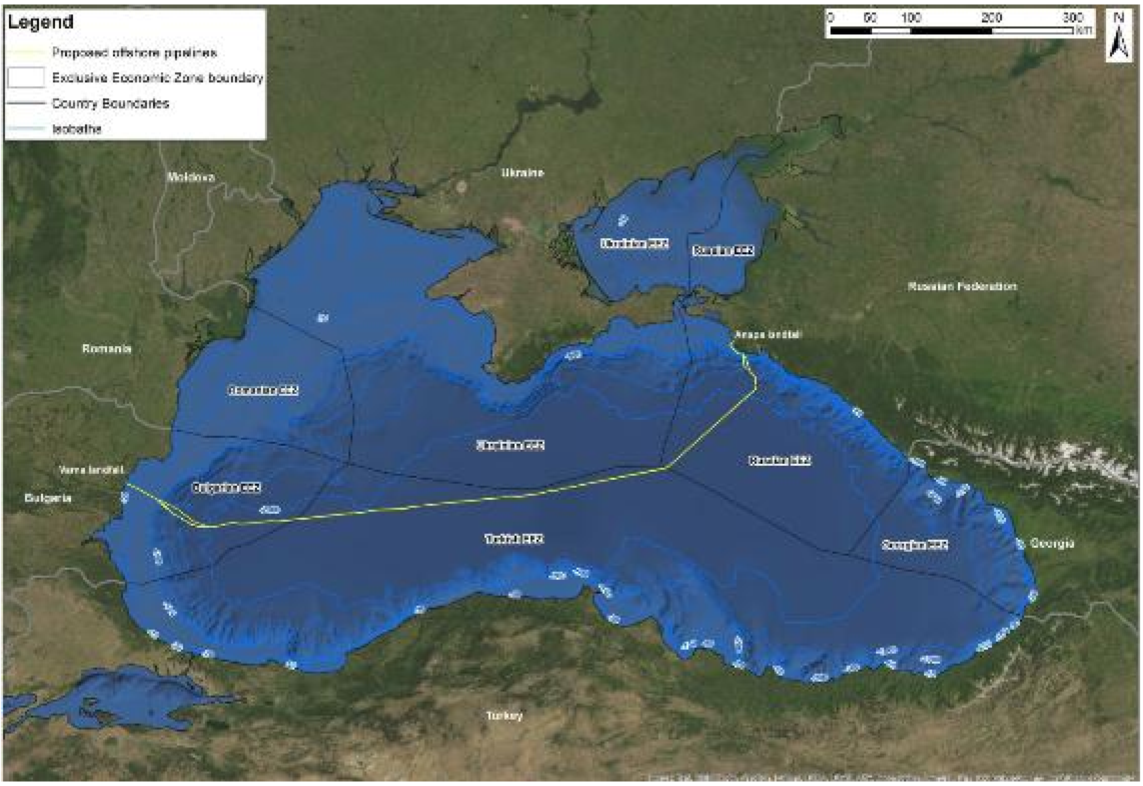


Figure 6.31: General Bathymetry of the Black Sea

Often the boundary between the continental shelf and continental slope has a tectonic origin. In the interval between Anapa and Gelendzhik the continental slope is erosive at the top, structural-erosive at the bottom in the east, and accumulative in the west (within paleodeltas of the ancient rivers Don and Kuban). Many parts of the continental slope are characterised by gravitational slope processes: avalanches, landslides and mass flows (Ref. 6.14).

Both Russian and Bulgarian continental slopes are characterised by complex segmented, branching systems of V shaped canyons which change into broad U shaped valleys in the deeper parts. The tops of submarine canyons are usually confined to the river mouths crossing the shelf and converging at the shelf edge, and then inflowing to the canyon mainstream, which cuts through the continental slope. The bottom of the canyons in the upper continental slope is covered with debris flow sediments and landslide masses that contain a significant amount of boulder-block inclusions. At the end of the canyon the debris fans of various orientations, which are often cut through by fluvial runoff channels, are visible (Ref. 6.14).

At the bottom, the continental slope flattens out and goes into the basin apron. The boundary between the continental slope and the continental rise is marked by a significant decrease in the slope of the seabed (angles of less than 1°). The lower boundary of the continental rise is approximately 2,000 m and delineates the area of the abyssal plain. The greatest width (up to 90 to100 km) of continental rise is in the north-western, north-eastern and south-eastern parts of the Black Sea.

The central region of the Black Sea basin is the abyssal plain, which is situated at the depths of 2,000 to 2,200 m. The bottom of the basin is a flat accumulative plain with a gentle slope to the south. Its area inside the 2,000 m depth contour comprises about 34% of the total area of the Black Sea. The Andrusov uplift, which is poorly manifested in the bottom topography, together with the Arkhangel'skii Rise, which is its southern continuation, divides the central Black Sea depression into its western and eastern parts.

Literature survey indicates that seabed features are present in the abyssal plain which are typically formed by mud volcano activity and may be 1 to 30 m high and 600 to 1,000 m wide. Ravines are typically associated with tectonic faults, are generally asymmetric in shape, with one relatively steep slope (typically 10 to 20 m deep) and one comparatively flatter slope; although some symmetrically shaped gently inclined ravines are also encountered. Ravines are typically between 500 to 1,000 m in length (minimum of 200 m and maximum of 4,500 m).

6.2.1.3. Fault Lines, Seismicity and Seismic Risks

At present the basin is framed by folded structures to the north, northeast, south, and southwest; to the northwest it borders on the Epihercynic platform, which forms part of the Black Sea shelf between the Balkan Peninsula coast and the Crimea. The tectonic map of the Black Sea Region is shown in **Figure 6.32** (Ref. 6.16).

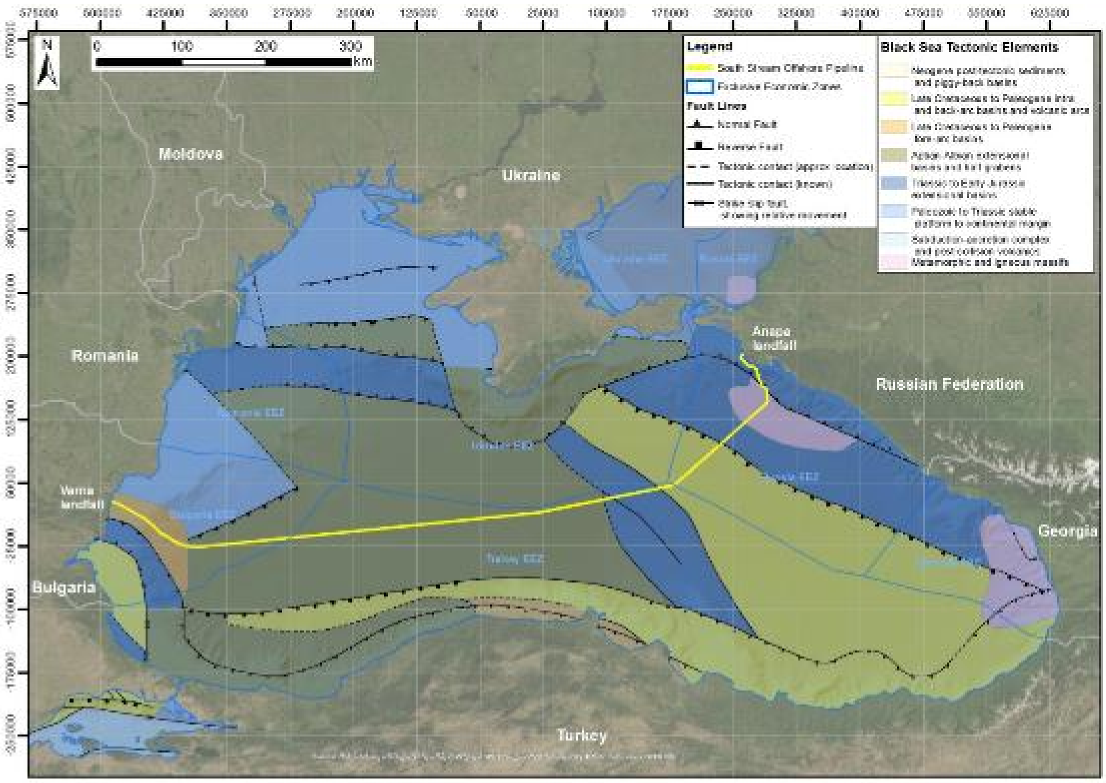


Figure 6.32: Tectonic Map of the Black Sea Region (Ref. 6.16)

The following tectonic structures from east to west are present in the Black Sea:

- *West-Utrish fault:* It has north-northwest orientation with a length is 48 km. Some experts indicate that the extensive development of blocks of gravitation-tectonic subsidence (**Figure 6.32**) in elevated wing of West-Utrish fault is an indication of current activity. Offshore surveys (Ref. 6.17) did not identify activity along the West-Utrish fault.
- *Tuapse trough*: It is 60-70 km wide and has an asymmetric structure: the north-eastern slope of the basin is very steep, while the southern slope (Shatsky uplift surface) is gentle.

- *Main Caucasian thrust*: It possesses regional character and west-north-western strike. Main Caucasian thrust is a large-scale shearage along which the Transcaucasus under-rides the Great Caucasus.
- *The Shatsky uplift*: It is a massive uplifted block of earth crust that forms the north-eastern margin of the deepwater Eastern Black Sea. It has a rough asymmetric form with a very steep south-western slope and a gentle north-eastern slope.
- *The Eastern Black Sea basin:* The maximum depth of the pre-Cenozoic bedrock in the basin is 13 to15 km, with its average depth under the abyssal plain of 12 km.

There are several hundred meters of Mesozoic sediments within the Eastern Black Sea basin margins and on the Andrusov uplift between the consolidated bedrock and Cenozoic strata (Ref. 6.16). These sediments are faulted and with the bedrock they form inclined blocks that underlay almost the entire basin. Seismic data indicates that Cenozoic sediments in the Eastern Black Sea basin are almost undisturbed by fault dislocations (**Figure 6.33**).

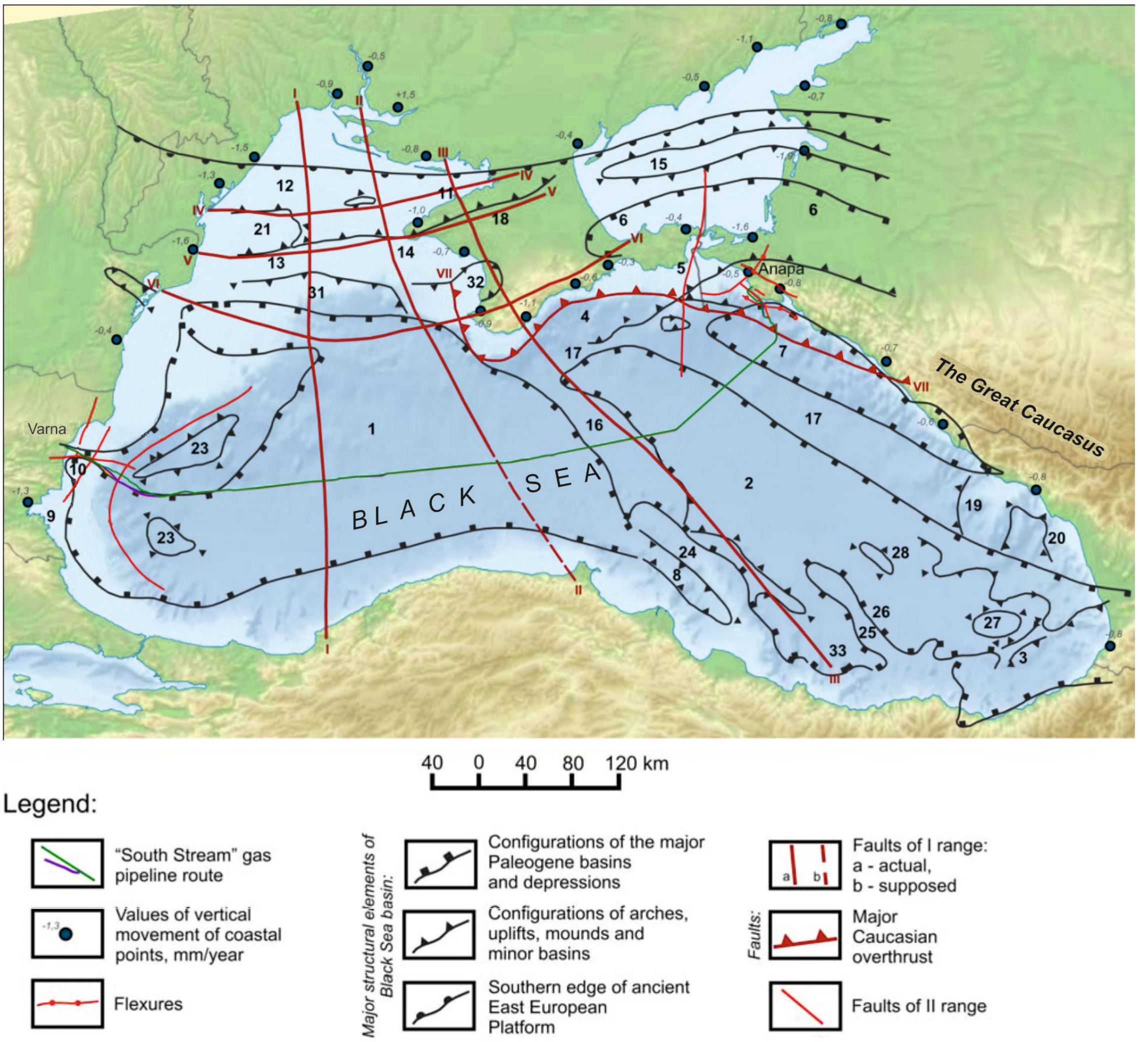


Figure 6.33: Black Sea Structural and Tectonic Classification Scheme (Ref. 6.18)

Numbers on the map indicate:

Major basins: 1- West Black Sea 2– East Black Sea;

Troughs: 3- Gurian, 4- Sorokin, 5- Nerchensk-Taman, 6- Indol-Kuban, 7- Tuapse, 8- Sinop, 9- Burgas, 10- Nizhnekamchinsk, 11- Kakitin, 12- Krylov;

Uplifts: 13- Gubkin, 14- Kalamitsk, 15- Azov, 16- Andrusov, 17- Shatsky;

Arches: 18- Crimean, 19- Gudauta, 20- Ochamchira;

Liftings: 21- Chilia, 22- Polshkov, 23– Druzhba, 24– Archangelsky, 25- Muratov, 26- Chikhachev, 27- Dzhanelidze, 28- Strakhov, 29– Bariernoye, 30- Golitsyn, 31– Krayevayastupen, 32- Alma Trench, 33- Giresunskaya Trench.

Roman numbers on the map indicate:

Regional faults: I- Odessa-Zonguldak, II- Western Crimea, III- Crimean-Eastern Pontic, IV- on the northern boundary of the Scythian plate, V- North Romanian-Crimean, VI- Central Romanian-Crimean, VII- South Crimean and the Main Caucasian thrust.

The seismic activity in the Black Sea is relatively weak. In central parts the seismicity is negligible; however, on the coasts moderate earthquakes have been recorded. There are two important seismic belts around the Black Sea; northern Turkey (the North Anatolian fault) and the Caucasus region. The North Anatolian fault is an east-west trending, highly active, right-lateral strike-slip fault. In the Caucasus region, active folding and thrusting is observed. The distribution of the epicentres between 1,900 and 2,000 (**Figure 6.34**), shows that the North Anatolian fault has produced strong seismic activity in historical times and present-day.

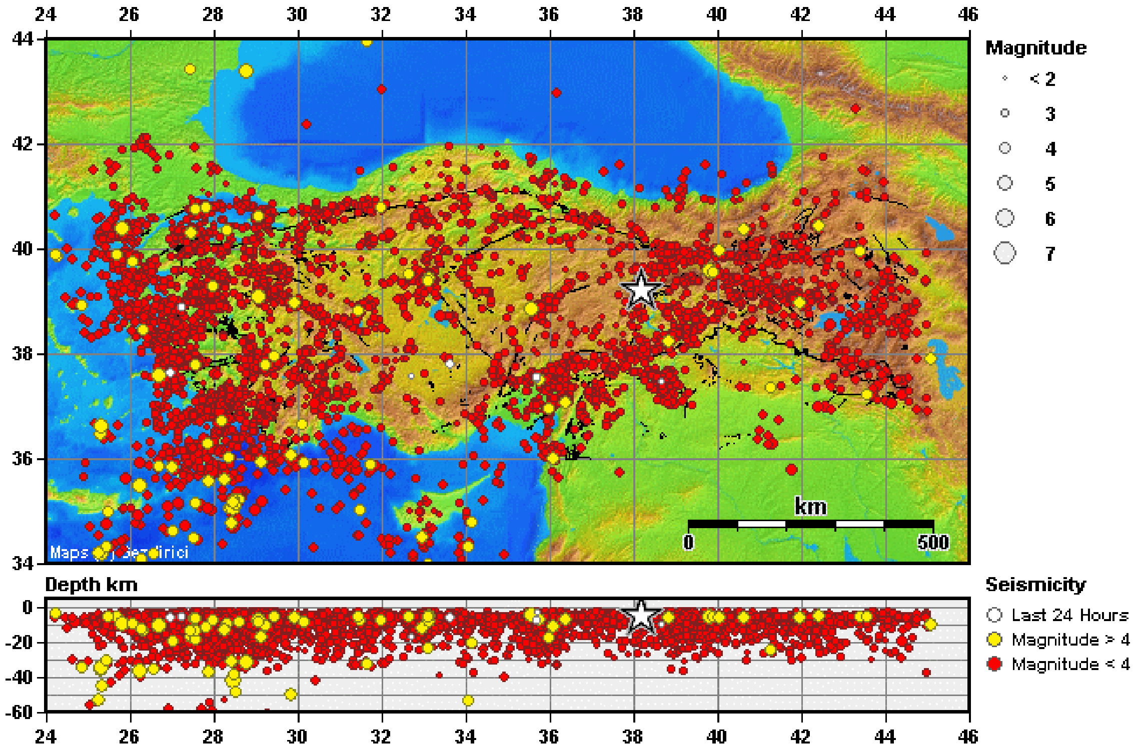


Figure 6.34: Map Schemes of Return Periods of Earthquakes of Varying Strength in Central and Eastern Parts of the Black Sea (Ref. 6.19)

Figure 6.35 shows seismic hazard map developed within the GSHAP Project (Global Seismic Hazard Assessment Project) for the Black Sea region (Ref. 6.17). The peak horizontal acceleration (PGA) values are 0.10g m/s^2 or less within the abyssal plain for recurrence interval of 1000 years.

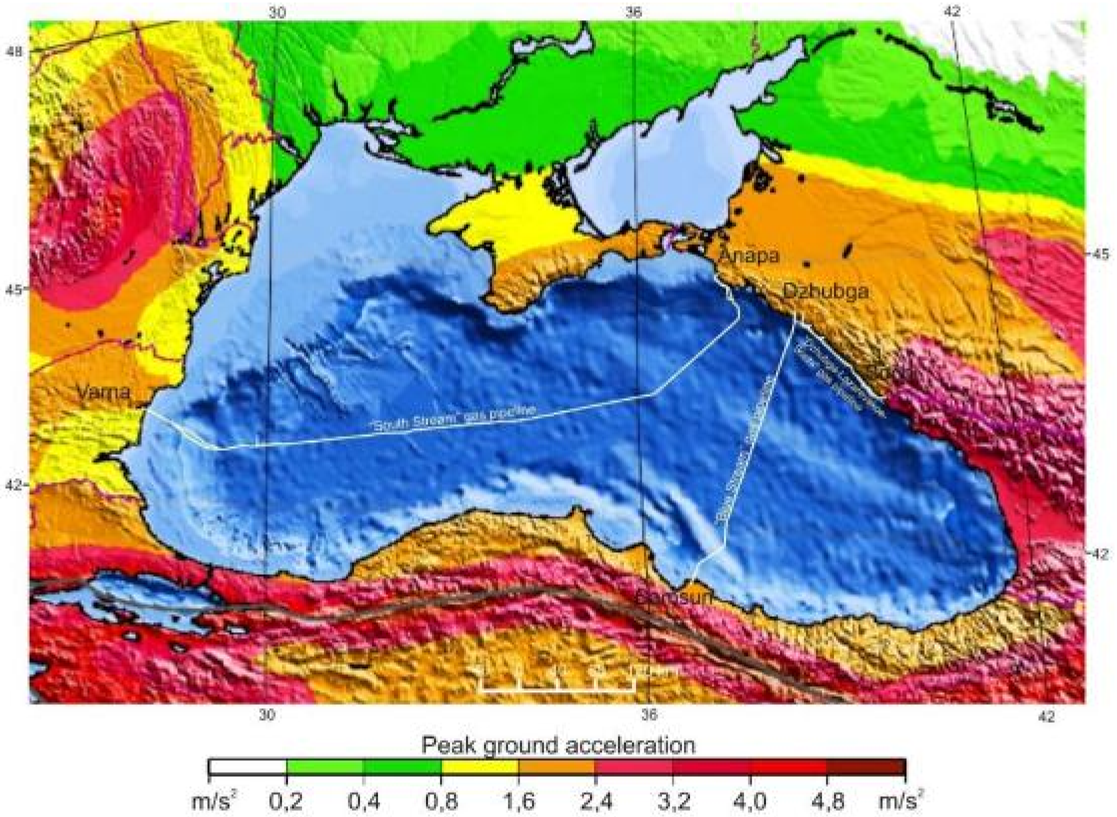


Figure 6.35: Fragment of seismic hazard map, constructed within the international project GSHAP, for the areas surrounding the Black Sea region. Note: The estimated seismic hazard is shown by colour in the units of the peak acceleration of ground vibration PGA (m/s^2) for the average recurrence interval T = 500 years. Calculated values of the accelerations relate to the typical stiff sedimentary soil, which approximately complies the soil of category II according to Russian Standard SNiP II-7-81.

The baseline seismicity assessment based on a probabilistic analysis was conducted as part of the seismic hazard estimation. The results showed that the 1,000 years recurrence interval peak ground accelerations change from Anapa to Varna from 0.33 to 0.28g m/s.

Mud volcanism is a manifestation of the release of natural gas on the seafloor from the deep sedimentary strata. Mud volcanoes of two main types are distinguished in the Black Sea: those along the periphery of the basin (Bulgaria, Kerch-Taman region) and those associated with fluidised sediment flow connected to ruptures on domes of gently sloping symmetrical anticlines in the central part of the Black Sea. Natural gas seeps on the bottom of the Black Sea are widespread on the continental margins and abyssal plain. Gas seeps on the abyssal plain are mainly associated with biogenic methane. In general, gas seeps in the Black Sea region are related to mud volcanoes and tectonic faults. A characteristic feature of some areas of the slope of the Black Sea (Bulgaria, Ukraine, and Turkey) is a high gas saturation of recent sediments and gas releases in the form of plumes (**Figure 6.36**). Numerous gas plumes in the water column were registered on the top of the Bulgarian and Ukrainian slopes down to depths of 650 to 700 m.

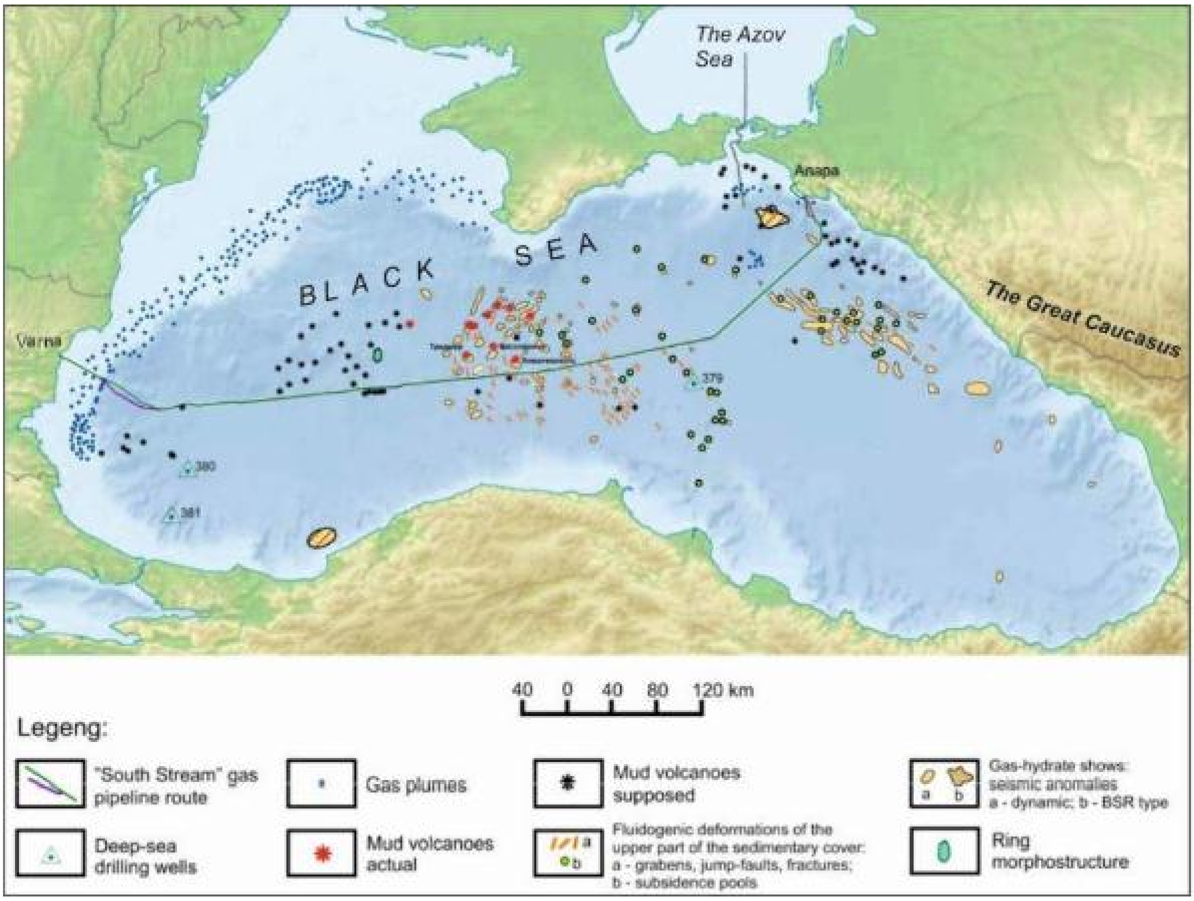


Figure 6.36: Mud Volcanism Features in the Black Sea (Ref. 6.17)

At the base of the Turkish slope (depth of 1,850 m) numerous tension fractures were identified as intensified Reflection horizons at the depths of 4 to 40 m from the seabed surface (probably the "gas pockets"), as well as the so-called "domes" (cones about 3 m high and 120 to140 m indiameter), possibly with an increased pore pressure in the thickness of constituent sediments. The abyssal plain also revealed a significant number of "flyuidogenic" deformations related to the rise of hydrocarbon fluids. They are represented by dislocations, small faults, small subsidence troughs and craters on the tops of very gentle anticlinal uplifts. The area of "flyuidogenic deformations" distribution is the same as the area of mud volcanoes, gas-saturated sediments, gas-hydrates. Development of landslide processes in the abyssal plain has not been detected and is not expected due to minor slopes of the seabed surface. Specific geohazard identification along the Project Area is given in **Section 6.2.2.6**.

6.2.2. Geology of the Seabed in the Project Area

6.2.2.1. The equipment and Systems Used

Engineering surveys were conducted during the Front End Engineering Design (FEED) process of the Project. The survey conducted within the Project Area aimed to:

- Identify bottom topography features;
- Evaluate the seabed morphology and subsurface geology;
- Establish geotechnical strength properties of the sediments; and
- Detect potential hazard objects and bottom topography features.

A number of vessels were used (RV Akademik Golitsyn, RV Professor Ryabinkin, RV Borey, RV Akademik, MB Angel boat "BH 7077 and GSP Prince) together with measuring instruments to perform the surveys. The measuring and sampling instruments (**Appendix 6.B** provides information on the equipment specifications used in the survey) included:

- Sound Velocity Profiler (SVP);
- Multi-Beam Echo Sounder (MBES);
- Single-Beam Echo Sounder (SBES);
- Sub-bottom Profiling (SBP);
- High-Frequency Sub-bottom Profiling (HF SBP);
- Low-Frequency Sub-bottom Profiling (LF SBP);
- Side-Scan Sonar (SSS);
- Autonomic underwater vehicle (AUV); and
- Cone Penetration Test (CPT), piston and grab samplers.

Information that was gathered from the surveys included geotechnical, geophysical, geomorphological, geohazards and sediment quality along the Project Area. These results were assessed to discuss the sediment characteristics, the bathymetry, geohazards and bathymetric features of the Project Area in this section of the EIA. Detailed results of the sampling programs are provided in **Appendix 6.C** and survey locations are given in **Appendix 6.D**.

Additional surveys were undertaken along the Project Area which was aimed at assessing the environmental characteristics of the sea bottom. These survey locations in the Turkish EEZ are shown in **Figure 6.37**. Quantitative chemical analysis of sediments was carried out according to the certified methods of measurement. The following characteristics were analysed: grain size composition, organic carbon, moisture, gross forms of metals (iron, copper, manganese, molybdenum, selenium, cadmium, nickel, zinc, lead, mercury, and chromium), arsenic, detergents, oil products and phenols.

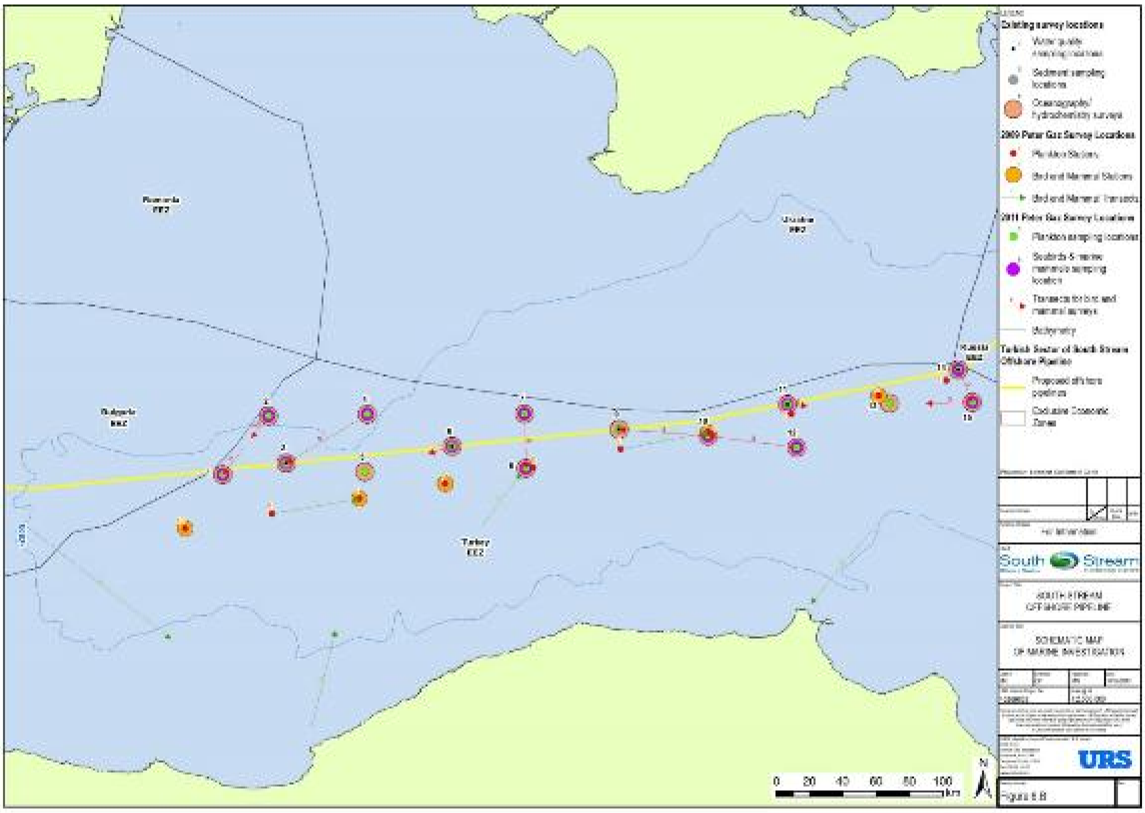


Figure 6.37: Survey Locations in the Turkish EEZ

6.2.2.2. Sedimentation

It was previously stated that the upper part of the sediments at the bottom of the abyssal plain along the Project Area is composed of a thick layer of terrigenous clay. The top layer of sediment (about 0.3 m) is of interest since the pipelines will be placed directly on top of this layer. Testing for water content, density, atterberg limits (tests which identifies the consistency and behaviour of a soil), particle size distribution, organic matter and carbonate content were conducted for classification of properties and soils at various sampling locations in the Turkish EEZ. The thermo-physical and geochemical soil properties were established by testing for thermal conductivity, conductivity, pH, carbonate and bicarbonate ions, chloride and sulphate ions and calcium and magnesium. Mechanical properties (including bearing strength) were assessed by triaxial (measures the mechanical properties of many deformable solids, especially soil) and oedometer testing(measures a soil's consolidation properties). The sampling results are given in **Appendix 6.C.** In summary:

Two hundred and forty six (246) sediment samples taken from sediment depths of between 0 to 7.0 m were tested for the above parameters. The results are summarised as follows:

- Two hundred and thirty four (234) samples were clayey soils and the remainder of the samples (12 samples) were sandy soils;
- Considerable organic content (6.8-66.2 %) was revealed in the samples;
- Approximately 60% of the soils belong to OH group (organic soils with high plasticity), 25% – to CH group (clayey soils with high plasticity) and the rest belonging to groups SM (silty sand) ML (silt) In accordance with American Society for Testing and Materials (ASTM);
- All the tested soils have shown the potential to adversely impact lead, aluminium and steel compounds;

- Approximately 80%of the tested soils have alkaline properties (pH>7) and the rest 20% have acid properties. (pH<7);
- The main part of the tested soils appeared to be slightly over consolidated with over consolidation ratio (OCR)varied between 0.4 and 2.7;
- The soils have high deformability, low strength and low permeability; and
- CPT test results show that the abyssal plain deposits (in the Russian, Bulgarian and Turkish EEZ) are presented in the top part by very soft organic clays.

Sediments collected for environmental characterisation from four deep stations (3, 6, 9 and 11 shown in **Figure 6.38**) also included testing for grain size, organic content and pH. The results of the fractional size analysis were converted into four key factions: gravel (10-1 mm), sand (1-0.1 mm), silt (0.1-0.01 mm) and pelite (<0.01 mm). A diagram showing the distribution of particle size of sediments on the main fractions is shown in **Figure 6.39**.

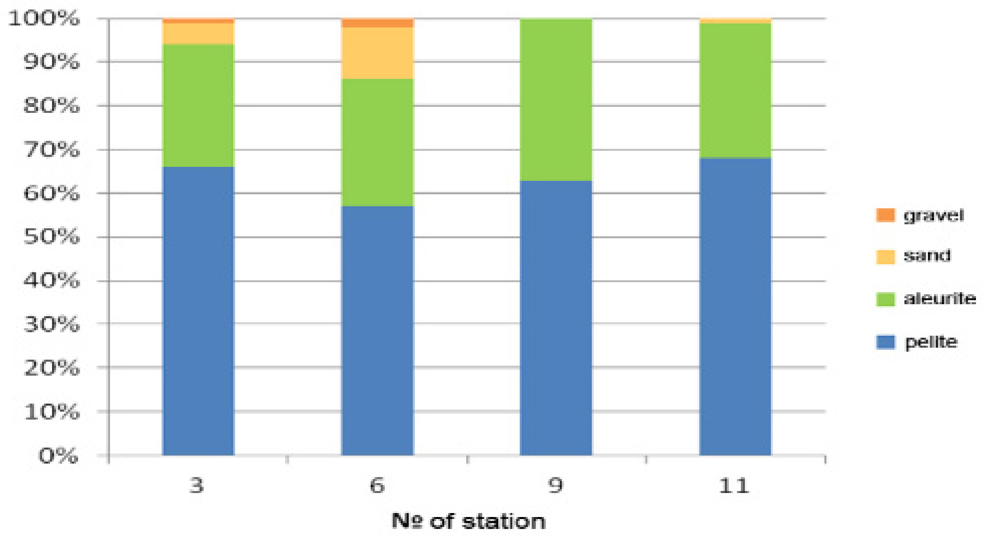


Figure 6.38: Grain Size Distribution of Sediments

Three out of four surveyed stations can be classified as silty clayey fine-grained clastic sediment and only at one station in the sediment there is slightly increased admixture of sand (**Figure 6.39**). The content of the main sediment fraction in all samples did not fall below 57% indicate lithologic homogeneity of the sediments of deep basins within the context of the survey.

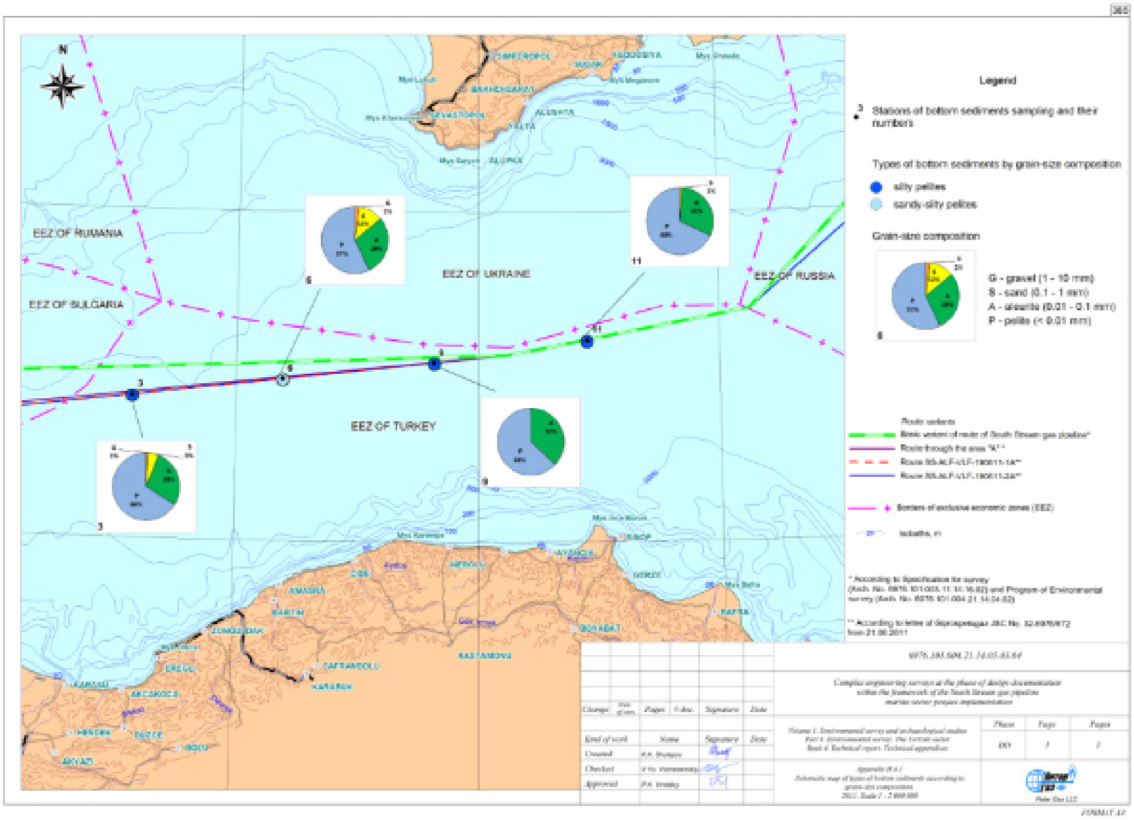


Figure 6.39: Grain Size Distribution

The content of the organic carbon in sediments varied from 0.9-1% (at Stations 9 and 11) to 3.3-3.4% (at Stations 3 and 6).There was no correlation between particle size of sediment and organic carbon content identified. The pH analysis of sediments characterises the sediment environment as a slightly alkaline. The pH varied from 8.1 to 8.7 (**Figures 6.40 and 6.41**).

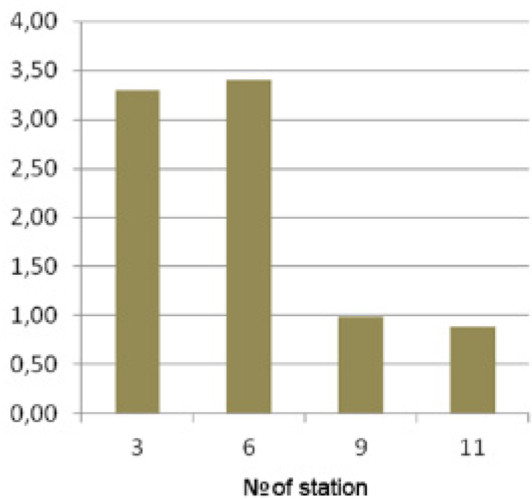


Figure 6.40: Content of Organic Carbon in Sediments (%)

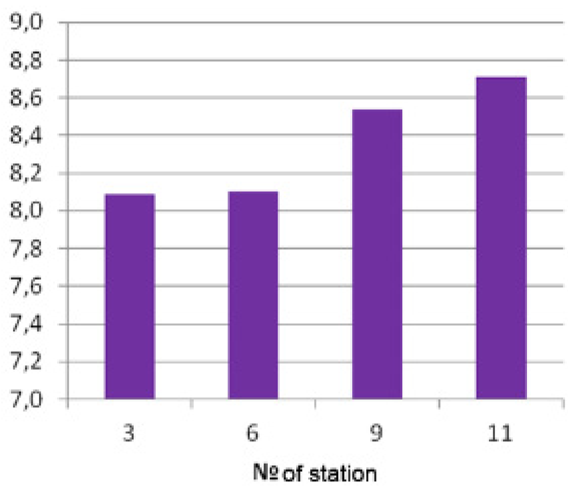


Figure 6.41:pH of Salt Extraction of Sediments

The geochemical assessment was conducted on the samples. The results are presented in **Figure 6.42** and **Table 6.16.**

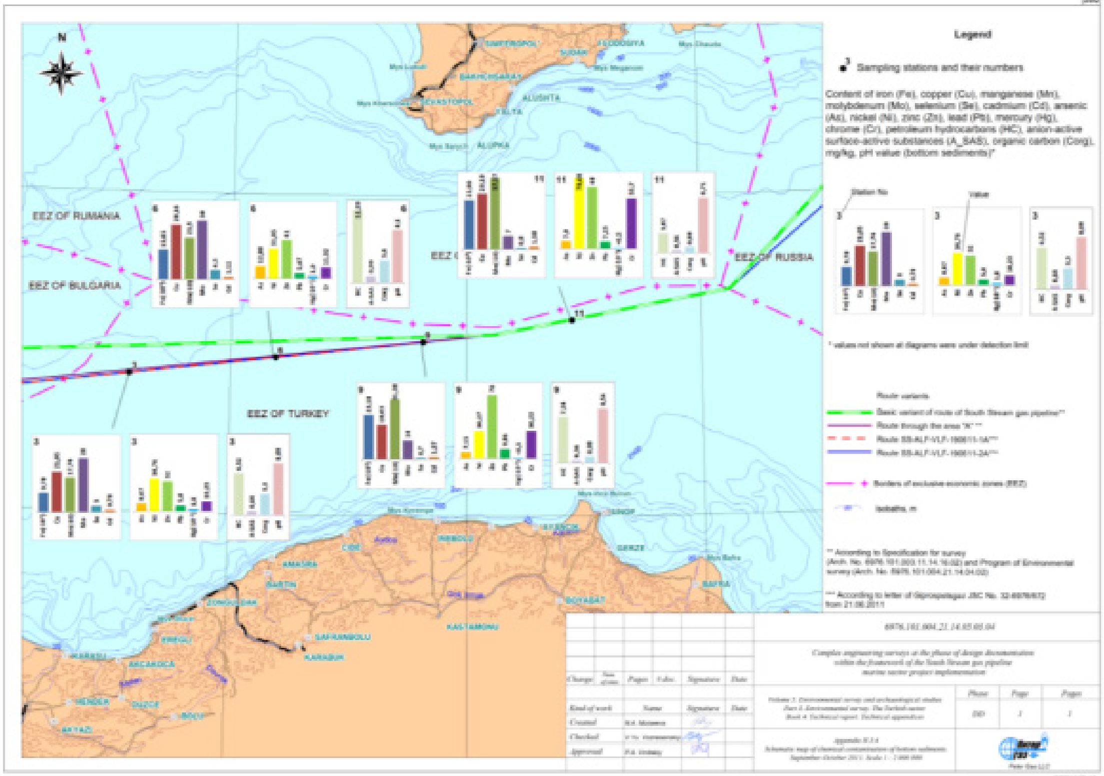


Figure 6.42: Sediment Chemical Concentrations

Table 6.16: Chemical Concentration in Sediments (mg / kg)

Pollutant	Station 3	Station 6	Station 9	Station 11
Arsenic	8	13	7	8
Cadmium	0.8	1.12	1.27	1.38
Chromium	10.2	11.3	30.2	55.7
Copper	21	28	18	29
Mercury	0.2	0.2	<0.05	<0.05
Lead	5.8	5.5	9.86	7.25
Nickel	35	32	30	79
Zinc	32	41	70	68
Selenium	3	4.5	0.7	0.8
Iron	9,783	15,046	23,179	25,899
Manganese	177	215	313	375
OH	6.5	11.29	7.24	3.07
AS	0.64	0.99	0.36	0.34
Phenols	<0.1	<0.1	<0.1	<0.1

These results are in line with previously published sediment sampling results in the Black Sea (Ref 6.20).

6.2.2.3. Bathymetry

The overall bathymetry in the Turkish sector can be seen from the exaggerated bathymetric profile is given in **Figure 6.43**.

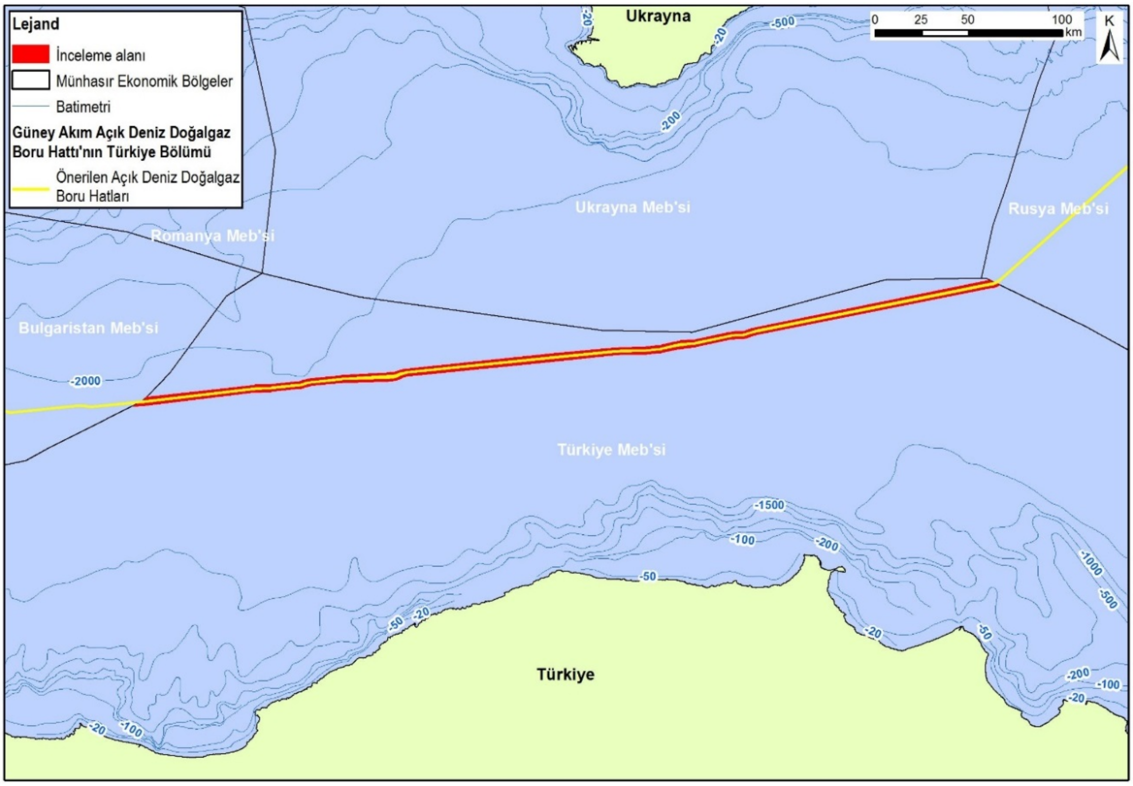


Figure 6.43: Highly exaggerated bathymetric profile along the Project Area.

The general bathymetry of the Turkish Sector is given in **Figure 6.44** as a exaggerative profile.

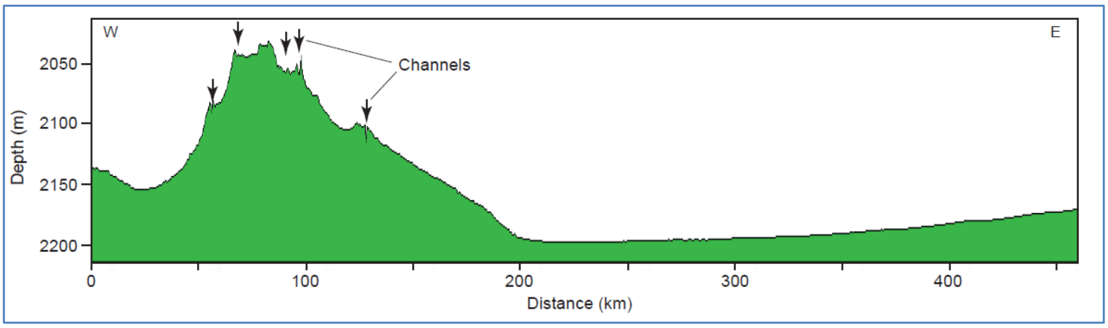


Figure 6.44: Highly exaggerated bathymetric profile along the Project Area.

Water depth within the Project Area varies from 2,025 to 2,199 m. Essentially, the eastern part of the Project Area is the deepest and is essentially flat. The western part has more irregular topography, resulting from a complex of channel levee systems that crosses this area. This forms an elevated ridge that rises about 50 m above the main abyssal plain and represents the distal part of the Danube Fan.

The topographic description of abyssal plain that included the Turkish EEZ sector was divided into sections as presented in **Figure 6.45**.

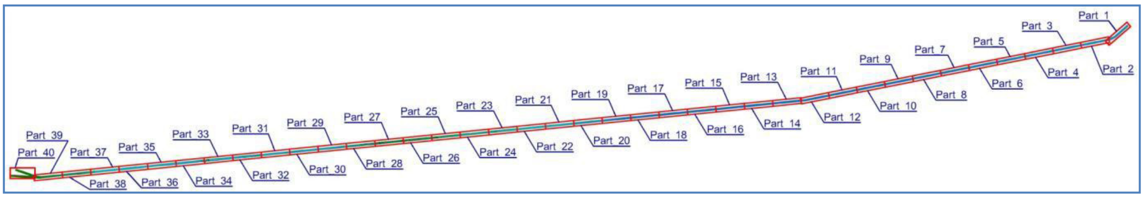


Figure 6.45: Topographic description of abyssal plain

Each section which is approximately 15 km in length has been described in **Appendix 6.E** (Bathymetry Investigation Results) as follows (**Figure 6.46**):

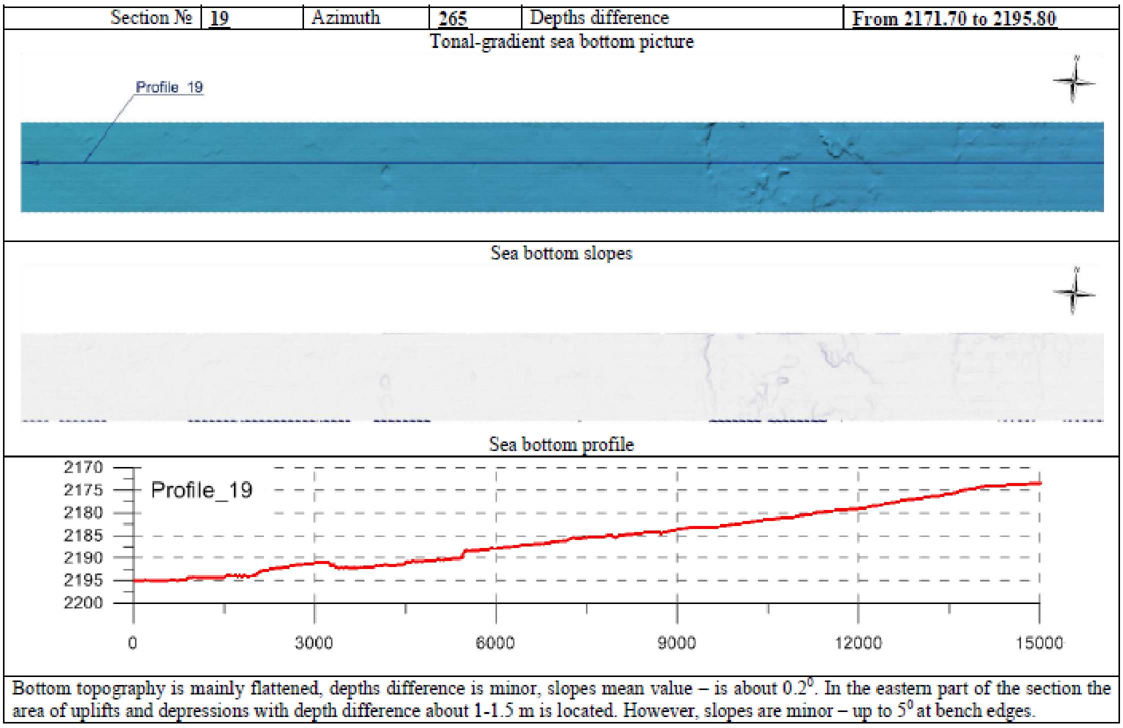


Figure 6.46: Topographic details of abyssal plain

The bathymetry of the Turkish EEZ has also been depicted using 1:10,000 scale maps that are also presented in **Appendix 6.E**.

6.2.2.4. Fault Lines, Seismicity and Seismic Risks

Seismic risks and mud volcanoes represent the main risks for the pipeline route selection in the Project Area. A literature survey indicated that the presence of active fault lines was not expected within the Turkish Sector. It is suggested that deep faults in the Black Sea depression are not likely to affect the Quaternary stratum. Their presence is identified by placated deformation of layers.

In the central part of the abyssal plain the faults were identified (**Figure 6.47**). Because these faults are reflected in topography and affect the recent sediments it is possible to assume that it is recent faults. Depth difference in place of fault is about 1.2 m.

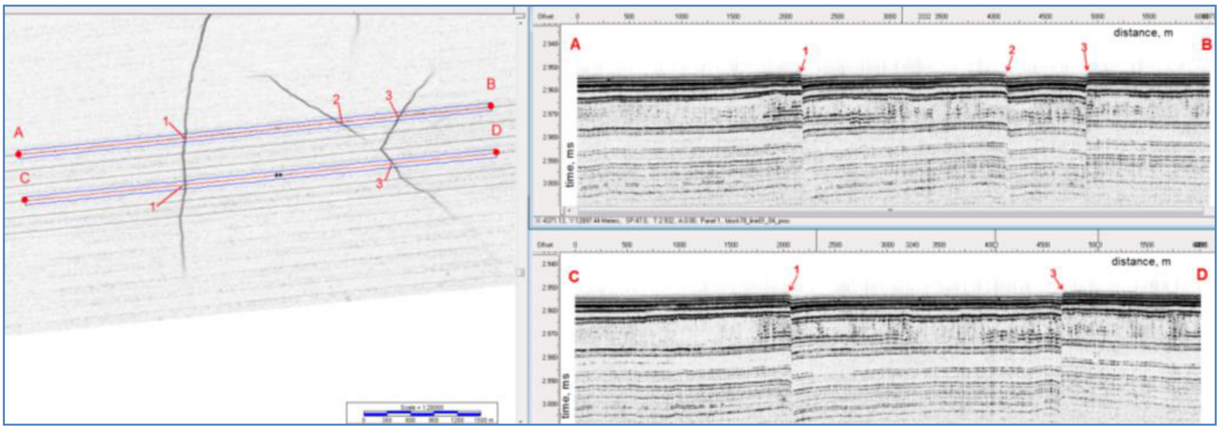


Figure 6.47: DTM (slope angle maximum are 30) acoustic profile through a recent faults

Minor faults, which are associated with sediment creep and formation of slide slopes, are more common (**Figure 6.48** and **Figure 6.49**).

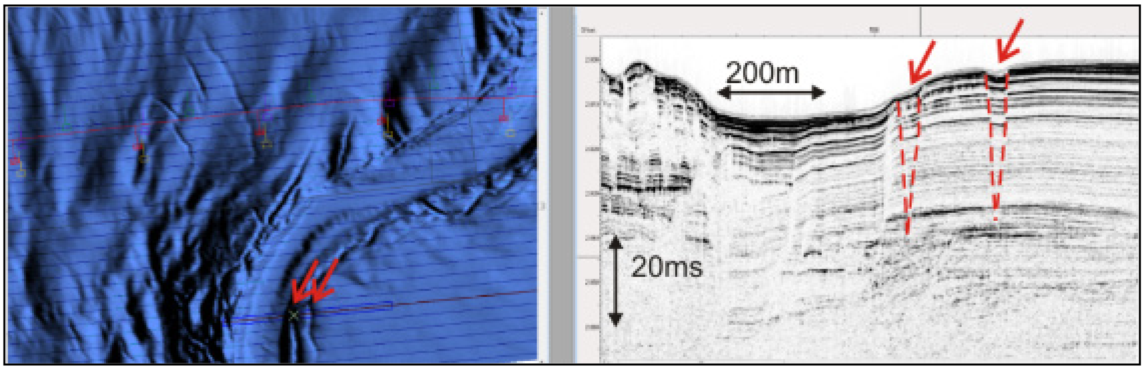


Figure 6.48: Micro grabens (red arrows) on channellevee

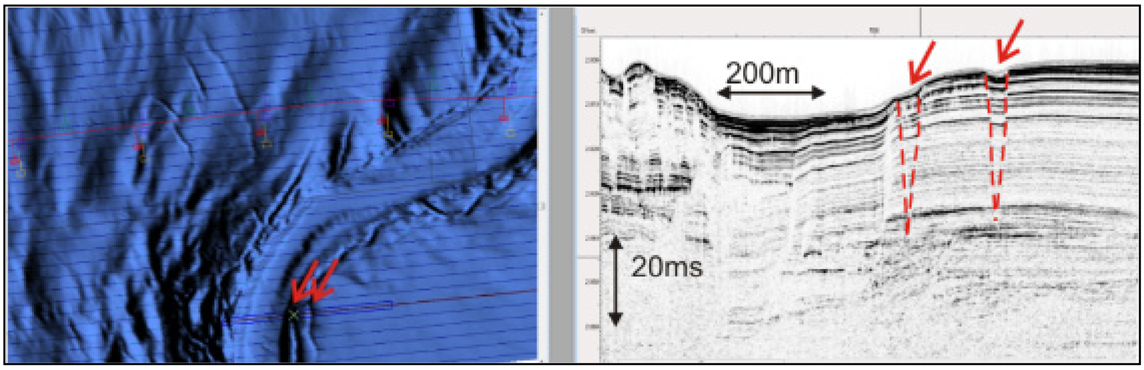


Figure 6.49: Micro faults (red dotted line and red arrow) within the Project Area

The fault lines that were located within the Project Area are given in the geohazard maps given in **Appendix 6.F**.

A second potential geohazard is the natural gas on the seabed. The presence of mud volcanoes within the Project Area was considered during risk analysis during design of the pipelines. Additional features that would pose a hazard to the pipelines include areas where creep motion is present, the presence of shelf breaks, submarine debris flows and turbidity current paths, faults, scarps, pockmark and pockmarks zone. Survey results conducted in the abyssal plain were used to develop geohazard maps. These maps were used in the preliminary placement of the pipelines. The geohazard map of the Project Area is shown in **Appendix 6.F** (Geohazard Maps).

6.2.2.5. Distribution of Sedimentation

Distribution of sedimentation in the corridor area was assessed with the interpretation of SBP data SBP data were interpreted simultaneously with SSS and MBES data. The SBP acoustic wave field pretty much simplifies on the transition from slope foot to abyssal plain. Almost flat seabed surface and the same flat reflecting horizons were observed through almost the whole length of the route corridor (with a few exceptions, which will be discussed below).

These flat areas are characterized by the following dynamic wave field feature: in the upper part from 0 to 10-20 ms of the amplitudes of reflection are high to very high, down below they are rapidly decreasing though there with no change in reflection geometry. The Pleistocene-Holocene unit of the sediments (mQI-IV) was observed in the upper section of the survey area. The internal reflecting horizons (R3 and R4) are observing within the unit (**Figure 6.50**).

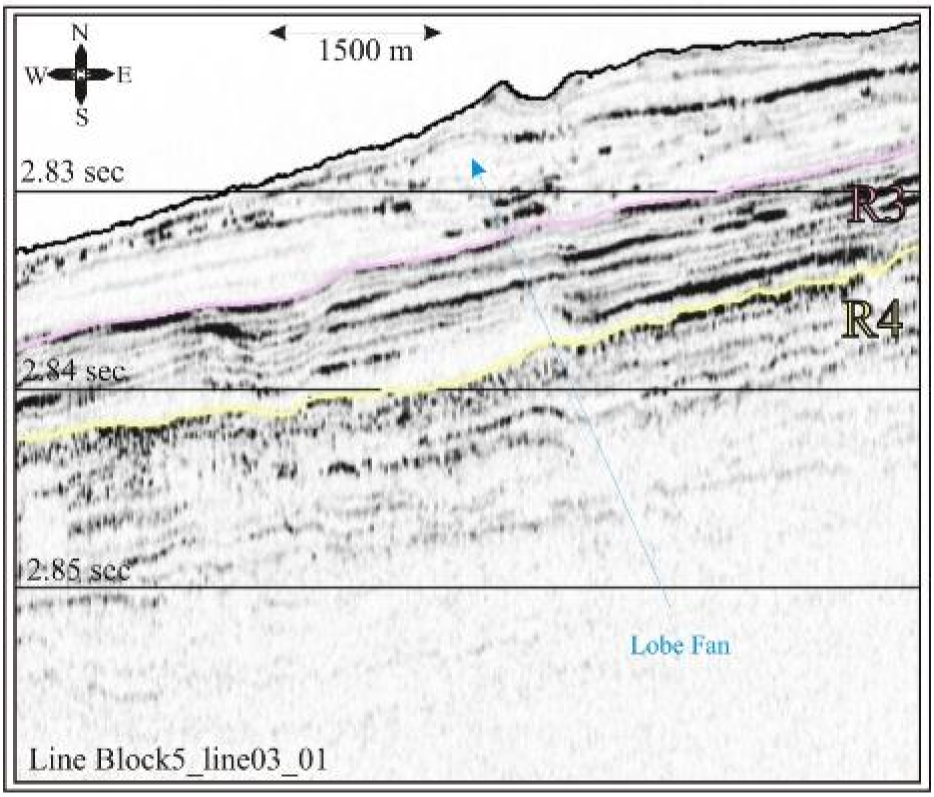


Figure 6.50: Subbottom Profiler record represents Quaternary Unit 1 structure on area where foot slope is changing to abyssal

According to the geological data these units consists of very soft to firm organic clay, very soft to soft, hard silt, very soft to firm clay, soft lean clay, sand. The observed thickness of selected unit of Quaternary sediments on the abyssal plain of Russian sector varies from 20 m to 34.0 m, gradually increasing toward the deep water, as evidenced by increasing in penetrating capacity of acoustic signal.

The recent silt deposits are predominantly occupied the near seabed section. In the nature of the areal distribution of recent marine surface silts could be noted its local facial replacement with clays and clayey silts.

The sections with different intensity of acoustic reflection were observed as part of the mosaic image and SBP data, which are probably due to erosion activity of near-bottom currents. From KP 127.6-128.2 (SS-ALF-VLF-300512-4) pipeline route crosses one of the lobes channel (supra-fan) of Kuban river fan (**Figure 6.51**).

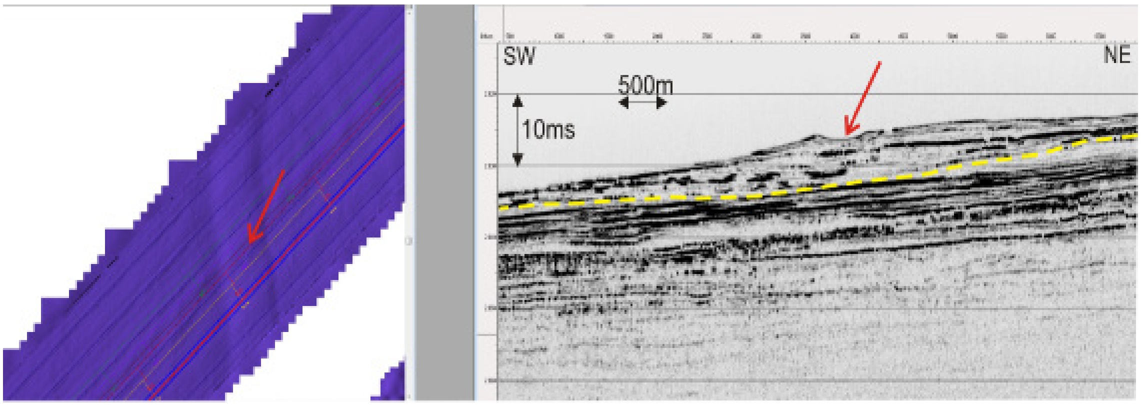


Figure 6.51: Subbottom Profiler pipeline route crosses one of the lobes channel (supra-fan) of Kuban river fan (KP 127.6-128.2 (SS-ALF-VLF-300512-4)

There is often an alternation of well layered and acoustically transparent formations, which is more distinct in the upper high amplitude part of the record. Another typical feature is the presence of acoustically transparent layer of 0.5 to 2.5 m thick right below the seabed surface. Described above seismic record features are typical for offshore deep water areas and correspond to inter bedded layers deposited by a turbidity current, suspended matter and pelagic sediments. Herewith upper transparent layer corresponds with Holocene and recent organic clay.

The B4 reflecting horizon, which was defined in the slope area, could be seen in the abyssal part as well. Most likely, it corresponds to the interface between near-bottom low amplitude or acoustically transparent sediments and under laying sedimentary unit with anomalous high amplitude reflections (**Figure 6.52**). Correlation of this horizon with ground sampling and CPT results shows its compliance with border between near-bottom very soft silt and under laying soft to firm (occasionally stiff) clay.

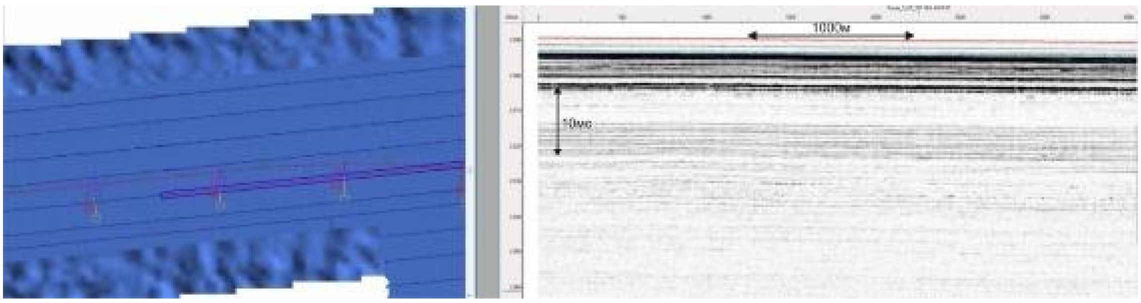


Figure 6.52: Acoustically transparent sediments and underlaying sedimentary unit with anomalous high amplitude reflections

Shallow lenses occurrence with acoustically transparent or chaotic seismic record type is typical for Turkish part. Their thickness as a rule is first meters and size is from some hundred meters to some kilometers in plain view. According to lenses seismic record type they are lobes of density flows fan (**Figure 6.53**).

The distribution of sedimentation across the abyssal plain are shown in the SBP data given in **Appendix 6.G** (Sediment Distribution in the Project Area)

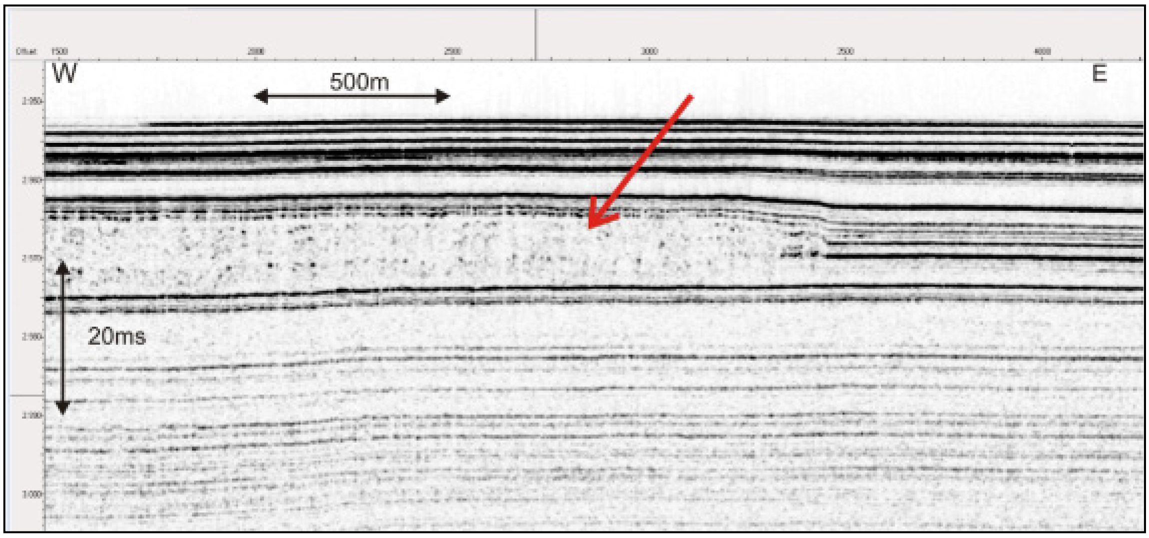


Figure 6.53: Buried density flow deposits (red arrow)

6.2.2.6. Bathymetric Features of the Project Area

The main bathymetric features of the Turkish sector of the abyssal plain were assessed from the abyssal plain survey data. These included are given in **Appendix 6.H** (Bathymetric features of the Survey area)

In general the deepest, eastern part of the abyssal plain lacks any large-scale features. However, sidescan sonar data shows abundant linear and irregular fine-scale markings (**Figure 6.54**), interpreted as tool marks caused by objects such as trees carried along by bottom currents and gouging the seabed (Ref. 6.21).

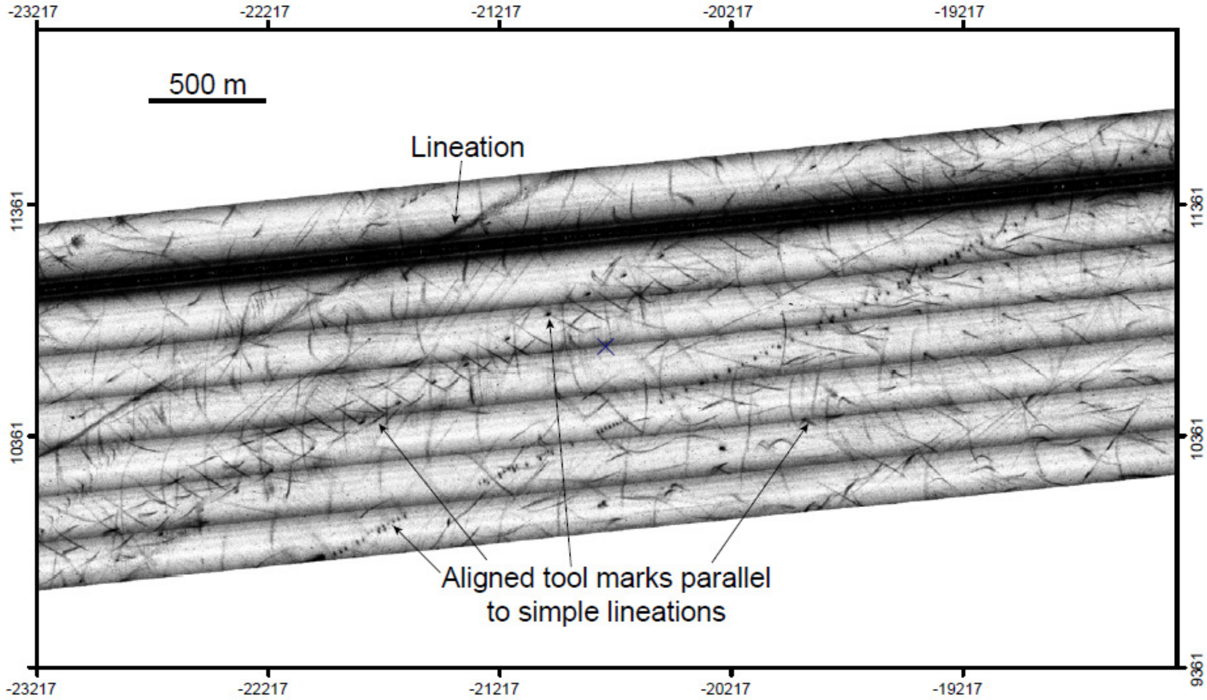


Figure 6.54: Sidescan sonar image of Survey Area showing marks
Note: that these features have no bathymetric expression, suggesting that they are relatively old features buried by later sedimentation.

They mainly trend NE-SW, tending to become more NNE-SSW towards the west. They are discussed in detail in Ref 6.21. SSS data (see **Appendix 6.G**) also show numerous small high backscatter targets that are typically scattered randomly but can on occasion form aggregated groups (**Figure 6.55**). These are also discussed in detail in Ref 6.21.

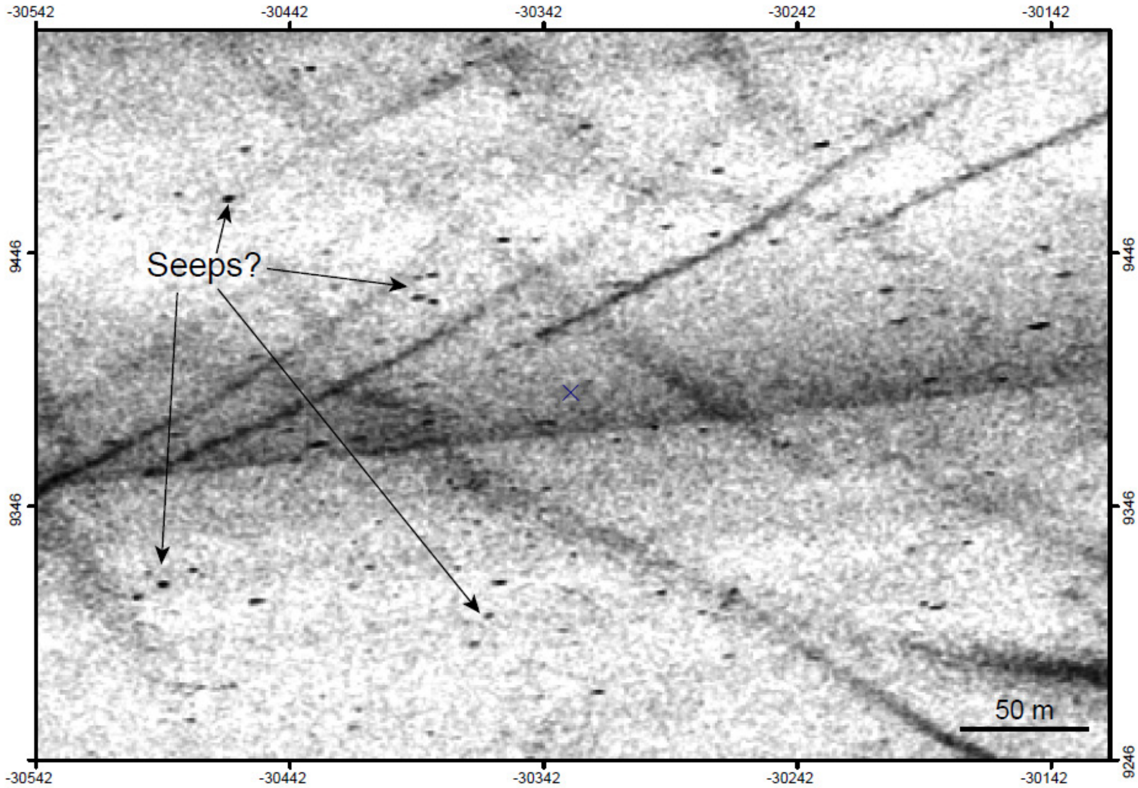


Figure 6.55: Sidescan sonar image showing small, randomly scattered but relatively strong targets.
Note**:** These could possibly be related to fluid seepage from the seafloor. None have been identified on video footage, suggesting that they may be buried features, hidden by a layer of soft organic-rich sediment.

West of easting -69,000, the seafloor rises gently onto the flank of the channel levee area. SSS data show the lower part of the levee complex flank to be covered by sediment waves. These are oriented approximately E-W, perpendicular to the adjacent channels and to the levee slope (**Figure 6.56- 6.57**). They are interpreted as sediment waves built by unconfined turbidity currents. Their location is consistent with turbidity flows moving south in the deep to the east of the levee, but pinned against the levee flank by Coriolis force. This interpretation is also supported by the occurrence of backscatter banding, oriented almost N-S that is the typical signature of sediment deposited by turbidity currents (Ref. 6.21).

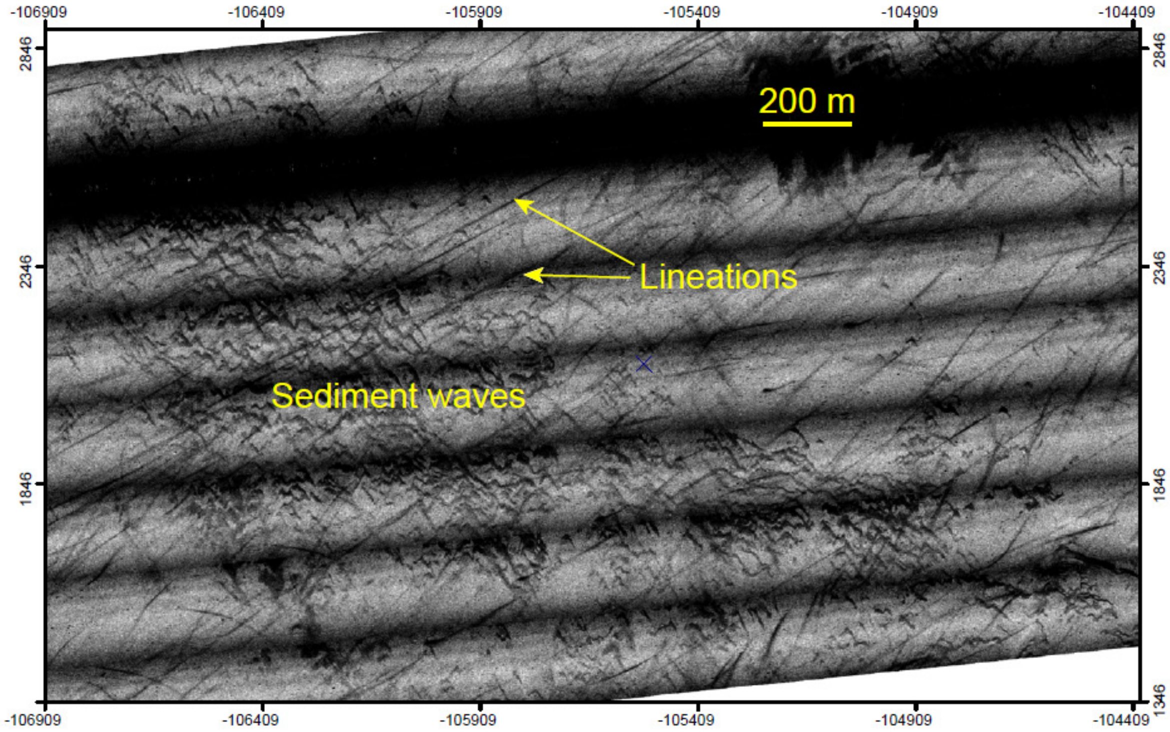


Figure 6.56: Sediment waves on the flank of the Danube Fan channel levee complex

Note: Waves are produced as a consequence of turbidity current deposition and indicate that currents flowed from north to south. Sediment waves are overprinted by fine-scale lineations and are thus older than the lineations.

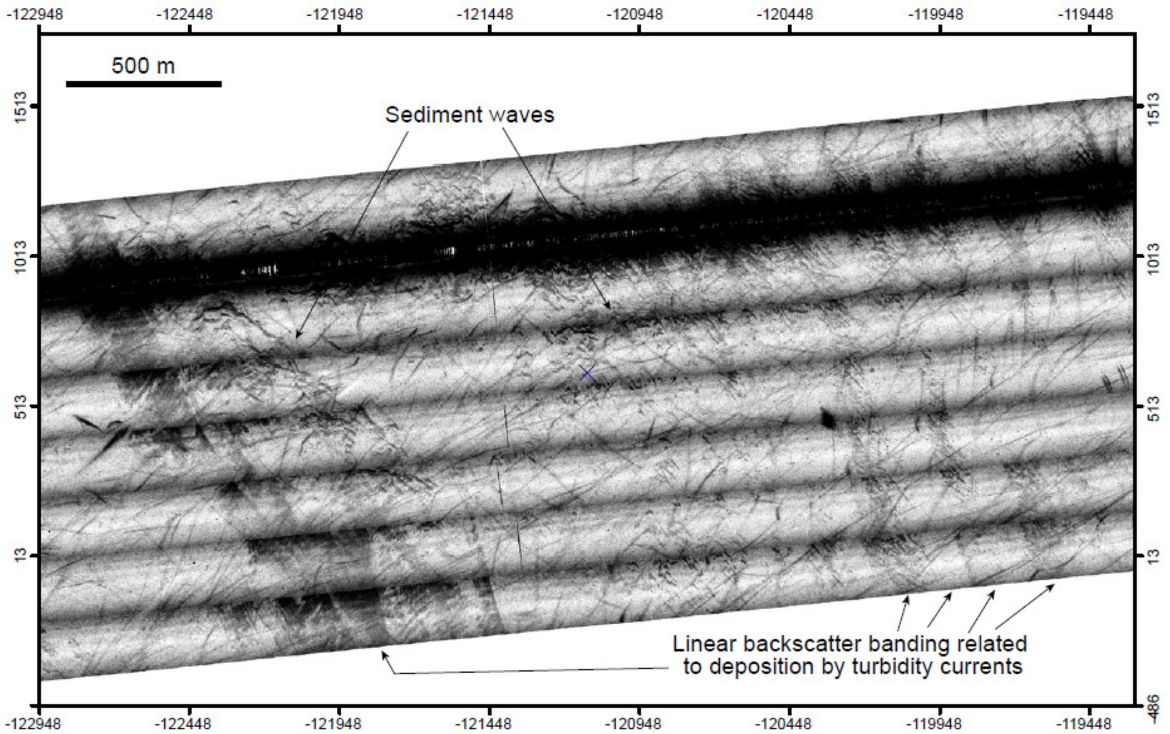


Figure 6.57: Linear backscatter banding, characteristic of sediments deposited by turbidity currents, on the flanks of the Danube Fan channel levee complex.

Note: Banding is oriented at 330-340°, indicating flow from the NNW.

Six channels crossing the Survey Area which can be identified in bathymetry data. Most of these have rather indistinct signatures on SSS data and are clearly partly buried. They can thus be inferred to be inactive (not subject to sediment flows, turbidity currents, moving through the canyon), although this needs to be confirmed by analysis of sediment cores. The easternmost channel, however, has a relatively sharp appearance on bathymetry and SSS data, as well as a clear backscatter contrast between channel floor and flanking levee (**Figure 6.58-6.59**). It is thus inferred to be the youngest channel in the overall channel levee complex, although recent activity cannot be confirmed or ruled out. This channel shows flanking features that could be interpreted either as terraces, or as channel wall failures. However, the position of these features, just downstream of bends in the channel and on the inside channel wall, supports their interpretation as terraces.

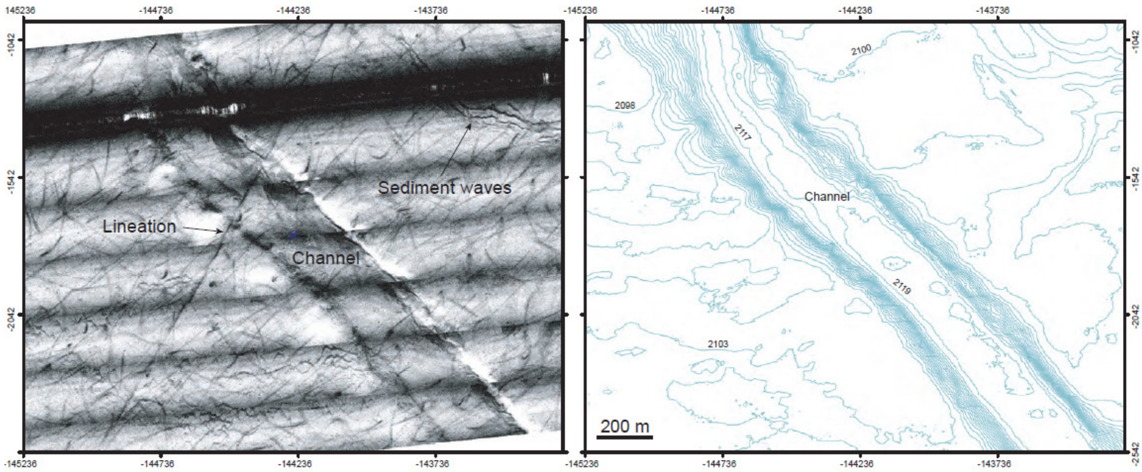


Figure 6.58: Sidescan sonar image (left) and bathymetry (right) showing part of a channel on the distal Danube fan.

Note**:** The channel is about 20 m deep. There is little backscatter contrast between the channel floor and surrounding seafloor, suggesting that both are draped with a layer of younger sediment. This is consistent with the age of the Danube fan, which became inactive about 9000 years ago. Lineations that cross-cut the channels are clearly younger than it.

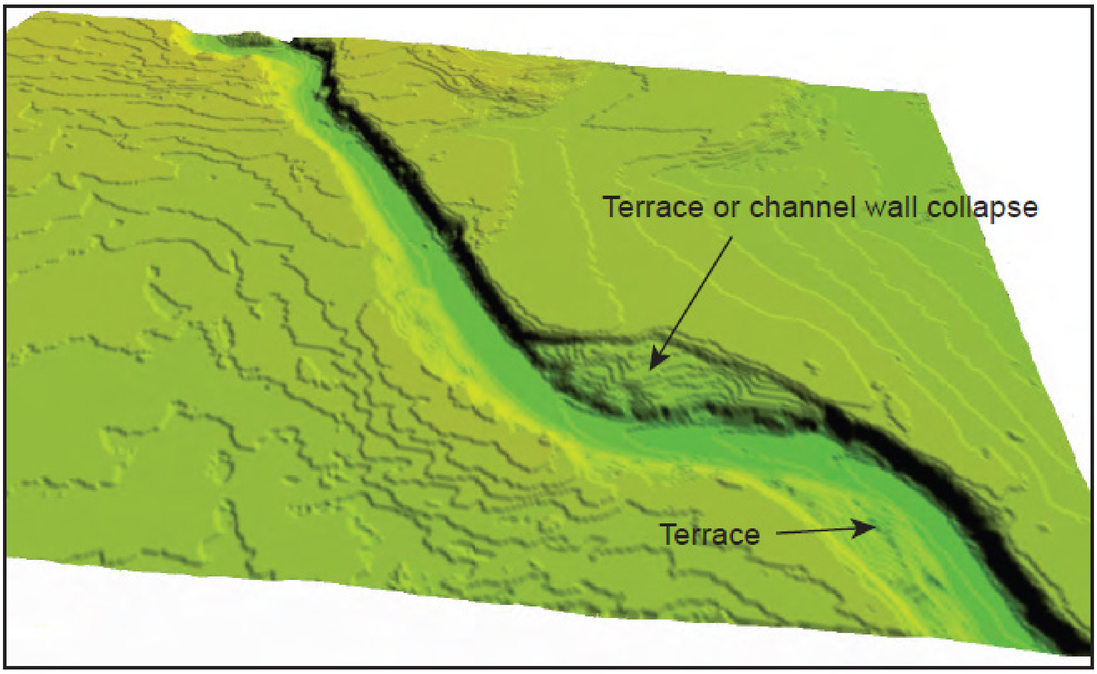
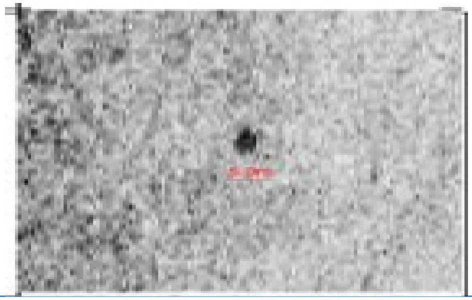
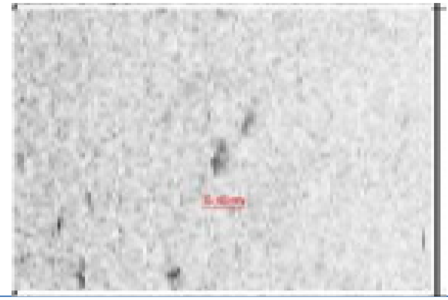
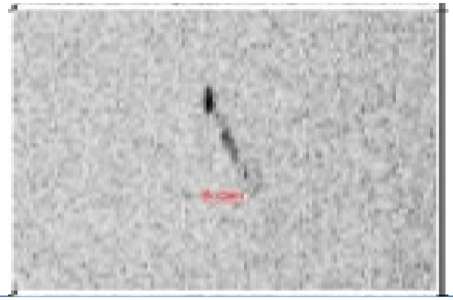


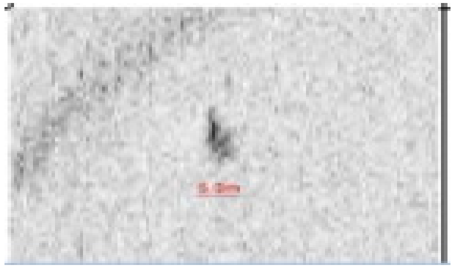
Figure 6.59: 3D bathymetric representation of the channel shown in figure 6.68.
Note: The image shows terraces or areas of channel wall collapse. Position of the features relative to channel meander bends supports a terrace interpretation. Linear and irregular fine-scale markings cover the sidescan sonar data from the top of the levee, with similar densities of markings as seen further east. . At least some lineations cross the channels (Figure 6.68). It thus appears that the lineation's post-date levee formation.

6.2.2.7. Sonar Surveys

The processed acoustic images from SSS surveys (Ref. 6.18) makes it possible to classify the shape of the bottom topography (furrow, ridge, crater), single sub-bottom acoustic lines (anthropogenic or geological) and assess the nature of sediments by the texture image. A catalogue of the objects identified on the seabed was created as a result of processing of the data (**Table 6.17**).

Table 6.17: A sample page of the catalogue of the detected acoustic contacts

X	Y	Image	Height (m)	Length (m)	Width (m)	Contact	Classification
188752,1207	55286,06627		0	3,1	2,7	R-B1-0001	Areal object
189073,5825	55580,97422		0	8,1	3,4	R-B1-0002	Areal object
189342,462	56249,04785		0	14,8	1,5	R-B1-0003	Linear object

X	Y	Image	Height (m)	Length (m)	Width (m)	Contact	Classification
189386,2916	56367,0207		0,4	7,3	2,9	R-B1-0004	Volumetric object

Total quantities of objects detected in the Survey Area from SSS are listed in **Table 6.18**.

Table 6.18: Total quantity of the objects detected at the abyssal plain

Object Classification	Block								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Total**
Areal Object	37	16	17	42	15	22	17	15	**181**
Linear Object	11	12	19	28	5	6	4	5	**90**
Volumetric Object	22	16	8	4	4	1	10	3	**68**
Linear Volumetric Object	8	27	20	10	2	6	10	3	**86**
TOTAL	**78**	**71**	**64**	**84**	**26**	**35**	**41**	**26**	**425**

Geological features were also assessed using the SSS data. It was noted that the Turkish Abyssal Plain between easting's -227,654 and -263,150 is marked by numerous small hard targets arranged in linear chains or irregular aggregates (**Figures 6.60 to 6.63**).

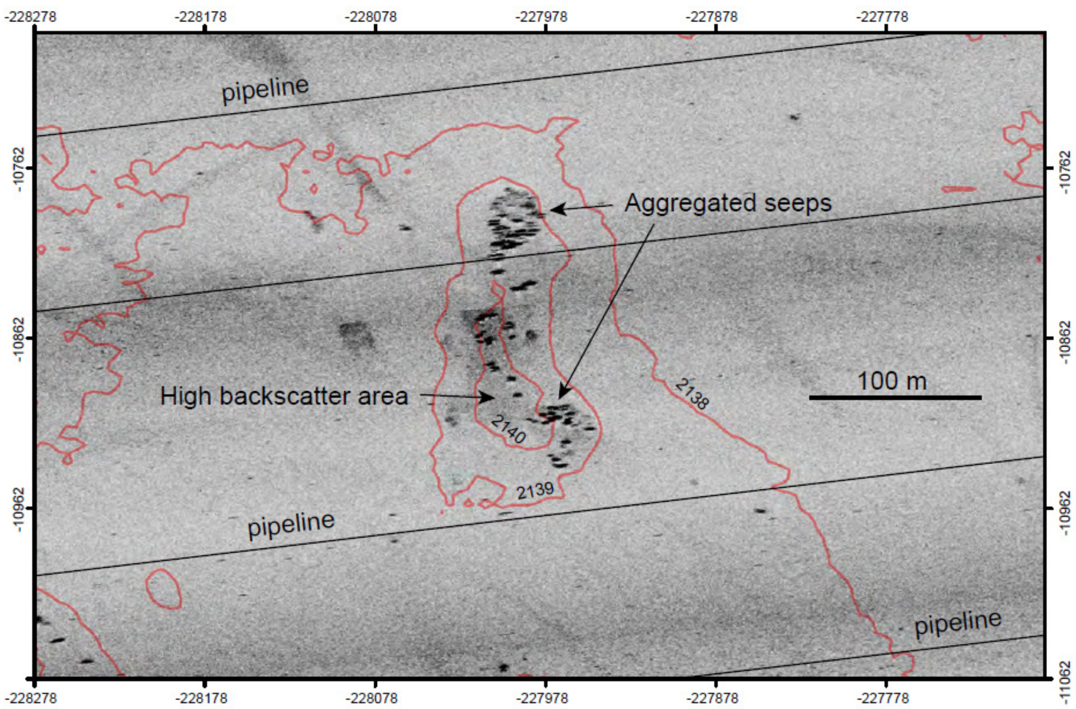


Figure 6.60: Cluster of small strong sidescan sonar targets contained within a shallow seafloor depression in the Project Area

Note that the area around the targets is characterised by slightly higher backscatter (dark). The origin of this feature is uncertain, but a pockmark containing small carbonate build-ups is one possible interpretation.

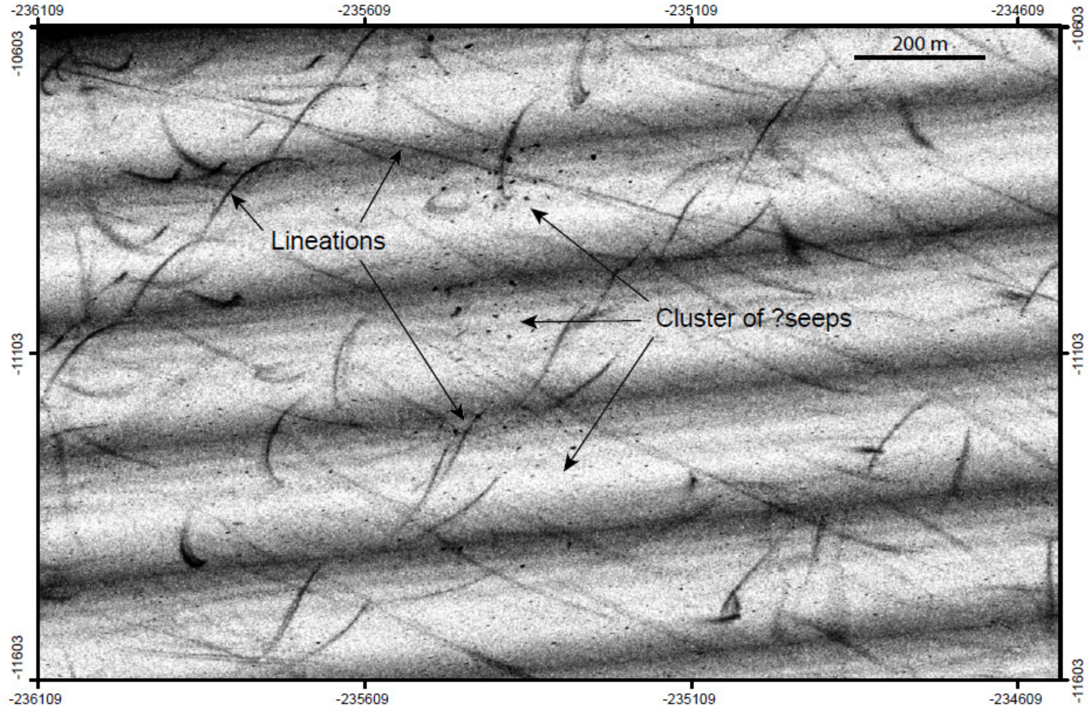


Figure 6.61: Loose cluster of small sidescan sonar targets. Origin unknown but possibly related to fluid seepage from seafloor.

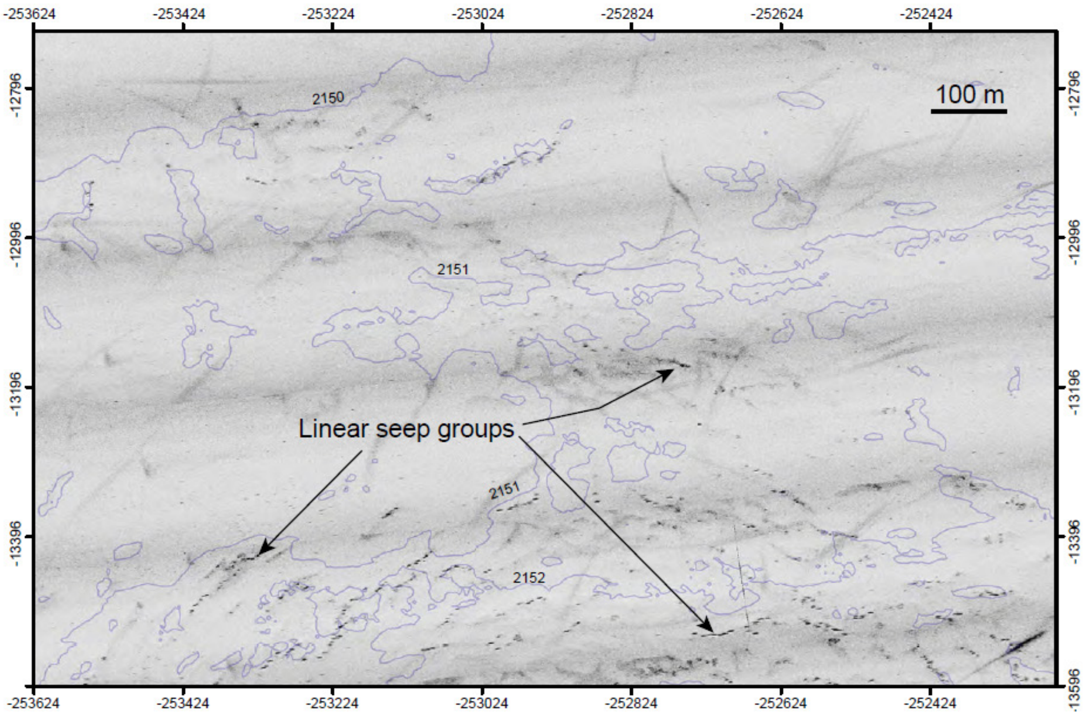


Figure 6.62: Clusters of small sidescan targets arranged in linear groups. A local high backscatter halo surrounds most seeps clusters. In this example, there is no clear relationship between targets and bathymetric lows or highs. The origin of these targets is uncertain, but small carbonate build-ups related to fluid seepage from the seafloor is one possible interpretation.

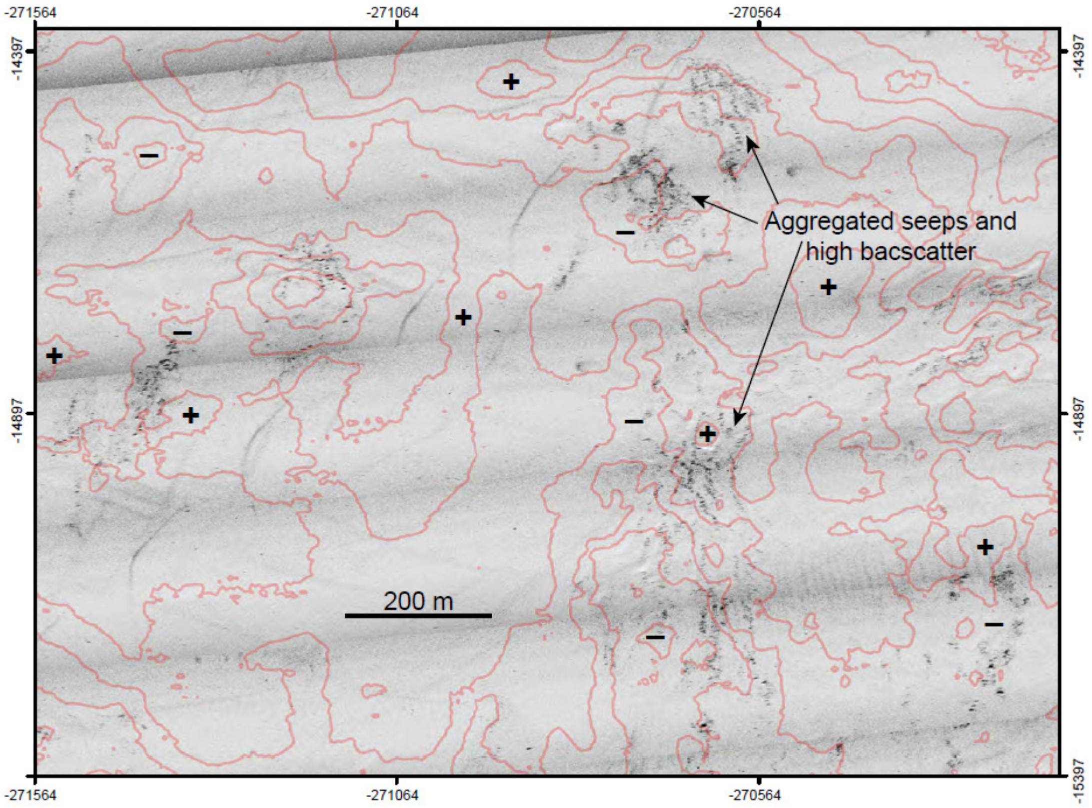


Figure 6.63: Clusters of small sidescan sonar targets associated with patches of high backscatter (dark). Most are located in subtle bathymetric lows.

Note: the origin of these features is uncertain, but irregular pockmarks containing small carbonate build- ups is one possible interpretation.

The data set which constitutes the background of of the summary of Section 6.2, comprising the hydrographic, oceanographic, geological and geophysical raw data collected for the Black Sea and the "Hydrographic, Oceanographic, Geological and Geophysical Survey Report for South Stream Offshore Natural Gas Pipeline Project - Turkey Sector" prepared within the scope of the EIA Report as a summary of this data set, has been approved by the Department of Navigation, Hydrography and Oceanography and presented in **Appendix 6.H**.

6.2.2.8. Geological Impacts which may arise during the Works and Procedures within the scope of the Project and Measures to Control and Mitigate these Impacts (Construction, Operation and Decommissioning)

The potential geological impacts have been assessed based on the anticipated activities related to the Construction, Operational and Decommissioning Phases of the Project. Detailed information on the Project phases are given in **Section 1.5** of this EIA Report. A list of the activities associated with the Project phases is given in **Table 6.19**.

Table 6.19: Project Phases and Activities

Phase	Activity	Impact
Construction	Pre-construction route surveys, as-laid ROV surveys.	Seabed disturbance, release of sediments into the water column and sediment transport.
	Laying pipe on seabed	

Phase	Activity	Impact
Operation	Pipeline inspection surveys	
Decommissioning (Pipeline left in situ)	Pipeline inspection surveys	Potential disturbance of local hydrodynamics and sediment transport.
Decommissioning (Pipeline removed from seabed)	Vessel operations associated with the removal of the pipeline.	Seabed disturbance, release of sediments into the water column and sediment transport.

The assessment of geological impacts has been conducted in line with **Chapter 2 Environmental Impact Assessment Approach** of this EIA Report. **Table 6.20** lists the controls which have been built into the design to limit potential geological impacts.

Table 6.20: Design controls

Design Controls
Pipeline routing has been optimised based on geophysical and geotechnical constraints in order to avoid physical features and ensure that no seabed intervention is required in the Turkish sector. The pipeline will be laid directly on the seabed to minimise seabed disturbance.
Following selection of the continental slope crossings in Bulgaria and Russia a straight line route through the Turkish EEZ was selected as far as possible to join up with the required EEZ boundary crossing locations for Bulgaria in the west and Russia in the east. This minimised the pipeline length and therefore its footprint on the seabed.
The pipe-lay vessels will be Dynamically Positioned. No anchors will impact the seabed.

Impacts from Construction

Pre-construction and as-laid route surveys have the potential to cause very short term and very localised disturbance of the top sediments releasing limited amounts of sediment into the water column. The layer of flocculated organic detritus that covers most of the seafloor in the Project Area (discussed in **Section 6.2.2.2**) may be stirred up by the wash of the ROVs used by the surveys. Its transport and release in the water column will however be very limited due to the very low current velocities at the sea bottom. Moreover, this organic matter is not contaminated (discussed in **Section 6.2.2.2**) and its temporary and localised release in the water column is not expected to impact water quality or other receptors. Disturbance to the clayey sediments beneath this organic layer (see paragraph below) is unlikely, due to the slow velocities of the ROVs. For these reasons, no mitigation is proposed for the pre-construction and as-laid route surveys.

Pipeline placement is likely to cause localised impact in the upper sediments and release limited amounts of sediment into the water column. The stratigraphy (discussed in **Section 6.2.2.2**) revealed that below the layer of organic detritus, the upper part of the sediments in the Project Area is composed of a layer of terrigenous clay. This top layer (about 0.3 m) will be disturbed by the laying of the pipelines on top of it. With the exception of possible active pockmarks (discussed in **Section 6.2.2.5**) no features were identified on the abyssal plain in the Turkish Sector that are likely to be impacted by the proposed pipeline route. The pipeline placement will affect a small area (less than 2 km^2 which represents approximately 0.001% of the Turkish Black Sea EEZ) of the sea bed which is homogenous in physical character. Geochemical characterization of the seabed sediments in the Project Area indicate that sediment displacement will not alter the geochemical structure of the seabed.

The pipeline route has been selected to avoid known physical features. Pre-lay surveys will aim to ensure features are avoided, wherever possible, as the pipelines are laid. As a result, potential geological impacts are unlikely. As such, no mitigation is proposed.

Impacts from Operation

Pipeline inspection surveys will have similar localised and temporary impacts to pre-construction and as-laid route surveys described in the previous section. The physical presence of the pipeline may alter local hydrodynamics and sediment transport. This will however be a very localised effect, and will decrease over time as the seabed reaches its new equilibrium. The physical presence of the pipeline will not alter the geochemical structure of the seabed.

Based on the above, the Project's design controls are considered sufficient to minimise any geological impacts from operation. As such, no mitigation is proposed.

Impacts from Decommissioning

At the time of writing this EIA Report, the strategy for decommissioning is unknown. If the pipelines are to be left in situ, no geological impacts are expected. If the pipelines are removed from the seabed, geological impacts from decommissioning activities are expected to be similar to those from the construction activities described above.

Impacts from Unplanned/ Emergency Events

No emergency situations are considered to impact geological conditions in the Project Area.

6.3 Hydrographic, Oceanographic and Hydrological Characteristics

6.3.1. General Hydrographic, Oceanographic and Hydrological Characteristics of the Black Sea

The Black Sea is an elongated and nearly-enclosed basin (connected with the Bosphorus Strait to the Mediterranean Sea. It has an area of 4.2 x 10^5 km^3 and a volume of 5.3 x 10^5 km^3 with a maximum depth of 2,200 m and represents the largest land locked basin in the world. Its waters are in a state of almost complete isolation from the world ocean, as a result of the restricted exchange with the Mediterranean Sea through the Istanbul Straits System (the Black Sea maintains a stratified system with colder, fresher surface waters overlying the warmer, more saline deep waters. The low salinity at the surface results from freshwater influence, while the higher salinity in deep waters is an imprint of the Mediterranean influence (**Figure 6.64**).

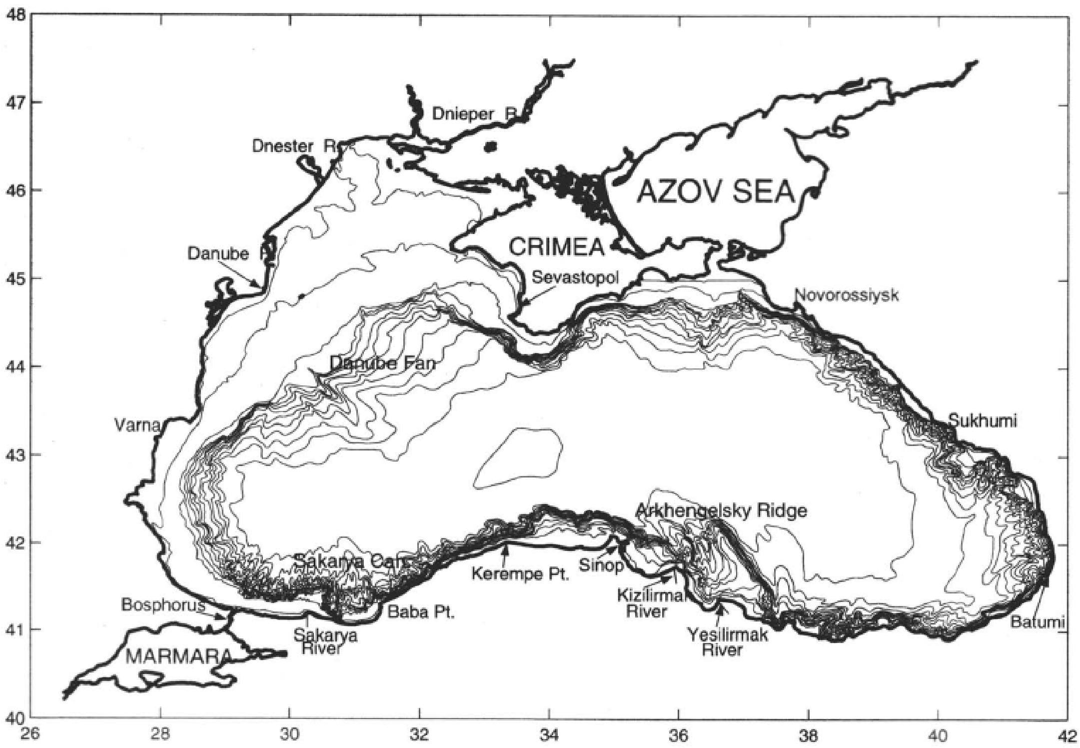


Figure 6.64: The Black Sea: geographic setting, main rivers and bathymetric features (Ref. 6.22)

The Black Sea has a positive water balance where the inputs from freshwater sources exceed losses by evaporation. The precipitation and surface runoff accounts for 300 km^3/yr and 350 km^3/yr as positive input where evaporation takes out 350 km^3/yr. The net flux of the stratified flow through the Bosphorus accounts for the remaining component of the water budget (Ref. 6.23). The mass flux and salinity budget of the Black Sea basin can be described in **Figure 6.65**.

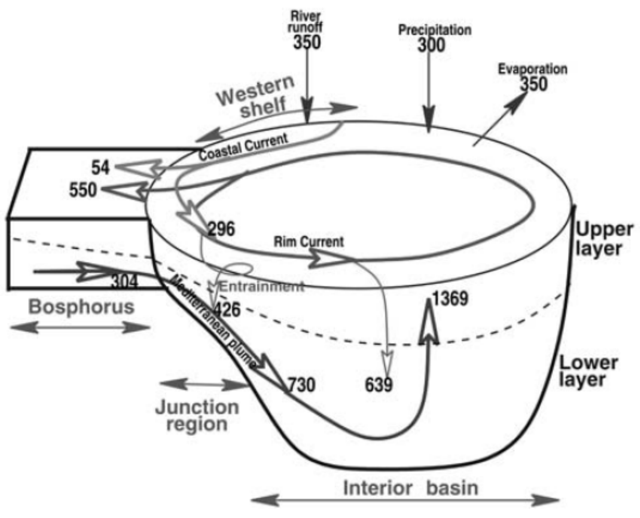


Figure 6.65: Schematic view of the five compartment box model representation of the Black Sea, and main inter-compartmental fluxes computed by the water and salt budgets (Ref. 6.24)

The mass flux of the Black Sea is summarised (Ref. 6.24) as follows:

- A surface outflow of 604 km^3/yr exits from the basin through the Bosphorus. It comprises a 54 km^3 /yr coastal flow of fresh water origin along the western shelf with salinity of 16.5, and 550 km^3/yr from the rest of the basin with an average salinity of 1;
- The denser Mediterranean water with the average salinity of 35.5 enters into the Bosphorus as an undercurrent at a rate of 304 km^3/yr. The physical characteristics of the Mediterranean undercurrent, including its volume, velocity, temperature and salinity, are modified considerably by mixing with the upper layer waters as they cross the continental shelf of the Black Sea. It spreads out as a thin layer along the bottom of the shelf, and becomes highly diluted by entrainment of relatively colder and less saline ambient waters of the Cold Intermediate Layer (CIL). There, the Mediterranean plume with salinity of 26.5 entrains the upper layer flow of 426 km^3/yr from the CIL to form a total transport of 730 km^3/yr which has an average salinity of 22;
- This input is balanced by the difference of downward and upward fluxes of 639 and 1,369 km^3/year, respectively, across the interface between the upper and lower layers; and
- The deepest part of the water column covering the entire abyssal plain of the sea, involves a vertically homogeneous and horizontally uniform water mass formed during several thousands of years by convective mixing due to the geothermal heat from the bottom of the sea.

The Black Sea stratification within the upper 100 m layer varies up to Sigma-t (σ_t) of approximately 5 kg/m^3 (**Fig. 6.66**). The pycnocline corresponding to the density surface σ_t of 16.2 kg/m^3 approximately conforms to 150 m depth within the interior cyclonic zone and may extend to 200 m within coastal anticyclones. The intermediate and deep water masses below a permanent halocline at depths of 100 to 150 m possess almost vertically uniform characteristics defined by temperature (T)of approximately 9^{o}C, salinity (S) of 22, and a σ_t of 17.0 kg /m^3 (Ref. 6.5). The deep homogenous layer that has a thickness of 2,000 m within the abyssal plain of the sea possesses almost vertically uniform characteristics below200 m within the range of values of T, S and σ_t of approximately of 8.9 to 9.1^{o}C, 22 to 22.5, and 17 to 17.3 kg/m^3, respectively. The deepest part of the water column (approximately below 1,700 m) involves homogeneous water mass formed by convective mixing due to the bottom geothermal heat flux during the last several thousands of years (Ref. 6.25.).

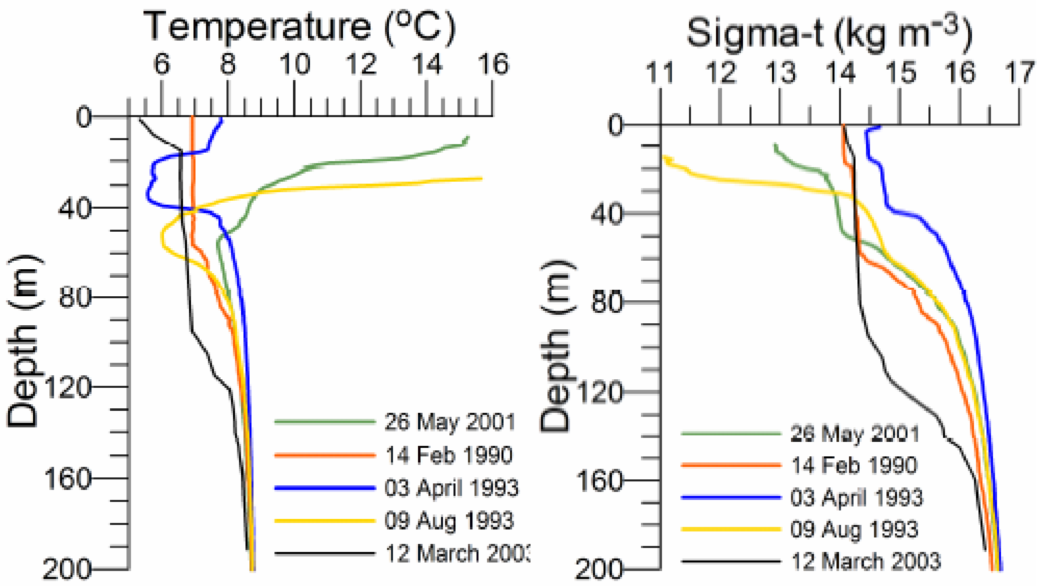


Fig. 6.66: Vertical variations of temperature T (°C) and density (expressed in terms of Sigma-t, kg/m3) at various locations of the interior basin during different months representing different types of vertical structures (Ref. 6.26)

The upper 50 to 60 m is homogenised in winter with T, S and $\sigma_{t\ of}$ approximately 6-7 °C, 18.5 to 18.8 and 14.0 to 14.5 kg/m^3 (Ref. 6.26) respectively when the north-western shelf and near-surface levels of the deep basin exposed to strong cooling by successive cold-air outbreaks, intensified wind mixing, and evaporative loss. As the spring warming stratifies the surface water, the remnant of the convectively generated cold layer is confined below the seasonal thermocline and forms the CIL of the upper layer thermohaline structure. Following severe winters, the CIL may preserve its structure for the rest of the year, but it may gradually warm up and loose its character in the case of warm winter years. Stratification in summer months comprises a surface mixed layer with a thickness of 10 t 20 m with T, S and σ_t of approximately 22 t 26°C, 18 to 18.5 and 10.5 to11.5 kg /m^3, respectively (Ref. 6.24).

6.3.1.1. Chemical Properties of the water of Black Sea

During the last three decades eutrophication has been identified as a key ecological problem for the coastal Black Sea regions and especially for its north western part where strong anthropogenic nutrient and pollution loads resulted in dramatic alterations in the chemical and biological regimes. In order to understand the conditions for the eutrophication, the biogeochemical structure in the Black Sea is discussed. An overview of the chemical pollution in the Black Sea is discussed in this section.

Biogeochemical Structure

The Black Sea has a two layer system with an upper biogeochemical structure overlying a deep anoxic layer. There are four distinct layers within this system: the oxic layer with an average depth of 40 to 50m, a layer distinguished by the presence of an oxyclyne and a nitracline with an average thickness of 20 to 30m, followed by a sub-oxic layer with an average thickness of 20 to 30m (Ref. 6.27). The last layer is the anoxic layer which extends to the bottom of the Black Sea. **Figure 6.67** shows the stratification with respect to σ_t.

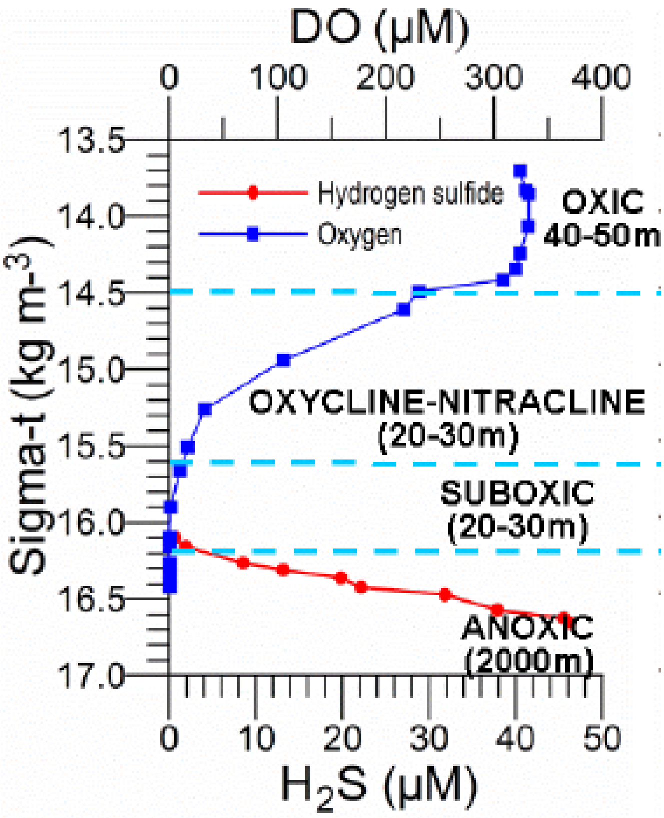


Figure 6.67: Stratified System Layers (Ref. 6.28)

The uppermost part from the water column to the depth of 1% light level is covered by a shallow euphotic zone with a maximum thickness of around 50 m. This layer is characterised by high oxygen concentrations on the order of 300 μM as well as seasonally varying nutrient and organic material concentrations supplied laterally from rivers and vertically from sub-surface levels through vertical mixing. In the interior basin, the surface mixed layer waters are poor in nutrients for most of the year except for occasional incursions from coastal regions, and by wet precipitation (Ref. 6.28). The euphotic layer oxygen concentration undergoes pronounced seasonal variations within a broad range of values from about 250 to 450 RM. The period from the beginning of January until mid-March exhibits vertically uniform mixed layer concentrations of 300 to 350 RM, ventilating the upper ~50 m of the water column as a result of convective overturning. After March, initiation of the warming season is accompanied by oxygen loss to the atmosphere and decreasing solubility, thus reducing oxygen concentrations within the uppermost 10 m to 250 RM during the spring and summer. A subsequent linear trend of increase across the seasonal thermocline links low near-surface oxygen concentrations to relatively higher sub-thermocline concentrations. Depending on the strength of summer phytoplankton productivity, the sub-thermocline concentrations exceed 350 RM in summer (Ref. 6.28).

Below the seasonal thermocline and in the deeper part of the euphotic zone, nitrate concentrations increase. The nutrient fluxes of anthropogenic origin in their rivers (mainly the Danube) along the northwest shelf are transported across the shelf and around the basin through an existing current system (Rim Current system), and supplied ultimately to the interior basin, and some of which is lost in the form of Bosphorus surface flow in winter months (Ref. 6.29). The river supply in the northwest shelf s rise to a high Nitrogen to Phosphate (N/P) ratio within the shallow water column, and further constitutes a major source of selectively nitrate enriched CIL in winter. The river influence markedly weakens toward the south along the coast and offshore for most of the year due to photosynthetic consumption of dissolved inorganic nutrients. Nevertheless, below the seasonal thermocline, the thicker CIL in coastal regions contains measurable concentrations of nitrate but very low (<0.02 mM) phosphate values, yielding abnormally high N/P ratios (Ref. 6.30, Ref. 6.31).

Figure 6.68 shows the organic characteristics of the two layer system (Ref. 6.29):

- When nitrate profiles are plotted against density, the position of the peak concentration coincides approximately with the σt 15.5 kg /m^3 level);
- Within the oxygen deficient part of the water column below σt 15.6 kg/m^3, organic matter decomposition proceeds via denitrification. This results in formation of the "lower nitracline" zone with sharp decrease of nitrate concentrations at a thickness of about 30–40 m from their peaks to their trace values around 100 m depth or σt 16.0 kg/m^3 isopycnal surface;
- Nitrite is often used to oxidize ammonium. The deep sulphide-bearing waters contain no measurable nitrate, but constitute large pools of ammonium and dissolved organic nitrogen. Ammonium concentration increases sharply below σt16.0 kg/m^3, reach at values of 10 RM at 150 m (σt ~16.5 kg/m^3) and 20 RM at 200 m;
- A nitrite peak with concentrations up to 0.5 μM is usually observed at σt 15.85±0.05 kg m^{-3} located approximately 10 m above the position of the zone of nitrate depletion (Fig. 6.58). This coincides with the position of the phosphate minimum. The thickness of the nitrite peak therefore marks the denitrification zone. The deep sulphide-bearing waters in the Black Sea contain no measurable nitrate, but constitute large pools of ammonium and dissolved organic nitrogen;
- The vertical structure of phosphate concentrations resembles that of nitrate in the upper layer but is quite complicated in the suboxic/anoxic layers; and
- The oxygen concentration decreases almost linearly within the upper nitracline zone to concentrations of about 100 μM at σt 15.3 kg/m^3 and about 10 μM at σt 15.6 kg/m^3 due to intense oxygen consumption during the decomposition process of organic matter. Oxygen concentrations vanish completely near the anoxic interface located at σt 16.2 kg/m^3 (**Fig. 6.68a**). The oxygen deficient (O_2< 10 RM), nonsulfidic layer having a thickness of 20-to-40 m coinciding with the lower nitracline zone is Referred to as the "Suboxic Layer (SOL)". This has been observed consistently (Ref. 6.27) all over the basin with almost similar characteristics.

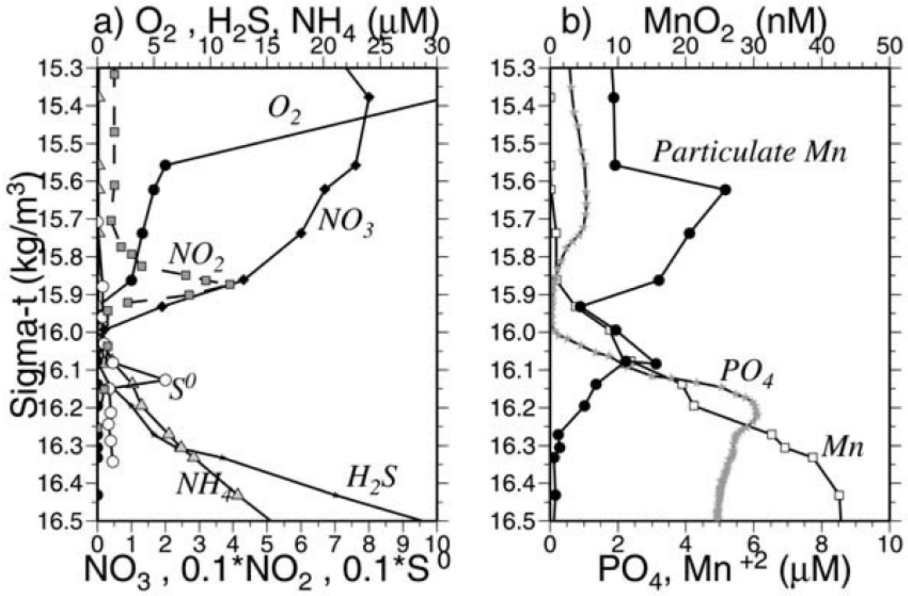


Figure 6.68: (a) Depth profile of density for the upper 150 m water column, (b) O_2, HS^-, NH_4^+, NO_3^-,NO_2^-, S0 profiles, and (c) MnO2, Mn, PO4 profiles (Ref. 6.24)

The boundary between the sub-oxic and anoxic layers involves a series of complicated redox processes. As dissolved oxygen and nitrate concentrations vanish, dissolved manganese, ammonium and hydrogen sulphide concentrations begin to increase. Marked gradients of particulate manganese around this transition zone near 16.0 kg m^{-3} reflect the role of manganese cycling. The deep ammonium, sulphide and manganese pools have been accumulating during the last 5,000 years as a result of organic matter decomposition.

The pH value is largely determined by the processes of oxidative degradation of organic matter. Therefore, the pH depends on the intensity of light, temperature, and the whole process of photosynthesis. The pH of seawater varies seasonally and spatially. The average vertical pH profile shows that pH is sharply decreasing between surface and core of cold intermediate layer (**Figure 6.69**) (Ref. 6.28).

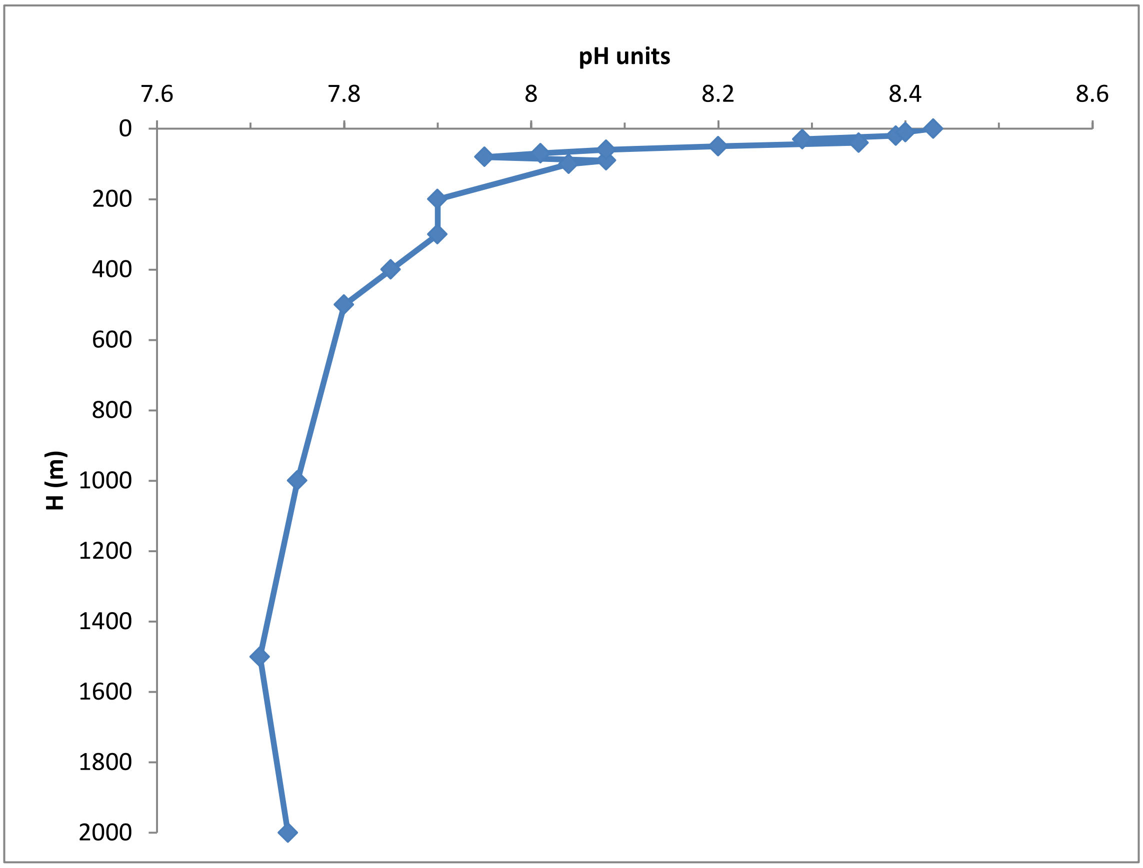


Figure 6.69: Mean profile of Black sea pH averaged at the standard levels using all data from 1924 to 2000. Insertion shows space distribution of pH observations for entire period (1924-2000's) (Ref. 6.28)

Chemical Pollution

Oil enters the sea as a result of operational discharges of vessels and accidents, as well as through land-based sources. The present level of oil pollution is not high in the open sea but is unacceptable in many coastal areas. The total amount of oil spilt into the Black Sea was generally less than 50 tonnes during 1996-2004 except 260 tonnes in 1997 and 530 tonnes in 2003. They were discharged by spill accidents of around 10-30 per year with the exception of 61 relatively low spill accidents reported in 2001 (**Figure 6.70**).

The mean concentration of total petroleum hydrocarbons (TPHs) in general exceeded the Maximum Allowed Concentration limit (MAC~0.05 mg/l) almost everywhere in the Black Sea (**Table 6.21**), but increased up to 25,0 mg/l along tanker and shipping routes between Odessa, Novorossiysk and Istanbul

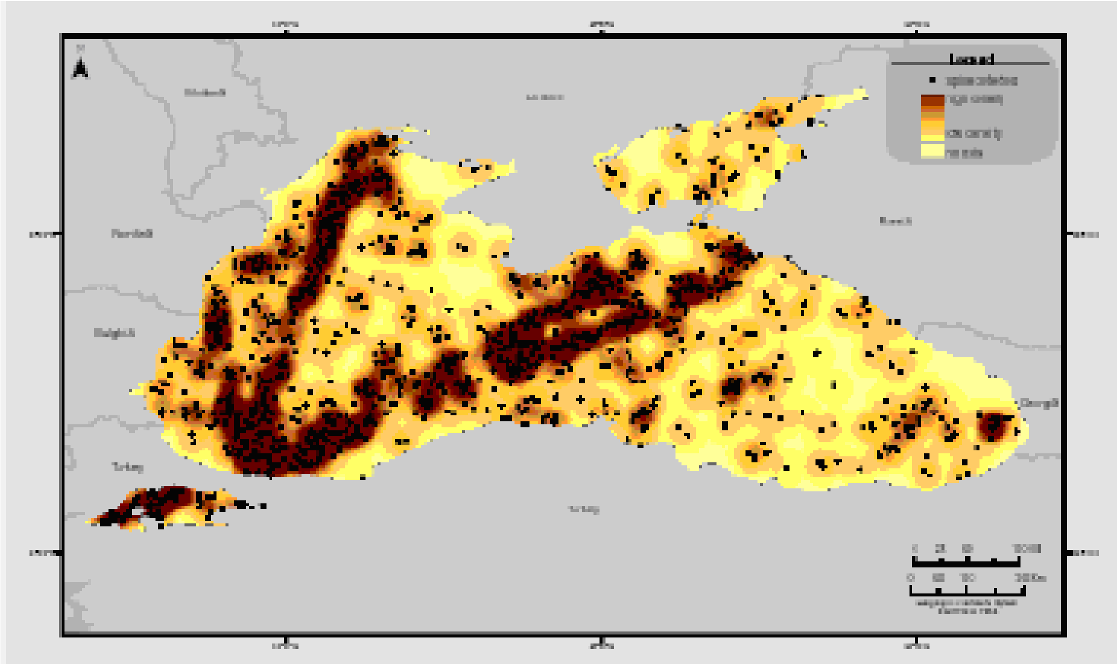


Figure 6.70: Composite map of oil spill anomalies in the Black Sea during 2000-2002 and 2004 based on the images taken by Synthetic Aperture Radars (SARs) of European satellites ERS-2 and Envisat (http://serac.jrc.it/midiv/ maps/). The oil spill density has been spatially normalized to the spill widths. The darker areas signify the high anomaly regions.

Table 6.21: Maximum and mean concentration of Total Petroleum Hydrocarbons (mg/l) in the Black Sea (Ref. 6.28).

Area	Year	Waters	Max	Mean
IAEA	1998	Western shelf	0.23 (Constantia)	0.084
IAEA	2000	Eastern open	3.27 (Feodosia)	0.097
Ukraine	1992-1999	coastal	1.20	0.050
Ukraine	2000-2005	Coastal	0.18 (Kerch)	0.050
Ukraine	2004	Coastal	0.51 (Odessa)	0.12 (Odessa)
Ukraine	2004	Coastal	0.85 (Dnieper – South Bug)	
Romania	2001-2005	Coastal	2.27 (Mandalia)	0.14-0.28
Turkey	2003	Coastal	0.255 (Bosphorus)	0.092
Turkey	2004	Coastal	0.077 (Sile)	0.011
Turkey	2005	Coastal	25.466 (Danube waters), 1.935 (Danube waters)	0.199 (without 3 extremes)
Georgia	2000	Coastal	6.81 (Georgia)	0.13 (140 samples)

Area	Year	Waters	Max	Mean
Russia	2002-2006	Coastal	3.200 (NovajaMatsesta, Sochi)	0.073
Black Sea [10]	1978-1989 Winter	Coastal + open, surface	0.89 (central Western shelf)	0.10 (519 samples)
Black Sea [10]	1978-1989 Spring	Coastal + open, surface	0.59 (offshore of Crimea)	0.08 (379 samples)
Black Sea [10]	1978-1989 Summer	Coastal + open, surface	0.55 (Odessa region)	0.08 (526 samples)
Black Sea [10]	1978-1989 Autumn	Coastal + open, surface	1.29 (Sinop region)	0.09 (425 samples)
Black Sea [10]	1978-1989	Coastal + open	1.29 (Sinop region)	0.09 (3828 samples)

Pesticides and heavy metals continue to cause pollution near certain well-identified sources. PCBs which are or have been produced for industrial use are now mostly restricted to closed systems, and the use of DDT has been banned or restricted in most countries of the Black Sea. Despite these restrictions, recent studies have shown high concentrations of DDT in Turkish rivers, streams, and domestic and industrial discharges, which indicate their illegal use (Ref. 6.7). The use of these chemicals in other Black Sea countries is currently unclear. Nevertheless, on the basis of available data, pesticide (total DDT and HCH) concentrations in surface waters were typically below their detection limit (0.05 ng/l) as shown in **Table 6.22** except for some very dense patches being detected occasionally.

Table 6.22: Maximum and average concentration of pesticides (ng/l), and number of observations (in parentheses) in marine waters of the Black Sea in 19929922 1 (Ref. 6.28).

Project	Year	Region	Ɣ-HCH	A-HCH	B-HCH	HCH total	DDT	DDE	DDD	DDT total	HCB*	Other
Monitoring [2]	1992-1999	Ukraine	4.0/0.48 (177)	-	-	-	14.4/1.081 (77)	5.4/0.55 (177)	6.3/0.38 (177)	-	4.18/0.26 (?**)	3.34/0.23 (?**)
Monitoring [3]	2005	Romania	0.3/0.064 (57)	-	-	-	6.95/0.12 (57)	1.89/0.07 (57)	5.91/0.13 (57)	14.75/0.32 (57)	-	-
IAEA Cruise [1]	09.1998	Western Black Sea	-	-	-	-	-	-	-	-	-	-
IAEA Cruise [1]	09.2000	Eastern Black Sea	-	-	-	-	-	-	-	-	-	-
Monitoring [3]	2005	Bulgaria	-	-	-	-	-	-	-	-	-	-

Project	Year	Region	Ɣ-HCH	A-HCH	B-HCH	HCH total	DDT	DDE	DDD	DDT total	HCB*	Other
AeroVisual Monitoring	2003	Russia	2.33/0.23 (40)	2.32/0.39 (40)	3.88/2.70 (40)	6.50/3.31 (40)	2.30/0.48 (40)	0.96/0.34 (40)	0.36/0.02 (40)	3.26/0.84 (40)	0.32/0.06 (40)	0.86/0.26 (40)
AeroVisual Monitoring	07-08.2004	Russia	3.60/0.14 (80)	0.59/0.11 (80)	4.99/3.14 (80)	7.21/3.38 (80)	1.28/0.17 (80)	0.39/0.04 (80)	0/0 (80)	1.66/0.21 (80)	0.28/0.06 (80)	0.18/0.01 (80)
AeroVisual Monitoring	10.2004	Russia	0.19/0.13 (100)	0.20/0.12 (100)	3.42/2.74 (84)	3.76/2.85 (100)	0/0 (84)	0.34/0.05 (84)	0/0 (84)	0.34/0.05 (84)	0.11/0.09 (84)	0/0 (84)
AeroVisual Monitoring	07.2005	Russia	0.35 /0.16 (59)	0.68 /0.43 (59)	6.81/3.98 (59)	7.80/4.55 (59)	0.64/0.15 (59)	0.23/0.02 (59)	0.77/0.08 (59)	1.29/0.20 (59)	0.14 /0.07 (59)	0.18 /0.09 (59)PCB

Notes: HCB* - hexachlorobenzene,

** - the onlysamples treated in 1999.

0.18/0.09/59PCB - pentachlorobenzene, maximum, average and number of samples.

Except some hot spot regions with clear anthropogenic influence from the main land base sources, heavy metal concentrations are generally lower than their Maximum Allowed Concentration (MAC) levels in coastal waters, and close to their natural background values in offshore waters. In particular, the copper and chromium pollutions were wide-spread over the north western shelf (Ref. 6.28). High chromium concentration was also found along the Crimea coast. A tendency of decreasing maximum mercury and cadmium concentrations in the Danube Delta region has been noted during last 10 years (Ref. 6.29).

6.3.1.2. Current Circulation and Seasonal Cycles

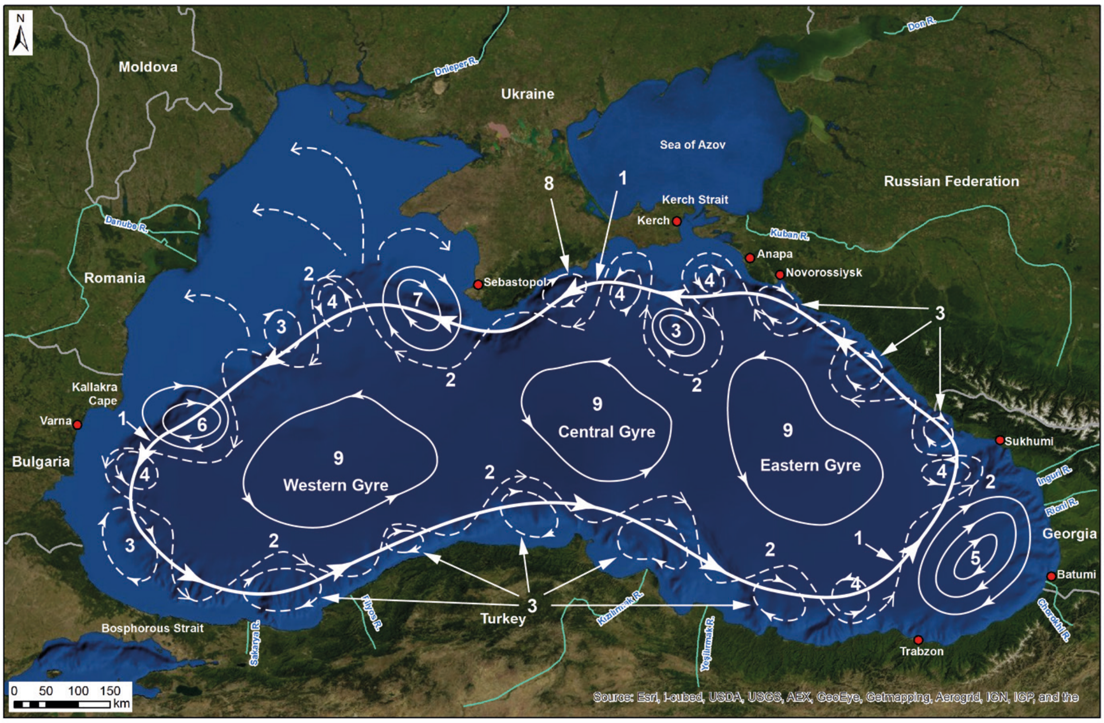
Circulation Patterns and Currents

The upper layer waters of the Black Sea are characterised by a predominantly cyclonic, strongly time-dependent and spatially-structured basin wide circulation. These analyses reveal a complex, eddy dominated circulation with different types of structural organisations within the interior cyclonic cell, the Rim Current flowing along the abruptly varying continental slope and margin topography around the basin, and a series of anticyclonic eddies in the onshore side of the Rim Current. The interior circulation comprises several sub-basin scale gyres; each of them involving a series of cyclonic eddies. They evolve continuously by interactions among each other, as well as with meanders, and filaments of the Rim Current. The Rim Current structure is accompanied by coastal-trapped waves with an embedded train of eddies and meanders propagating cyclonically around the basin (Ref. 6.29, Ref. 6.33). Over the annual time scale, westward propagating Rossby waves further contribute complexity to the basin wide circulation system (Ref. 6.28).

The most notable features of the circulation system, as schematically presented in **Fig. 6.71** include (Ref. 6.24)

- The meandering Rim Current system cyclonically encircling the basin;
- Two cyclonic sub-basin scale gyres comprising four or more gyres within the interior;
- The Bosphorus, Sakarya, Sinop, Kizilirmak, Batumi, Sukhumi, Caucasus, Kerch, Crimea, Sevastopol, Danube, Constantsa, and Kaliakra anticyclonic eddies on the coastal side of the Rim Current zone;
- Bifurcation of the Rim Current near the southern tip of the Crimea; one branch flowing southwestward along the topographic slope zone, and the other branch deflecting first northwestward into the shelf and then contributing to the southerly inner shelf current system;
- Convergence of these two branches of the original Rim Current system near the southwestern coast; and
- Presence of a large anticyclonic eddy within the northern part of the northwestern shelf.

The basic mechanism which controls the flow structure in the surface layer of the north-western shelf is spreading of the Danube outflow. Wind stress and Rim Current structure along the offshore side of the shelf are additional modifiers of this system. The freshwater discharge influences not effect only the circulation and mixing properties, but also the ecosystem of the entire shelf region along the western coast. The Danube plume generally forms an anticyclonic bulge confined within the upper 25 m layer. The leading edge of this plume protrudes southward (i.e. downstream) as a thin baroclinic boundary current along the western coastline. The coastal jet is separated from the interior waters by a well-defined front with salinity differences of more than 3.0 over an approximately 50 km zone along the coast. It is often unstable, exhibits meanders and spawns filaments, which extend across the wide topographic slope zone. The shelf and interior waters undergo cross-shelf exchanges as reported consistently in hydrographic surveys, satellite imagery, and altimeter data (Ref. 6.17).



Key:
1: mean position of the cyclonic Rim Current jet current
2: Rim Current meanders
3: anticyclonic coastal eddies
4: cyclonic eddies
5: Batumi anticyclonic eddy
6: Kaliakra anticyclonic eddy
7: Sebastopol anticyclonic eddy
8: Crimea anticyclonic eddy
9: quasi-stationary cyclonic gyres

Figure 6.71: Schematic diagram of currents within the Black Sea

According to the Acoustic Doppler Current Profiler measurements (Ref. 6.32), the Rim Current jet has a speed of 50 to 100 cm/s within the upper layer, and about 10 to 20 cm/s within the water depths of 150 to 300 m. Apart from complex eddy-dominated features, larger scale characteristics of the upper layer circulation system possess a distinct seasonal cycle, as suggested by objectively analysed, optimally interpolated and dynamically assimilated sea level anomaly data provided by the Topex-Poseidon and ERS-1/2 altimeters period from 1 January 1993 to 31 December 1998 (Ref. 6.33). As shown by the model-derived circulation patterns (**Fig. 6.72**) the interior cyclonic cell in winter months involves a two-gyre system surrounded by a rather strong and narrow peripheral jet without any appreciable lateral variations (**Fig.6.72a**). This system transforms into a multi-centred composite cyclonic cell surrounded by a broader and weaker Rim Current zone in summer (**Fig. 6.72b**). The interior basin flow field further weakens and finally disintegrates into smaller scale cyclonic features in autumn (**Fig. 6.72c**). A composite peripheral current system is hardly noticeable in this season. The turbulent flow field is, however, rapidly converted into a more intense and organised structure after November and December.

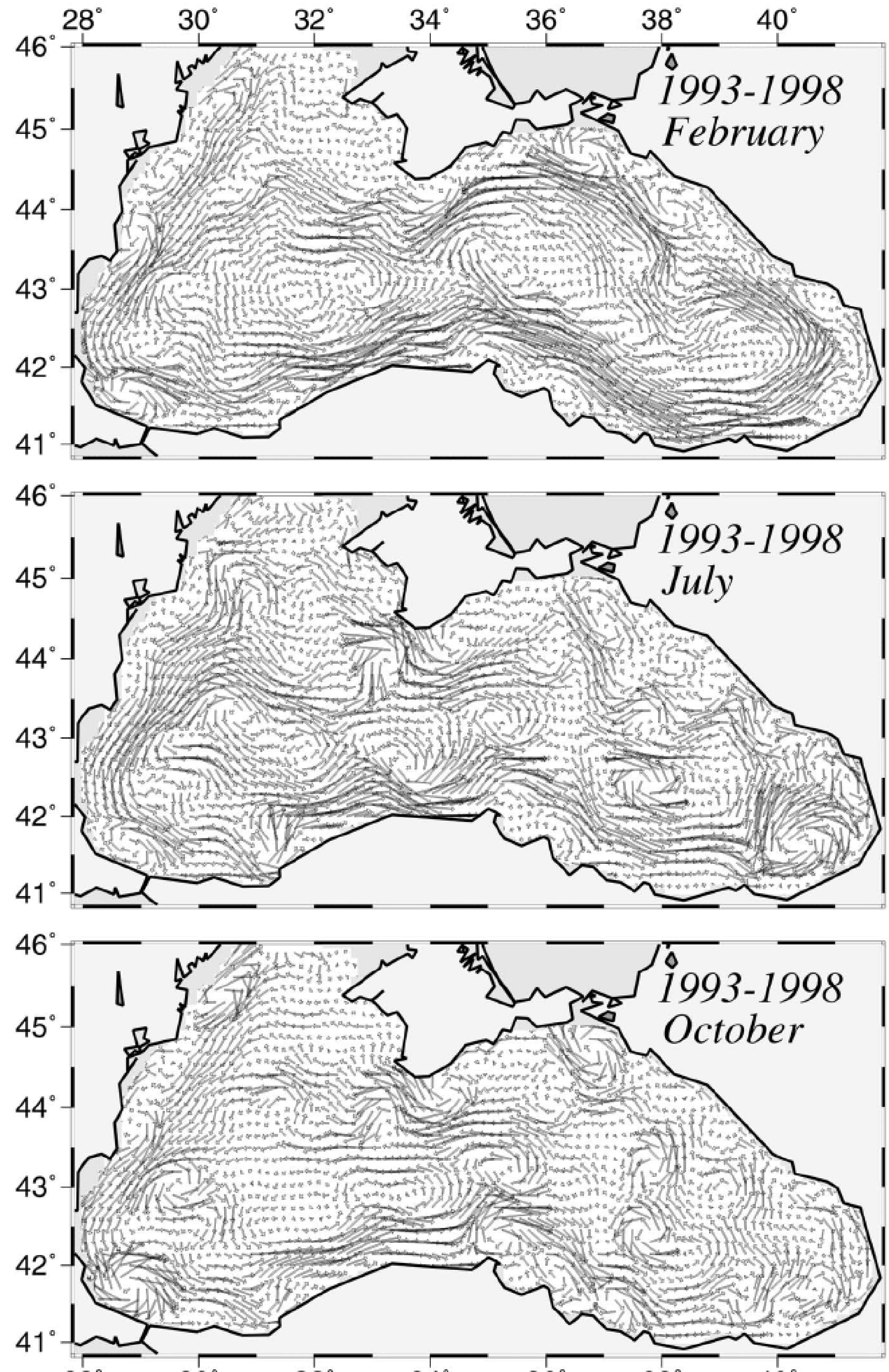


Figure 6.72: The upper layer circulation maps for (a) mid-February, (b) mid-July, (c) mid-October, constructed by the six year (1993–1998) averaging of the daily circulation fields computed by assimilating the Topex-Poseidon and ERS-I,II altimeter data into a 1.5 layer reduced gravity model (Ref. 6.33)

Lagrangian subsurface current measurements by three autonomous profiling floats deployed into the intermediate layer and deep layers permitted new insights on strength and variability of the flow field (Ref. 6.32). The data suggested active role of mesoscale features on the basin-wide circulation system at 200 m similar to the case observed in the upper layer (<100m) circulation system. The currents reach a maximum intensity of 15 cm s^{-1} along the Rim Current jet around the basin, which is consistent with the findings of ADCP measurements (Ref. 6.12). The magnitudes of deep currents may reach to 5 cm s^{-1} at 1,500 m depth along the steep topographic slope (Ref. 6.32). The results are shown in **Figure 6.73**.

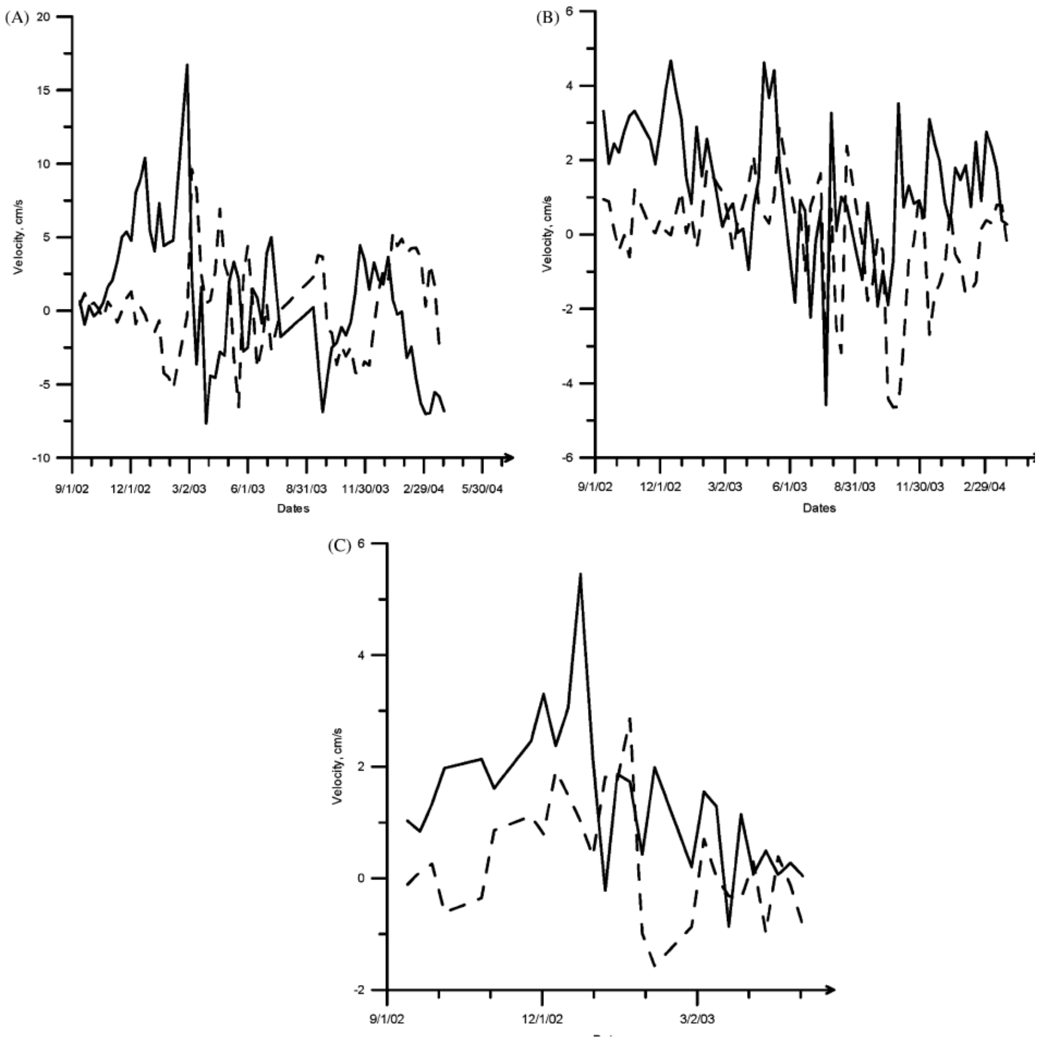
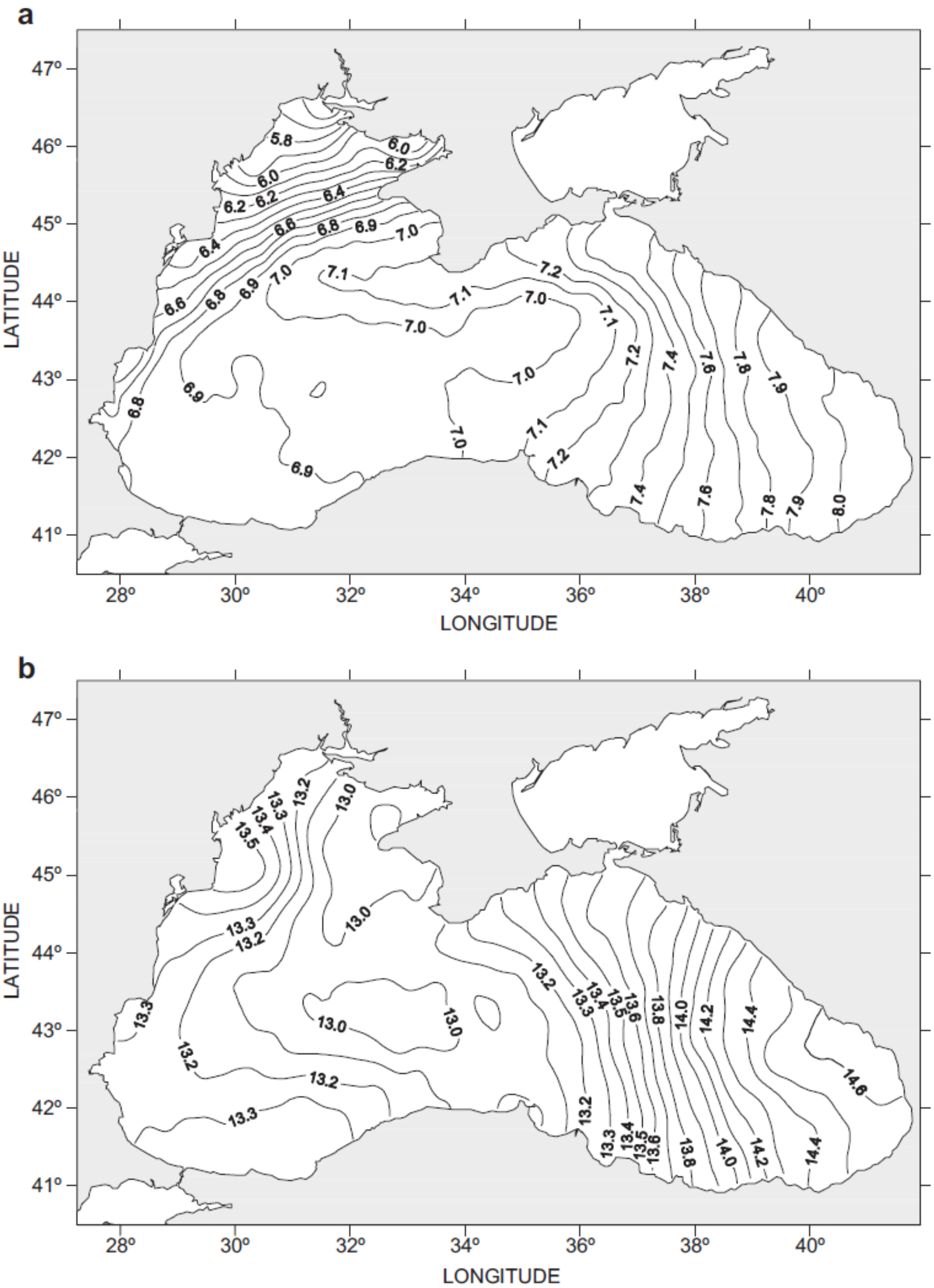


Fig. 6.73: Temporal evolution of the velocity components at the depth (A) 200 m, (B) 750m and (C) 1550 m. Solid line represents the zonal component, and the dash line represents the meridional component (Ref. 6.32)

Because of small thickness of its upper mixed layer, sea surface temperature (SST) respond quickly to the atmospheric forcing. For this reason, the Black Sea SST is exposed to significant seasonal, inter-annual and synoptic variability. Regional peculiarities of the thermal regime are conditioned by regional climatic conditions, advective heat transport by currents, river discharge, water exchange with the Azov Sea and the Sea of Marmara through straits, upwelling and down welling. The 19-yearly (1982–2000) mean SST fields for the central months of four hydrological seasons (winter: January–March; spring: April–June; summer: July–September; autumn: October–December) are presented in **Fig. 6.74**.


a
b
LATITUDE
LONGITUDE
47°
46°
45°
44°
43°
42°
41°
28°
30°
32°
34°
36°
38°
40°

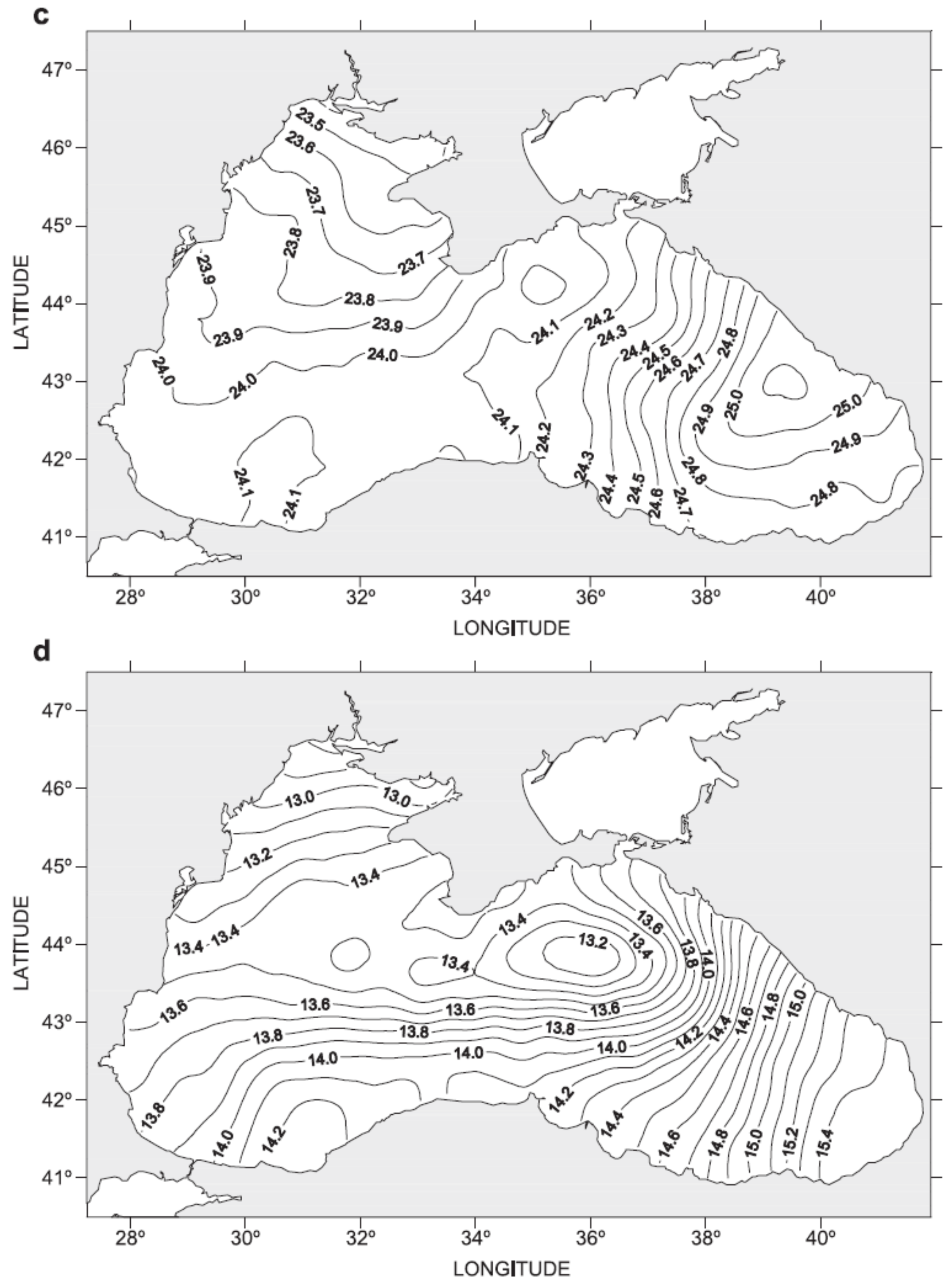


Figure 6.74: The satellite-derived SST fields averaged for the period 1982– 2000: (a) in February, (b) in May, (c) in August, (d) in November (Ref. 6.34)

Wave Heights

Wind regime is cyclic, with light breezes from May to September and heavy wind in the winter. The predominant direction of the spring and summer winds are west and south-western and southern. But the greatest number of days with strong winds in summer reaches only 3 to 5. In autumn and winter the winds predominately blow from the northern, north-eastern and eastern areas. The maximum speed of up to 40 m/s, with the largest number of days of strong winds (October-March), equal to 12 to15 (Ref. 6.17).

In the Turkish sector of the Black Sea there are favourable conditions for the development of storm waves i.e. a large surface area, great depth, a weak irregularity of the coast. Throughout the summer, the frequency of wave height of less than 1 m is 60- to70%. In winter, the frequency of these waves is reduced to 20 to 30%. Wave height of 2 to 3 m is most often observed in winter with their frequency during this period reaching 20% whereas in the rest of the year this does not exceed 15%. Wave heights of 6 m or more are rare; their frequency does not exceed 1% (December to February). In the coastal regime of waving is very volatile and depends on the characteristics of a particular area. Storms (over VI scores) are more common during the cold season, when their frequency is 10%. The frequency of calm periods in summer is up to 10 days (**Table 6.23**).

Table 6.23: Waving frequency in the different seasons (Ref. 6.17)

Wave height, m	Winter	Spring	Summer	Fall
<1	27	45	70	42
1—2	43	40	24	42
2—3	20	12	5	12
3—6	9	3	1	4
6-11	1	0	0	0
>11	0	0	0	0

6.3.2. Hydrographic, Oceanographic and Hydrological Characteristics of the Project Area

6.3.2.1. Chemical Characteristics of Sea Water

Marine environmental surveys in the Project Area were undertaken in September-October 2011 (Ref. 6.17). The survey was conducted to assess hydro-chemical and water contamination. Water samples were collected at 15 locations, the results are shown in **Appendix 6.I** (Sea water quality sampling results). Detailed information on the sample collection, analysis and results interpretation are given in Ref. 6.17.

The hydro-chemical studies included a collection and analysis of 51 samples. The samples were collected at:

- Twelve stations (No 1, 2, 4 to 8, 10 to 13 and 15) along the surface, pycnocline and hydrogen sulphide boundary layer; and
- Three stations (No 3,9 and 14) along the surface, pycnocline layer, hydrogen sulphide boundary layer, depth of 1,000m and the seabed.

The hydro-chemical testing included Dissolved Oxygen, Ammonium Nitrogen (N-NH_4), pH, BOD_5, Phosphate (PO_4-P), Total and Organic Phosphorus, Nitrite (N-NO_2), Nitrate (N-NO_3), Total and Organic Nitrogen, Silicate (Si), Hydrogen Sulphide (H_2S) and Alkalinity. Testing was undertaken at:

- Two stations (No 6 and 11) along the surface, pycnocline and hydrogen sulphide layer; and
- Three stations (No 3, 9 and 14) along the surface, pycnocline layer, hydrogen sulphide boundary layer, depth of 1000m and the bottom layer.

The list of defined components included: petroleum hydrocarbons, AS (anionic surfactants), OCPs (organochlorine pesticides), phenols, suspended substances, manganese, arsenic, iron, mercury, nickel, lead, cadmium, zinc, chromium, copper, selenium and molybdenum.

Measurement and sampling were conducted using CTD-complex “Sea-Bird” (“SBE 911 plus”), equipped by sensors of temperature, electro-conductivity and pressure, with the rosette “SBE 32 carousel” (12 5-litre bathometers). The temperature and salinity data obtained were processed using software from the manufacturer of the probe. Analysis of samples were either conducted on board or forwarded to accredited laboratories.

The distribution of hydrological characteristics and hydro-chemical parameters are shown on in **Appendix 6.I**. The assessment of selected tested parameters is described below.

Temperatures ranged from 21.2 to 22.7 °C in the surface layer while showing a sharp decrease to 8-9 °C at depths starting from 15 to 20m. These values did not exceed 8.5 °C in the anoxic layer beginning at a depth of 80 to 100 m and showed a slight increase up 9.1 °C at depths of about 2,000 m. **Fig. 6.75** shows a typical temperature profile.

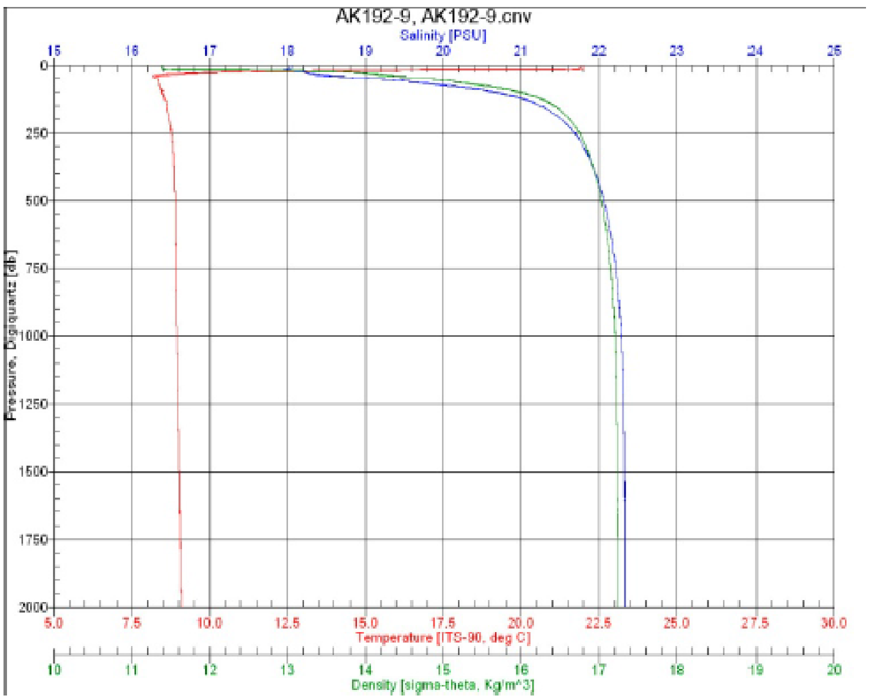


Figure 6.75: Vertical distribution of temperature, salinity and density at station number 9 (Temperature, ºC; Salinity, ‰; Density of water, kg/m^3)

Salinity values are constant at 18 PSU to a depth of 30 m following which a pronounced increase to values of 21 PSU at depths of 80-100 m. A smoother increase in salinity is observed from a depth of 200 to 1000 m. The average values are 22 PSU at depths of 2,000 m (**Fig. 6.75**).

The values of pH ranged from 7.14 to 8.39. The pH was greater than at the surface at most stations in the water layer above the pycnocline (30-40 m). A decrease in pH with depth was noted in all of the stations. The sharp decrease in the pH values associated with the anoxic layer can be seen in the Stations 3 and 9 pH variation with depth in **Figure 6.76**.

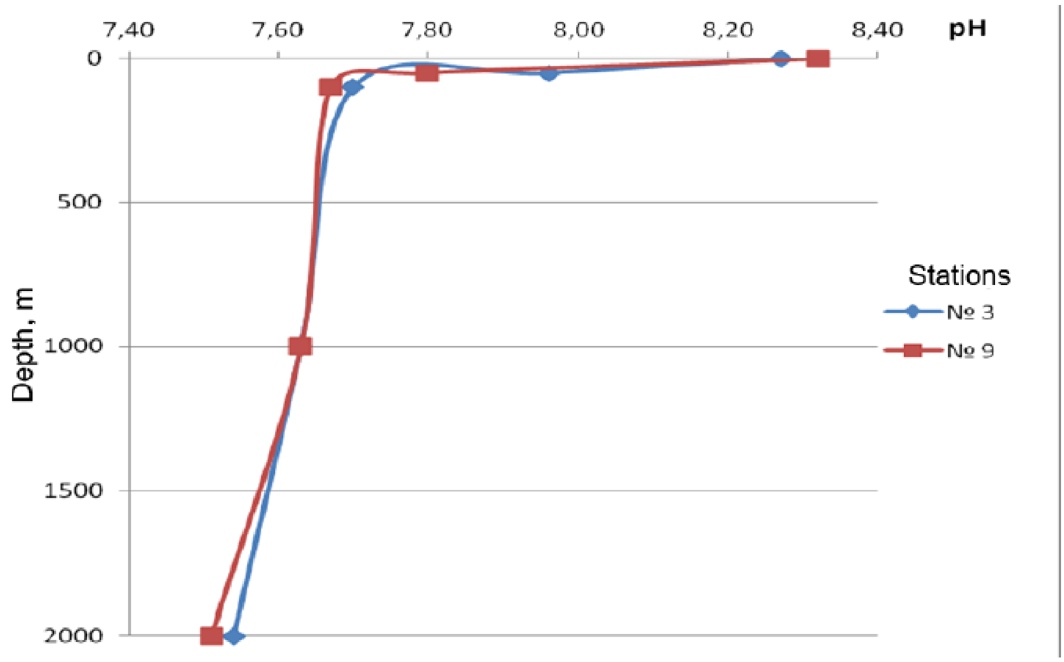


Figure 6.76: Distribution of pH in the water column at Stations 3 and 9

Alkalinity showed a uniform distribution in the biotic layer and were in the range from 2.7 to 3.0 mg-ekv/dm^3. The values increased 4.0 mg-ekv/dm^3 in anoxic layers.

Dissolved oxygen content varied from 8.3 to 9.8 mg/dm^3 at the surface. The values varied between 9.0 to 9.82 mg/dm^3 at 40-50 m depths. The dissolved oxygen concentration decreased to 0.2-0.1 mg/dm^3 starting at depth of 80 to100 m. The variation of the O_2 levels is given in **Figure 6.77**.

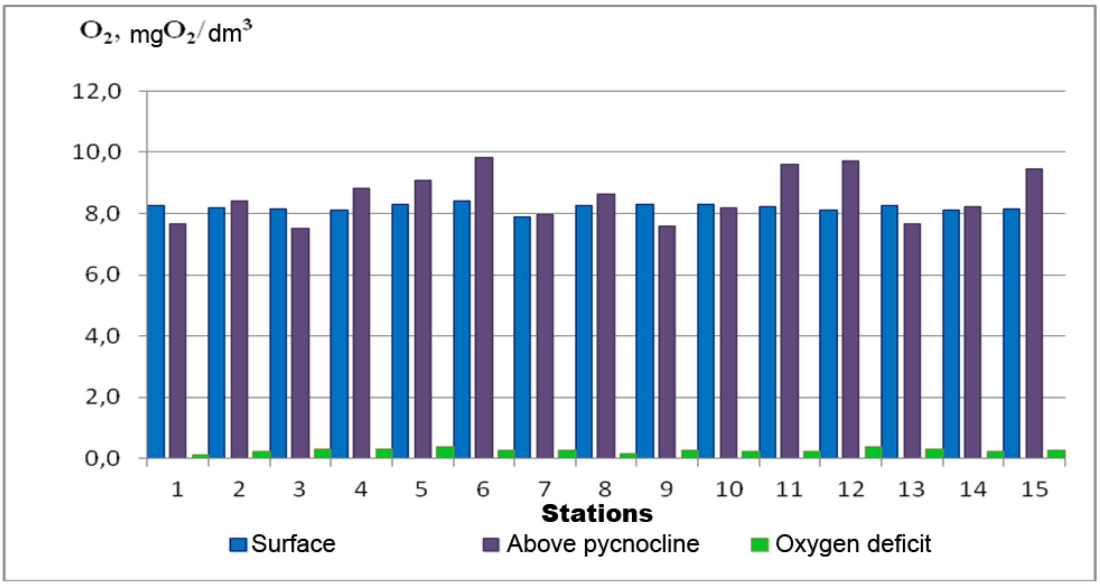


Figure 6.77: The distribution of dissolved oxygen in water layers (mgO_2/dm^3)

BOD$_5$ values ranged from 0.5 to 1.9 mg O_2/dm^3. The lowest values in the surface layer were recorded at three stations (1, 9, 11) at below the detection limit (<0.5 mgO_2/dm^3). The highest values were observed above the pycnocline) at 1.9 mgO_2/dm^3. BOD$_5$ values were 0.8-1.1 mgO_2/dm^3in the bottom layers.

The content of hydrogen sulphide varied from its absence on the surface (<0.05 mg/dm^3) to a gradual rise to 11.4-12,9 mg/dm^3 (Fig. 2.3.1.2.9) in the deepest sample depths. The sharp increase in the values of hydrogen sulphide began at a depth of approximately 100 to 150 m, where the values averaged 10.5 mg/dm^3 (Figure 6.78).

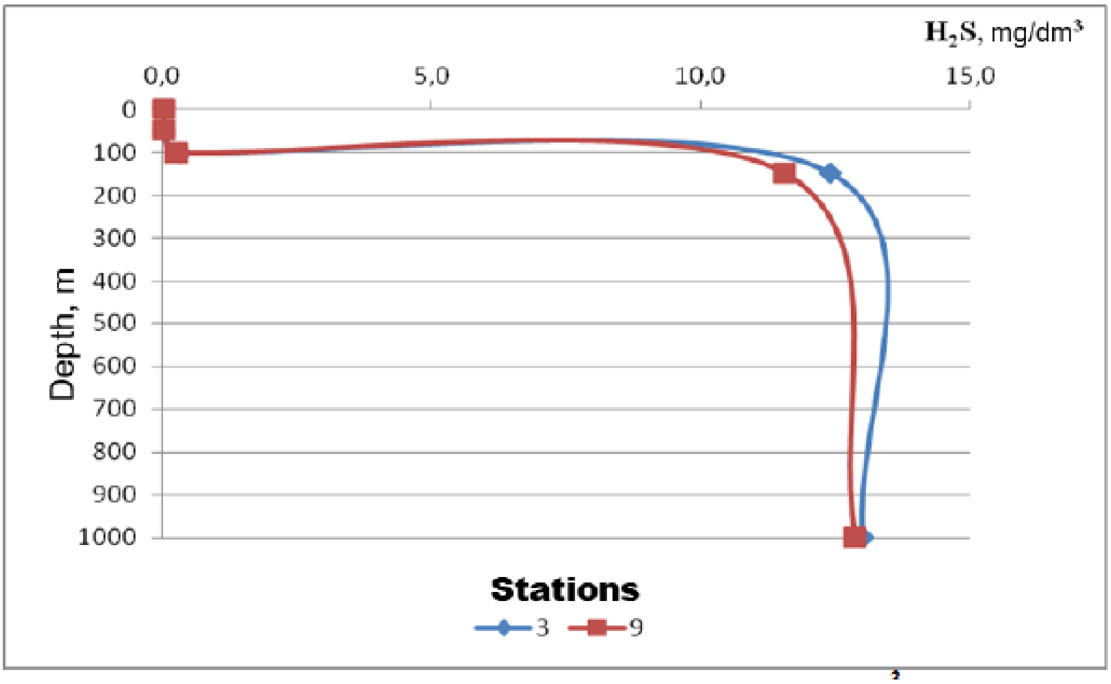


Figure 6.78: The distribution of hydrogen sulphide (mg/dm^3) in the water column

The values of nitrate nitrogen were below detection limit (<5 µg/dm^3) at almost all the stations and at most horizons. The exceptions were Station 3 (9 µg/dm^3 at 49 m depth), station 6, (11 µg/dm^3 at the surface) and Station 9 (6 and 7 µg/dm^3 above the pycnocline and in the layer of oxygen deficiency, respectively).

The Nitrite nitrogen (N-NO_2) values were generally low at the surface. The values were below detection limit (<0.5 µg/dm^3) at six stations (1, 2, 4, 5, 6, 9). The values increased in the layer above the pycnocline and ranged from 0.6 to 6.3 µg/dm^3.These values decreased to 0.6 to 2.4 µg/dm^3 depths of 100 to 120 m. Ammonia nitrogen (N-NH_4+) ranged from 19 to 66 µg/dm^3 at the surface with an average concentration of 40 µg/dm^3. Most stations showed an increase in the layer above the pycnocline to an average of 53 µg/dm^3. Ammonia nitrogen averaged 100 µg/dm^3 in the anoxic layer. The concentration reached values from 558 to 913 µg/dm^3 at a depth of about 2000 m. The content of organic nitrogen (Norg) throughout the water column was below the detection limit (<250 µg/dm^3).Total nitrogen (Ntot) was below the detection limit (<250 µg/dm^3) at the surface and anoxic layer. High values were recorded only at depths of 2000 m (from 773 to 1096 µg/dm^3). Phosphate phosphorus (P-PO4) were practically absent (<5 µg/dm^3) at the surface with the exception of two stations (9, 15). The values increased between 6 and 14 µg/dm^3 in the layer of water above the pycnocline. The highest concentrations were recorded between 108 and 201 µg/dm^3 in the anoxic layer. Organic phosphorus values ranged between 7 to 64 µg/dm^3 in the surface layer. The values increased between 8 to 73 µg/dm^3, with an average grade of 35 µg/dm^3 at a depth of 40 to 50 m and reached average values of - 343 µg/dm^3 in the anoxic layer. Organic phosphorus values averaged 618 µg/dm^3 at 2000 m depths. Total phosphorus ranged from 8 to 69 µg/dm^3, with an average of 53 µg/dm^3 in the surface. These values increased to an average of 40 µg/dm^3 and 476 µg/dm^3 in the layer above the pinocline and anoxic layer, respectively. The average values were recorded at 835 µg/dm^3 at 2000 m depth. Lead concentrations were mostly below the limit of detection methods (<0.002 mg/dm^3) or exceed it slightly. Values of 0.032 mg/dm^3 and 0,005 mg/dm^3 were recorded at a depth of 35 m at Station 11 and a depth of 1970 at Station 14.

The content of dissolved iron in seawater ranged from <0.01 to 0.039 mg/dm^3, with an average of 0.024 mg/dm^3. The manganese content ranged from 0.0017 to 0.240 mg/dm^3, with an average grade of 0.11 mg/dm^3. There was an increase in concentration with depth starting from the depths of 100-110 m. The highest concentrations of manganese were observed in the bottom layers (Stations 3, 9 and 14). The distribution of manganese in the water layer was uniform throughout the Project Area. Concentrations of mercury, cadmium, copper, chromium, selenium, arsenic, molybdenum and cadmium were below the detection limit in all samples. The content of nickel and zinc were also below the detection limit in all samples, except for the sample obtained in the bottom layer at Station14.The content of petroleum products in the waters of the Survey Area was quite high and ranged from <0.02 to 0.73 mg/dm^3, with an average grade - 0.34 mg/dm^3. The content of anionic surfactants (AS) was fairly levels ranging between from 0.15 to 0.59 mg/dm^3. AS concentration decreased to an average of 0.19-0.2 mg/dm^3 with increasing depth but with a depth of 150-200 m once again increased to 0.25-0.4 mg/dm^3. The phenol content ranged from 0.002 to 0.015 mg/dm^3.The content of DDT and its breakdown products in the Survey Area waters throughout the water column was below the detection limit (<0.001 µg/dm^3). HCH Pesticides were also not detected (<0.001 µg/dm^3).

The following conclusions can be drawn from the chemical properties tested in the Survey Area:

- Hydrological characteristics are generally consistent with long-term data obtained from previous studies and described in Section 6.3.1;
- The concentration of inorganic pollutants in most samples was below the detection limit which would indicate un-impacted environmental conditions of marine waters;
- Relatively high concentrations of mineral oil, anionic surfactants and phenols were observed which would indicates adverse anthropogenic impact on the waters of the Black Sea; and
- Organochlorine pesticides – DDT and HCH – were below the detection limit of the analysis methods used.

6.3.2.2. Current Circulation and seasonal Cycles

Data Collection Program

Seventeen Autonomous Buoy Stations (ABS) were placed to collect Metocean data along the Project Area at the locations shown in Figure 6.79. The ABS were located in the Russian (ABS 1-7), Turkish (ABS 8-12) and Bulgarian section of the Project (ABS 13-17). The ABS configurations are shown in Fig. 6.80. The Metocean data collection program over the period from May to December 2011 is summarised in **Table 6.24**.

The data collection in the Turkish section involved current velocity and direction, sea level, water temperature and salinity measurements at the sea bottom. The measurements were collected using Recording Current Meter 9 Light Weight (RCM 9 LW), Recording Current Meter 9 Intermediate Water (RCM 9 IW), Recording Current Meter Seaguard (RCM Seaguard). A Doppler principle is used for velocity measurements, acoustic waves are an operating signal. The instruments are equipped with a magnetic compass.

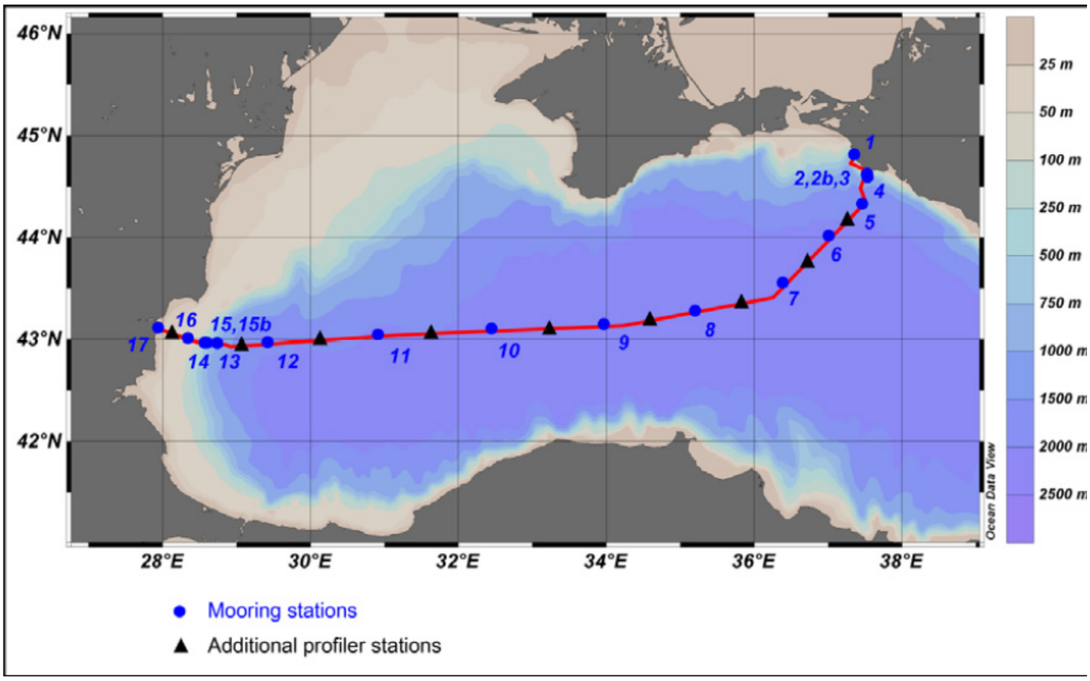


Figure 6.79: ABS locations and CTD-profiling points along the Pipeline Route (Ref. 6.17)

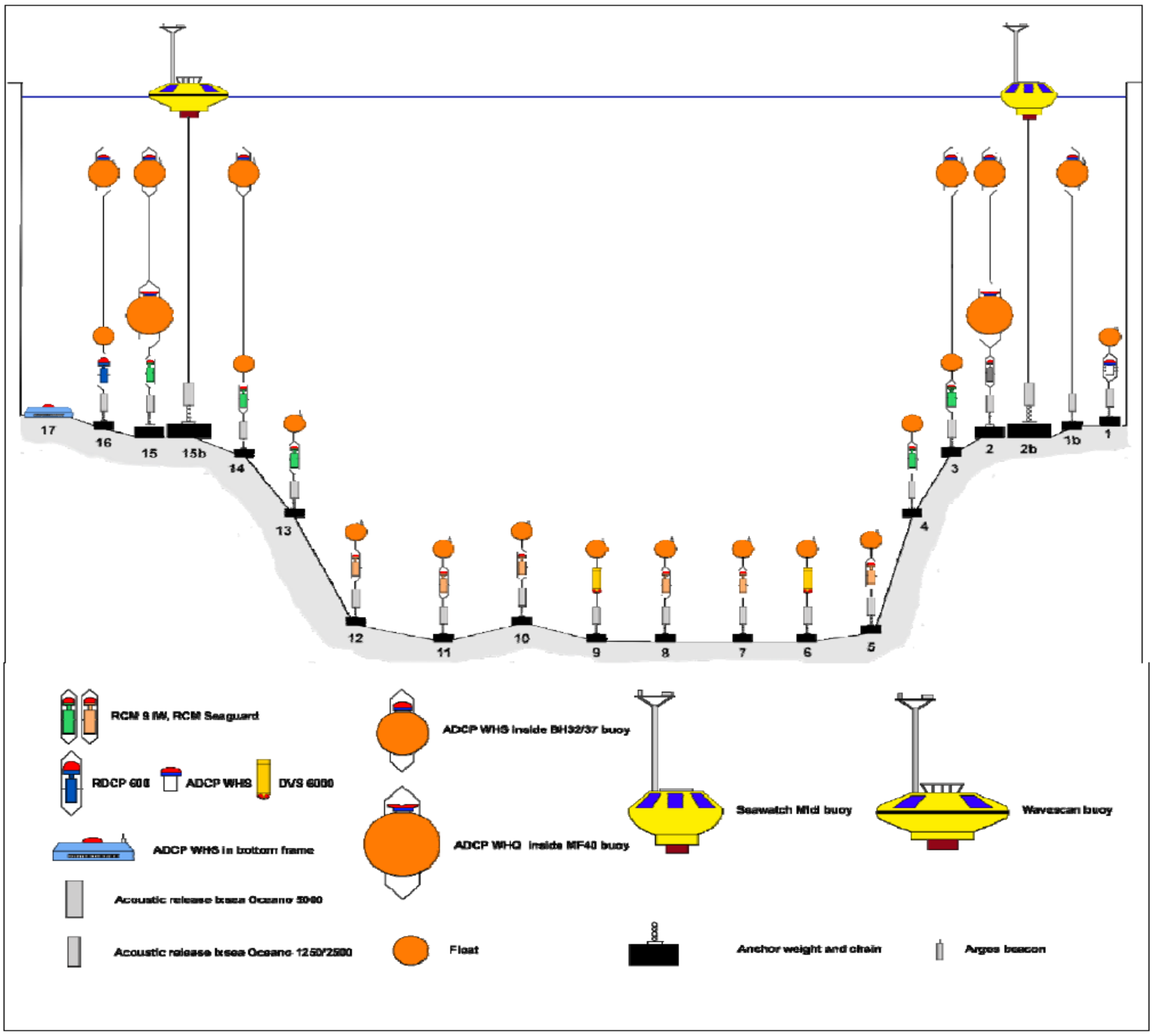


Figure 6. 80: ABS Configuration along the Project Area

Table 6.24: Metocean Data Collection Program

ABS	Measuring Unit	Location (WGS-84) Depth, m	Start of observations	Service at the 3rd stage	Quantity of days	Volume of data collected	Observed parameters
1	ADCP 600	$44^0$48.75' N $37^0$20.97' E 22 m	15.05.11	01.08.11	72	45%	Current velocity and direction, sea level, water temperature, waves
	SBE 37		15.05.11		0	0	Water temperature and salinity
1b	ADCP 300	$44^0$38.55' N $37^0$30.68' E 78 m	15.05.11	05.11.11	174	100%	Current velocity and direction, sea level, water temperature, waves
2	ADCP 300	$44^0$37.57' N $37^0$31.71' E	16.05.11	04.11.11	172	100%	Current velocity and direction, sea level, water temperature, waves

ABS	Measuring Unit	Location (WGS-84) Depth, m	Start of observations	Service at the 3^{rd} stage	Quantity of days	Volume of data collected	Observed parameters
	ADCP 150	365 m	16.05.11	04.11.11	172	100%	Current velocity and direction, sea level, water temperature
	RCM 9		16.05.11	04.11.11	172	100%	Current velocity and direction, water temperature and salinity
	RCM 9		03.08.11	04.11.11	172	54%	Sea level
2b	Seawatch Midi	44^{0}37.51’ N 37^{0}31.16’ E 250 m	16.08.11	18.10.11	63	78%	Wind speed and direction, air temperature and humidity, atmospheric pressure
	Seawatch Midi		16.08.11	04.11.11	81	100%	Waves
3	ADCP 300	44^{0}37.01’ N 37^{0}31.41’ E 485 m	16.05.11	04.11.11	172	100%	Current velocity and direction, water temperature, sea level, waves
	RCM 9		16.05.11	04.11.11	172	100%	Current velocity and direction, water temperature and salinity
4	RCM 9	44^{0}26.87’ N 37^{0}37.48’ E 1750 m	03.08.11	06.11.11	96	55%	Current velocity and direction, water temperature and salinity
5	RCM 9	44^{0}20.30’ N 37^{0}27.59’ E 1790 m	25.05.11	06.11.11	165	100%	Current velocity and direction, water temperature and salinity
6	DVS	44^{0}01.08’ N 37^{0}00.48’ E 2088 m	12.07.11	31.10.11	111	96%	Current velocity and direction, water temperature
7	RCM Seaguard	43^{0}33.33’ N 36^{0}23.08’ E 2129 m	26.05.11	08.11.11	136	82%	Current velocity and direction, water temperature and salinity
8	RCM Seaguard	43^{0}17.22’ N 35^{0}12.12’ E 2150 m	23.05.11	30.11.11	191	100%	Current velocity and direction, sea level, water temperature and salinity

ABS	Measuring Unit	Location (WGS-84) Depth, m	Start of observations	Service at the 3rd stage	Quantity of days	Volume of data collected	Observed parameters
9	DVS	43^{0}08.80’ N 33^{0}57.60’ E 2175 m		Lost			
10	RCM Seaguard	43^{0}06.36’ N 32^{0}26.82’ E 2055 M	19.05.11	01.12.11	196	100%	Current velocity and direction, sea level, water temperature and salinity
11	RCM Seaguard	43^{0}02.86’ N 30^{0}54.93’ E 2025 m	19.05.11	02.11.11	197	100%	Current velocity and direction, sea level, water temperature and salinity
12	RCM 9	42^{0}58.26’ N 29^{0}24.83’ E 1968 m	20.05.11	02.12.11	195	100%	Current velocity and direction, sea level, water temperature and salinity
13	RCM 9	42^{0}46.24’ N 28^{0}56.67’ E 1602 m	29.06.11	08.12.11	162	100%	Current velocity and direction, sea level, water temperature and salinity
14	ADCP WHS	42^{0}54.30’ N 28^{0}35.34’ E 591 m	07.08.11	08.12.11	123	73%	Current velocity and direction
	ADCP WHS		22.06.11	08.12.11	169	100%	Water temperature, sea level, waves
	RCM 9		22.06.11	08.12.11	169	100%	Current velocity and direction, water temperature and salinity
	RCM 9		27.08.11	08.12.11	103	61%	Sea level
15	ADCP WHS	42^{0}55.22’ N 28^{0}32.35’ E 291 m	07.08.11	07.12.11	122	73%	Current velocity and direction, sea level, water temperature, waves
	ADCP 150		22.06.11	07.12.11	169	100%	Current velocity and direction, sea level, water temperature
	RCM 9		22.06.11	07.12.11	169	100%	Current velocity and direction, water temperature and salinity
	RCM 9		07.08.11	07.12.11	122	73%	Sea level

ABS	Measuring Unit	Location (WGS-84) Depth, m	Start of observations	Service at the 3^{rd} stage	Quantity of days	Volume of data collected	Observed parameters
15b	Wavescan buoy	$42^{0}55.41'$ N $28^{0}32.12'$ E 250 m	08.08.11	07.12.11	121	100%	Wind speed and direction, air humidity, atmospheric pressure, water temperature and salinity, waves
	Wavescan buoy		08.08.11	07.12.11	96	79%	Air temperature
16	ADCP WHS	$43^{0}00.38'$ N $28^{0}20.40'$ E 72 m	23.08.11	21.11.11	151	90%	Current velocity and direction, water temperature, sea level, waves
	ADCP WHS		07.08.11	06.12.11	122	74%	Current velocity and direction, water temperature, sea level
17	ADCP WHS	$43^{0}04.60'$ N $28^{0}02.26'$ E 20 m	27.07.11	01.11.11	97	100%	Current velocity and direction, water temperature, sea level, waves

The Turkish Sector data collection involved current velocity and direction, sea level, water temperature and salinity using Recording Current Meter 9 Light Weight (RCM 9 LW), Recording Current Meter 9 Intermediate Water (RCM 9 IW), Recording Current Meter Seaguard (RCM Seaguard). A Doppler principle is used for velocity measurements, acoustic waves are an operating signal. The instruments are equipped with a magnetic compass; it is possible to install temperature, conductivity, pressure (level), turbidity, dissolved oxygen content and instrument inclination sensors.

Data Results

Sea water temperature and salinity results are given in **Table 6.25**. The results indicate that the temperature is almost constant near the seabed in the survey Area and varied between 9.10 and 9.12^{0}C along the measurement points. Salinity measurements also showed very little variation during the data collection period. The measured salinity values varied between 22.3 and 22.75 in practical salinity units (PSU).

Table 6.25: Temperature and Salinity Measurements (Ref. 6.20)

ABS	Depth, m	Observational period	Temperature, ^{0}C			Salinity, PSU		
			min	mean	max	min	mean	max
1	19	15.05.-01.08.2011	8.93	12.09	27.20			
1b	20	15.05.-05.11.2011	8.55	13.10	24.14			

ABS	Depth, m	Observational period	Temperature, ^{0}C			Salinity, PSU		
			min	mean	max	min	mean	max
2	48	16.05.-02.08.2011	7.68	8.18	8.97			
	374	16.05.-04.11.2011	8.90	8.95	8.97	21.19	21.58	21.98
3	24	16.05.-04.11.2011	8.21	12.70	24.30			
	494	16.05.-04.11.2011	8.88	8.88	8.88	22.01	22.06	22.38
4	1749	03.08.-06.11.2011	9.10	9.10	9.10	22.76	23.03	23.08
5	1789	25.05.-06.11.2011	9.60	9.60	9.60	22.52	22.54	22.58
6	2086	12.07.-31.10.2011	9.50	9.50	9.50			
7	2128	26.05.-06.07.2011 05.08.-08.11.2011	9.12	9.12	9.12	22.35	22.38	22.40
8	2167	23.05-30.11.2011	9.12	9.12	9.12	22.32	22.34	22.38
10	2075	19.05-01.12.2011	9.11	9.11	9.11	22.33	22.36	22.40
11	2026	19.05-02.12.2011	9.10	9.11	9.11	22.30	22.36	22.40
12	2100	20.05-01.12.2011	9.10	9.10	9.10	22.56	22.72	22.77
13	1597	29.06-08.12.2011	9.06	9.06	9.06	22.66	22.75	22.82
14	5	22.06-07.08.2011	18.25	23.22	25.92	-	-	-
	23	07.08-08.12.2011	9.62	16.73	24.15	-	-	-
	574	22.06-08.12.2011	8.90	8.90	8.90	21.66	21.79	21.85
15	27	07.08-07.12.2011	8.45	14.04	22.80	-	-	-
	280	22.06-07.12.2011	8.69	8.78	8.82	21.52	21.73	21.88
15b	1	08.08-07.12.2011	10.08	18.63	26.09	16.80	17.92	18.36
16	20	23.06-11.12.2011	9.76	16.68	23.80	-	-	-
	67	07.08-06.12.2011	7.88	8.94	18.17	-	-	-
17	20	27.07-01.11.2011	10.80	18.43	23.73	-	-	-

Currents near the seabed were noted to be very slow. The maximum observed do not exceed 10 cm/s, mean values are close to 2 cm/s. Results of the current measurements for Stations 8, 10, 11 and 12 are given in **Tables 6.26-6.29**,respectively.

Table 6.26: Maximum observed current velocity, estimated values with different return periods and recurrence of sea currents by directions. Station 8 (depth 2167 m)

Direction	Return period, years					Maximum observed, cm/s	Recurrence, %
	1	5	10	50	100		
N	6.6	7.2	7.4	7.9	8.2	6.2	9.7
NNE	7.1	7.7	7.9	8.5	8.7	6.4	10.1
NE	7.5	8.2	8.5	9.1	9.3	6.8	8.7
ENE	7.0	7.7	7.9	8.5	8.7	6.5	4.9
E	6.3	7.0	7.3	7.9	8.2	5.4	3.1
ESE	5.1	5.7	6.0	6.6	6.8	5.1	2.4
SE	4.4	5.0	5.2	5.6	5.8	4.4	2.9
SSE	4.4	4.7	4.9	5.2	5.3	4.0	4.7
S	4.4	4.7	4.8	5.0	5.1	4.0	7.3
SSW	5.0	5.3	5.5	5.8	6.0	4.7	7.7
SW	4.7	5.1	5.2	5.6	5.7	4.6	6.6
WSW	4.5	4.8	5.0	5.2	5.4	4.2	5.9
W	5.1	5.6	5.8	6.2	6.4	4.6	5.2
WNW	6.1	6.6	6.8	7.3	7.5	5.1	6.1
NW	6.1	6.6	6.8	7.2	7.4	5.7	6.9
NNW	5.6	6.0	6.2	6.5	6.7	5.0	7.8
Omni-directional	7.5	8.2	8.5	9.1	9.3	6.8	100.0

Table 6.27: Maximum observed current velocity, estimated values with different return periods and recurrence of sea currents by directions. Station 10 (depth 2075 m)

Direction	Return period, years					Maximum observed, cm/s	Recurrence, %
	1	5	10	50	100		
N	6.8	7.4	7.6	8.1	8.3	5.9	4.0
NNE	6.9	7.3	7.5	7.8	7.9	6.0	10.2
NE	6.6	7.0	7.2	7.5	7.6	6.0	11.3
ENE	6.8	7.3	7.5	7.9	8.0	5.9	7.4
E	6.6	7.1	7.3	7.7	7.9	6.1	6.2

Direction	Return period, years					Maximum observed, cm/s	Recurrence, %
	1	5	10	50	100		
ESE	6.2	6.6	6.8	7.3	7.4	5.5	6.0
SE	6.2	6.7	6.9	7.4	7.5	5.6	5.4
SSE	6.4	6.9	7.1	7.5	7.7	5.6	5.4
S	6.1	6.6	6.8	7.2	7.4	5.7	5.7
SSW	7.1	7.8	8.1	8.7	8.9	6.8	6.2
SW	8.7	9.5	9.9	10.6	11.0	7.9	7.4
WSW	8.3	9.0	9.3	9.9	10.1	8.6	7.7
W	6.9	7.5	7.7	8.1	8.3	6.6	7.3
WNW	6.2	6.9	7.1	7.7	7.9	5.2	4.5
NW	4.9	5.8	6.1	7.0	7.3	4.9	2.9
NNW	5.0	5.8	6.2	6.9	7.3	4.9	2.3
Omni-directional	8.7	9.5	9.9	10.6	11.0	8.6	100.0

Table 6.28: Maximum observed current velocity, estimated values with different return periods and recurrence of sea currents by directions. Station 11 (depth 2026 m)

Direction,	Return period, years					Maximum observed, cm/s	Recurrence, %
	1	5	10	50	100		
N	6.8	7.5	7.8	8.4	8.7	6.3	3.9
NNE	6.0	6.6	6.8	7.4	7.6	5.7	3.7
NE	6.6	7.1	7.3	7.7	7.9	6.2	5.8
ENE	6.6	7.0	7.2	7.5	7.6	6.4	7.6
E	6.7	7.2	7.4	7.9	8.1	6.4	5.7
ESE	6.4	7.1	7.4	8.1	8.3	5.6	3.0
SE	6.8	7.6	7.9	8.6	8.9	6.3	2.6
SSE	5.9	6.5	6.7	7.3	7.5	5.2	2.6
S	4.9	5.3	5.5	5.9	6.1	4.4	2.8
SSW	5.0	5.5	5.7	6.1	6.3	5.0	4.7
SW	9.5	10.8	11.3	12.5	5.0	8.9	10.4

Direction,	Return period, years					Maximum observed, cm/s	Recurrence, %
	1	5	10	50	100		
WSW	12.2	13.0	13.4	14.1	14.4	11.3	19.8
W	11.6	12.3	12.6	13.2	13.4	11.0	14.8
WNW	11.2	12.7	13.3	14.7	15.3	8.3	5.4
NW	6.2	6.9	7.1	7.7	8.0	5.6	3.5
NNW	6.4	7.1	7.3	7.9	8.2	5.3	3.7
Omni-directional	12.2	13.0	13.4	14.7	15.3	11.3	100.0

Table 6.29: Maximum observed current velocity, estimated values with different return periods and recurrence of sea currents by directions. Station 12, (depth 1974 m)

Direction	Return period, years					Maximum observed, cm/s	Recurrence, %
	1	5	10	50	100		
N	4.2	4.8	5.0	5.6	5.8	3.5	2.6
NNE	5.3	6.1	6.4	7.0	7.3	4.7	3.4
NE	5.3	6.0	6.3	6.9	7.2	4.7	3.9
ENE	4.5	5.0	5.2	5.6	5.8	4.4	4.2
E	3.8	4.1	4.3	4.6	4.7	3.2	3.8
ESE	3.8	4.2	4.4	4.8	5.0	3.5	3.8
SE	3.9	4.4	4.6	5.0	5.2	3.8	3.9
SSE	4.0	4.5	4.7	5.2	5.4	3.5	4.2
S	4.1	4.5	4.6	5.0	5.1	3.8	5.8
SSW	5.1	5.6	5.8	6.2	6.4	4.7	9.4
SW	5.4	5.8	6.0	6.4	6.6	5.0	13.9
WSW	6.0	6.5	6.7	7.2	7.4	5.9	15.8
W	5.4	5.9	6.1	6.6	6.8	5.3	11.1
WNW	5.4	6.1	6.4	7.0	7.3	5.3	6.7
NW	4.1	4.6	4.8	5.2	5.4	3.5	4.4
NNW	3.5	3.9	4.1	4.5	4.7	3.2	3.1

Direction	Return period, years					Maximum observed, cm/s	Recurrence, %
	1	5	10	50	100		
Omni-directional	6.0	6.5	6.7	7.2	7.4	5.9	100.0

Sea level data derived from hydrostatic pressure sensors installed on the measuring instruments are given in **Table 6.30**.

Table 6.30: Minimum and maximum sea level marks between May – December 2011. Sea level marks are given in cm relative to MSL over the data series

ABS	Observational period	Maximum observed	Minimum observed	Range of sea level variation
1	15.05-01.08.2011	0.25	-0.26	0.51
1b	15.05-05.11.2011	0.83	-0.26	1.09
2	16.05-02.08.2011	0.159	-0.211	0.37
	03.08-04.11.2011	0.259	-0.161	0.42
	03.08-04.11.2011	0.185	-0.175	0.36
7	26.05-08.11.2011	1.2	-0.48	1.68
8	23.05-30.11.2011	0.13	-0.15	0.28
10	19.05-02.11.2011	0.42	-0.38	0.8
11	19.05-02.11.2011	0.13	-0.29	0.42
14	07.08-07.12.2011	0.5	-0.55	1.05
15	07.08-07.12.2011			
	07.08-06.12.2011	0.35	-0.29	0.64
16	07.08-06.12.2011	0.92	-0.15	1.07
17	27.07-01.11.2011	0.6	-0.29	0.89

The metocean data collection along the Turkish Section of the Project indicates the following:

- The measurements obtained along Stations 8 to 12 (depths greater than 2,000 m) were very similar and showed very little time or distance variation The data taken in the points therefore be used to estimate currents and water temperature values in the near bottom layer; and

- The measured data were within the range of previously reported results in the literature. Mean current values were close to 2 cm/s near the seabed. The temperature and salinity values varied between 9.10 to 9.12^{0}C and 22.3 to 22.75, respectively.

6.3.3. Impacts which may arise during the Works and Procedures within the scope of Project and Measures to Control and Mitigate these Impacts (Construction, Operation and Decommissioning).

The potential hydrographic, oceanographic and hydrological impacts have been assessed based on the anticipated activities related to the Construction, Operational and Decommissioning Phases of the Project. Detailed information on the Project phases are given in **Section 1.5** of this report. A list of the Projects' phases and associated activities is given in **Table 6.31**.

Table 6.31: Project Phases and Activities

Phase	Activity	Impact
Construction	Mobilisation of vessels to and from site and vessel operations within construction spread	Waste and wastewater discharge to sea could cause localised deterioration of water quality.
		Non-routine leaks and spills could cause localised deterioration of water quality.
		Unplanned or emergency events leading to chemical or fuel spills could cause localised deterioration of water quality.
	Storage of fuel and other hazardous materials.	Non-routine leaks and spills could cause localised deterioration of water quality.
	Bunkering	
	Welding, weld testing and coating of pipe sections.	
Operation	Mobilisation of vessels to and from pipeline locations and vessel movements along pipeline (Pipeline condition survey)	Waste and wastewater discharge to sea could cause localised deterioration of water quality.
		Non-routine leaks and spills could cause localised deterioration of water quality.
		Unplanned or emergency events leading to chemical or fuel spills could cause localised deterioration of water quality.
Decommissioning (Pipeline left in situ)	Vessel operations associated with inspection surveys.	Waste and wastewater discharge to sea could cause localised deterioration of water quality.
		Non-routine leaks and spills could cause localised deterioration of water quality.
		Unplanned or emergency events leading to chemical or fuel spills could cause localised deterioration of water quality.

Phase	Activity	Impact
Decommissioning (Pipeline removed from seabed)	Vessel operations associated with the removal of the pipeline.	Waste and wastewater discharge to sea could cause localised deterioration of water quality.
		Non-routine leaks and spills could cause localised deterioration of water quality.
		Unplanned or emergency events leading to chemical or fuel spills could cause localised deterioration of water quality.

The assessment of impacts on water quality has been conducted in line with **Chapter 2 Environmental Impact Assessment Approach** of this EIA Report. An assessment of impacts compared to relevant national standards is given in **Chapter 9 Assessment of Project Activities** of this EIA Report.

Table 6.32 lists the controls which have been built into the design to limit potential impacts on water quality.

Table 6.32: Design controls

Design Controls	Receptor
Vessel discharges will be compliant with Marpol 73/78 cognisant of the Black Sea's status as an IMO special area with respect to oil and garbage.	Water quality
All activities will be undertaken in line with the Project's Environmental and Social Management Plans (ESMPs) including an Emergency Response Plan addressing spills.	
All activities will be undertaken in line with contractor's Environmental Management Plan / Shipboard Oil Pollution Emergency Plan (SOPEP) compliant with Marpol 73/78 Annex I and International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC).	
A waste management plan will be adopted as part of the Environmental and Social Management system developed for the Project (see section 11.2.3 of this Report).	

6.3.3.1. Impacts from Construction

The type and quantities of wastewater and waste expected to be generated during Construction are presented in **Section 9.7** of this EIA Report. All routine waste within the scope of MARPOL and wastewater will be managed in compliance with MARPOL 73/78 and the Regulation of Water Pollution Control (Official Gazette with Date: 31 December 2004 and No: 25687). Any routine discharges of waste waters to the Black Sea will be rapidly dispersed. Impacts associated with routine discharges are therefore expected to be local, reversible and short-term.

Despite the prevention measures and management procedures built into the design of the Project there is always a small risk that an oil or chemical spill can occur. Most spills are very small and have only limited local, reversible and short-term environmental effects.

Based on the above and **Section 9.7** of this EIA Report, the Project's design controls are considered sufficient to minimise impacts on water quality from construction. As such, no mitigation is proposed.

6.3.3.2. Impacts from Operation

The type and quantities of waste and wastewaters expected to be generated during Operation are presented in **Section 9.7** of this EIA Report. Those will be limited to waste and wastewater from vessels required by the periodic inspection and maintenance of the pipelines. Quantities will be much lower than those from construction activities. All routine waste within the scope of MARPOL and wastewater will be managed in compliance with MARPOL 73/78 and the Regulation of Water Pollution Control (Official Gazette with Date: 31 December 2004 and No: 25687). Impacts associated with routine discharges from the vessels involved during operation are expected to be local, reversible and short-term.

Based on the above, the Project's design controls are considered sufficient to minimise impacts on water quality from operation. As such, no mitigation is proposed.

6.3.3.3. Impacts from Decommissioning

At the time of writing this EIA Report, the strategy for decommissioning is unknown. If the pipelines are to be left in situ, discharges would be limited to those of the inspection survey vessels and potential impacts from decommissioning activities are expected to be similar to those from operation described in 6.3.3.2 of this EIA Report. If the pipelines are removed from the seabed, potential impacts from decommissioning activities are expected to be similar to those from construction described in 6.3.3.1 of this EIA Report.

6.3.3.4. Impacts from Unplanned / Emergency Events

In the event of a spill arising from an unplanned or emergency situation, water quality could be impacted. However, the likelihood of such spills is low. Should one occur, the proposed Emergency Response Plan (**Section 11.2.1**) and the contractor's Shipboard Oil Pollution Emergency Plan (SOPEP) will set out the strategy and specific actions that will be implemented.

Weathering processes, distance to the Turkish territorial waters, and the time afforded to the response effort suggest impacts associated with a large fuel spill are likely to be local, reversible, short-term and are not expected to reach the Turkish territorial waters.

In the event of a loss of pipeline containment, impacts are likely to be minimal because as the gas travels approximately 2,000 m to surface waters it will become dispersed across a wider area by water movement.

6.4 Fishing and Aquatic Products

Turkey is the dominant country in Black Sea fisheries. However, historical total catches of marine fish in the Black Sea by Turkey show large fluctuations, due to a number of environmental factors (as discussed in Section 7.2.2 of this EIA Report) and over-fishing. Fishing activity in the Black Sea, and Turkish waters, is largely confined to the shallower waters of the continental shelf areas where concentrations of fish species are greatest (in water depths up to 150 m). The European anchovy (*Engraulis encrasicolus*) dominates Turkey's Black Sea fisheries in terms of the quantity caught and its economic value; it is the most important marine fish resource for Turkey in the Black Sea.

A dedicated fish and fisheries study was conducted for the Project and is given in **Appendix 7.A**. The information presented below summarises the outcomes of this study.

6.4.1. Fish Migration and Feeding Areas

The main commercial pelagic species in the Black Sea of importance for the Turkish fish catch are European anchovy, sprat, Black Sea horse mackerel and Atlantic bonito (see **Section 6.4.2** below). These species all display migratory behaviour in the Black Sea. The main spawning and feeding grounds of the European anchovy are in the north-western and western continental shelf of the Black Sea, along the coastal waters of Bulgaria, Romania and Ukraine (Ref 6.36). Spawning occurs between May and August (Ref. 6.37) with the main feeding and growth seasons also in the summer months. Anchovy winter in the coastal waters of Turkey and Georgia, where they are targeted by commercial fisheries. The main spawning, feeding and wintering grounds are shown in **Figure 6.81**.

The European anchovy display two seasonal migrations as shown in **Figure 6.81**. In the autumn falling temperatures trigger a southward migration between October and November through the Black Sea and along coastal waters to the Turkish and Georgian coasts (Ref. 6.36 & Ref. 6.38). In the spring anchovy migrate from southern coastal wintering grounds to spawning areas in the north-western coast. These migration routes pass through the Black Sea from northern coasts to southern coasts, and back again. However, the exact timings of these migrations vary year to year, and up-to-date information is not available. The Institute of Marine Science at the Middle East Technical University is conducting an on-going fisheries research project, in conjunction with the Ministry of Food, Agriculture and Livestock, to establish the distribution of spawning grounds, over-wintering behaviour and migratory behaviour of anchovy in the Black Sea. However, results from this work were not available at the time of writing (Ref 6.39).

Figure 6.81 shows both the Azov and the European anchovy migrations and spawning, wintering and feeding areas. The Azov anchovy winters near the Crimea Peninsula and the Russian Federation. The migration route for the Azov anchovy is from the Sea of Azov to the Ukrainian and Russian coastal wintering grounds and back. The migration route of the European anchovy is either through the middle of the Black Sea or along the western coast.

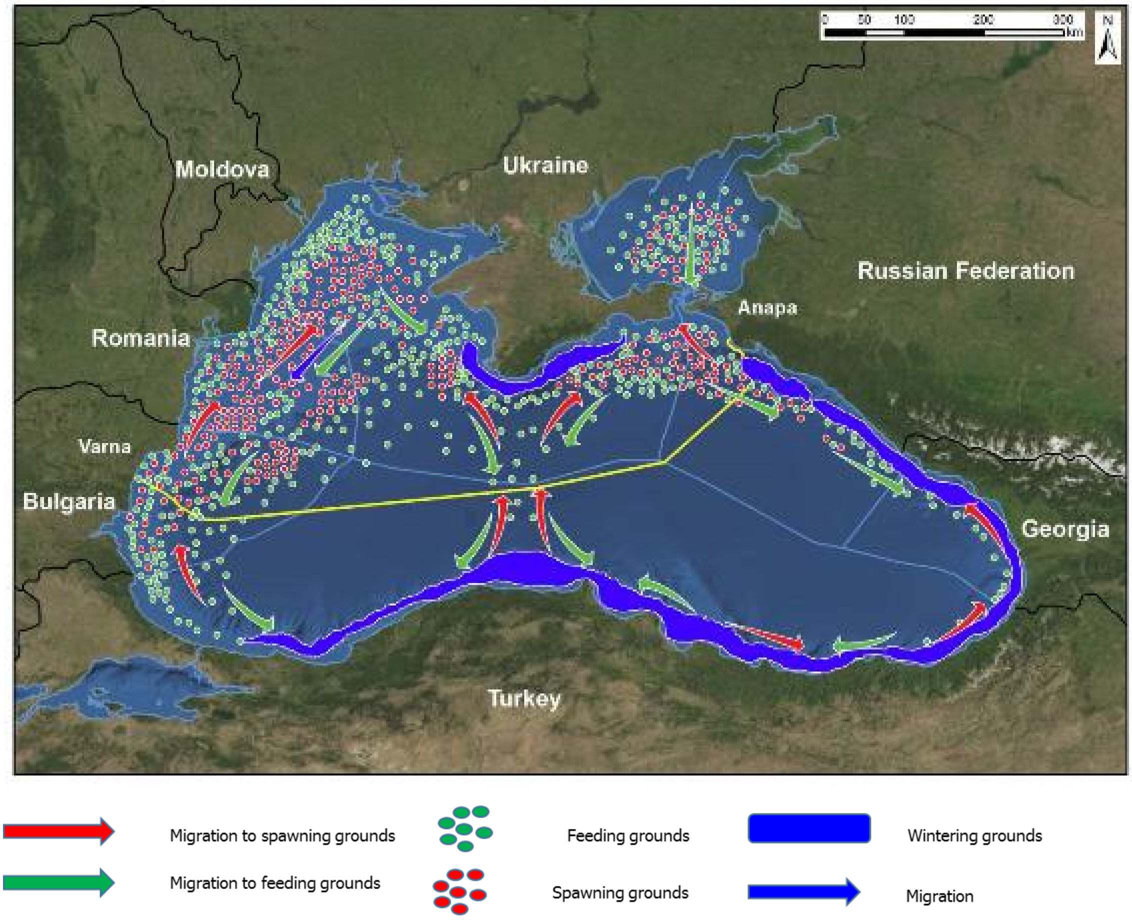


Figure 6.81: Migratory routes, spawning grounds and feeding grounds of anchovy in the Black Sea

Sprat (*Sprattus sprattus*) undertake seasonal migrations between inshore feeding grounds and offshore spawning grounds between depths of 10 to 20 m (Ref. 6.36) as shown in **Figure 6.82**. Migrations do not take place along coastal waters and sprat do not have specific wintering grounds. The main feeding and spawning grounds and migration routes are not near the Project Area in Turkey's EEZ.

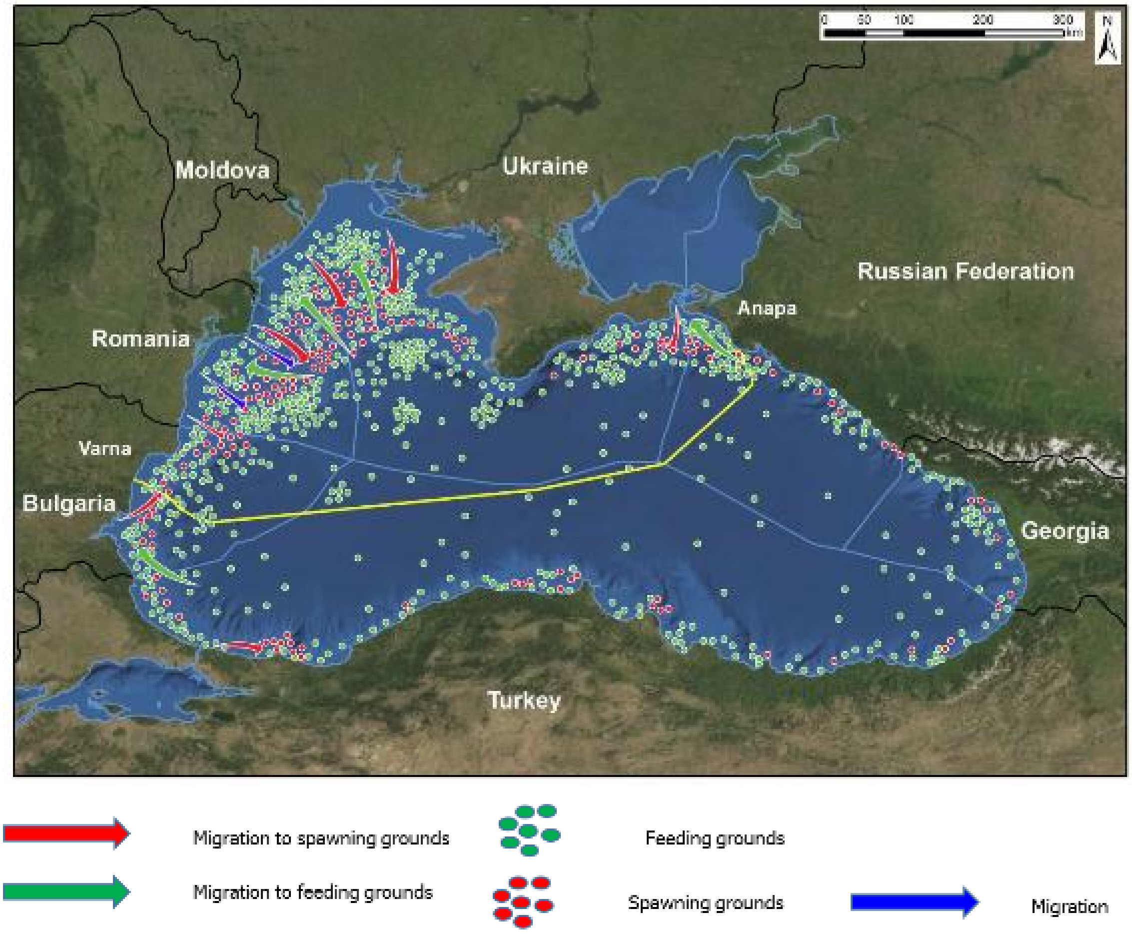


Figure 6.82: Sprat distribution, migratory routes, spawning and feeding grounds in the Black Sea

Main spawning and feeding grounds for the Black Sea horse mackerel (*Trachurus mediterraneus ponticus*) are in the north-western and western continental shelf regions of the Black Sea, but they also spawn in the north east of the Black Sea along the Russian Federation's coast and along the Turkish coast as shown in **Figure 6.83**. In the autumn (September to November) they migrate along the coastal waters to wintering grounds. In the spring (Mid-April) they migrate back to feeding and spawning grounds (Ref. 6.40). The spawning grounds, feeding grounds and migration routes are not near the Project Area in Turkey's EEZ.

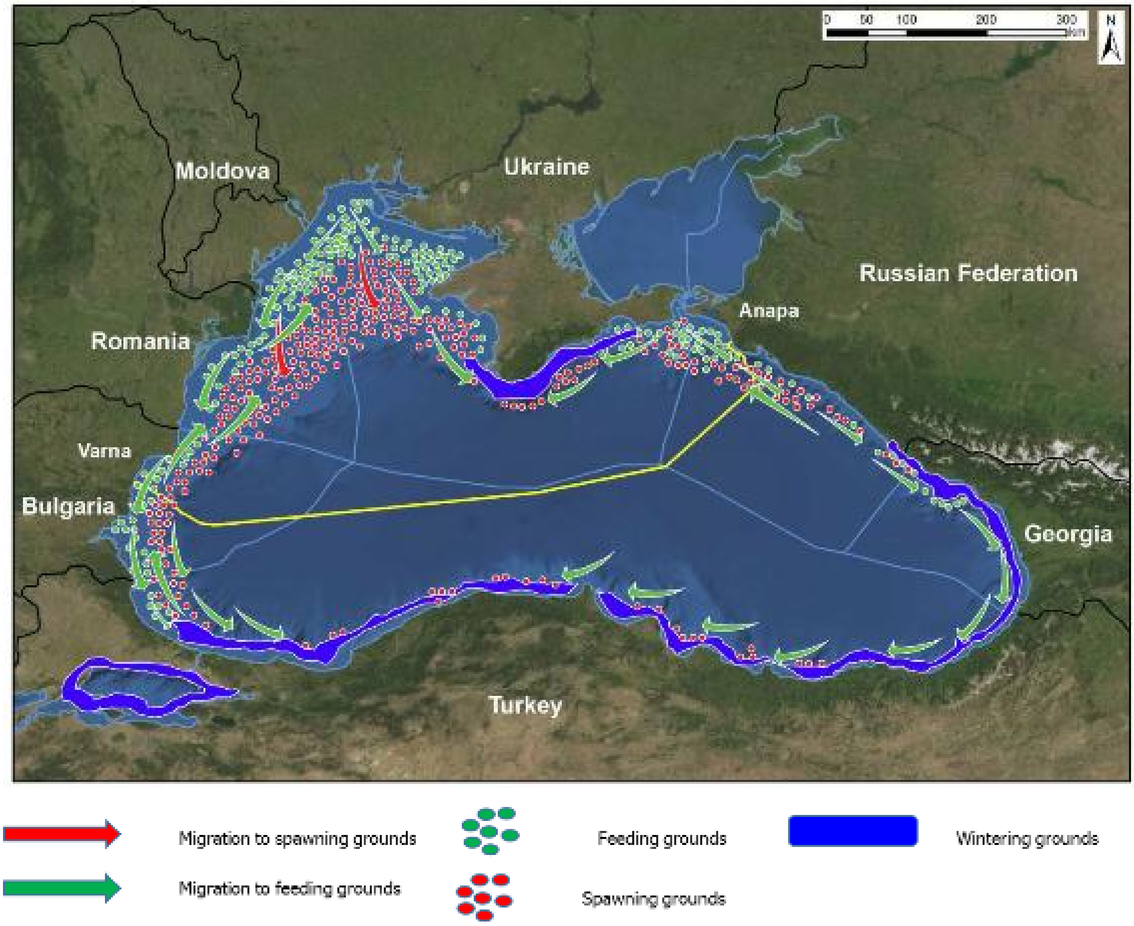


Figure 6.83: Black Sea horse mackerel distribution, migratory routes, spawning and feeding grounds in the Black Sea

The Black Sea contains large spawning grounds for Atlantic bonito (*Sarda sarda*) which migrate from the Aegean Sea and Sea of Marmara into the Black Sea between April and August to spawn and feed (Ref. 6.40). Atlantic bonito spawn in the north-western and western parts of the Black Sea between the end of May until the middle of July (Ref. 6.41). In the autumn, adult Atlantic bonito migrate back into the Sea of Marmara. Part of the stock also migrate along the southern coast of the Black Sea forming shoals and they remain in these wintering grounds until the beginning of March when they begin to migrate north to their spawning grounds (Ref 6.42). The spawning grounds, feeding grounds and migration routes are in coastal waters and are not near the Project Area in Turkey's EEZ.

6.4.2 Types of Fish and Annual Quantities

The four small pelagic species of importance, both in terms of quantity caught and economic value, caught in Turkish waters of the Black Sea are European anchovy, sprat, Black Sea horse mackerel and Atlantic bonito. All other species represent only 6.2% of the total catch. **Figure 6.84** illustrates the species composition of the Black Sea catch in 2011 from Turkish vessels.

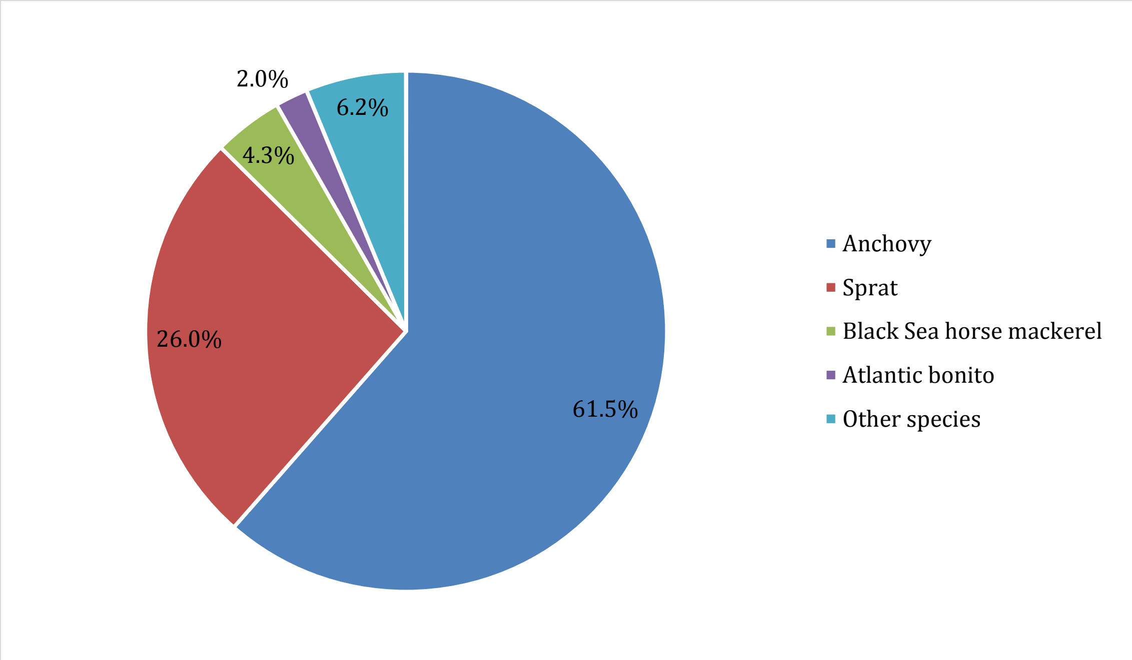


Figure 6.84: Species composition of Black Sea catch in 2011 (Ref. 6.43)

Of all the fish species in the Black Sea less than 12 are of economic value and these account for 98% of the total catch in Turkey between 1996 and 2008 (Ref. 6.40). Turkey's top 10 species (based on catch data from 2007 – 2011) in the Black Sea are shown in **Table 6.33**.

Table 6.33: Top 10 species caught in Turkish waters of the Black Sea (Ref 6.43)

Common Name	Scientific name	Type	% of 2011 catch
European anchovy	*Engraulis encrasicolus*	Pelagic Migratory	61.5
Sprat	*Sprattus sprattus*	Pelagic Migratory	26.0
Black Sea horse mackerel	*Trachurus mediterraneus ponticus*	Pelagic Migratory	4.3
Whiting	*Merlangius merlangus*	Demersal Migratory	2.4
Atlantic bonito	*Sarda sarda*	Pelagic Migratory	2.0
Scad (Atlantic horse mackerel)	*Trachurus trachurus*	Pelagic Migratory	1.0
Striped red Mullet	*Mullus surmuletus*	Demersal	0.9
European pilchard	*Sardina pilchardus*	Pelagic	0.6
Bluefish	*Pomatomus saltator*	Pelagic Migratory	0.5
Grey mullet	*Mugil cephalus*	Demersal	0.3

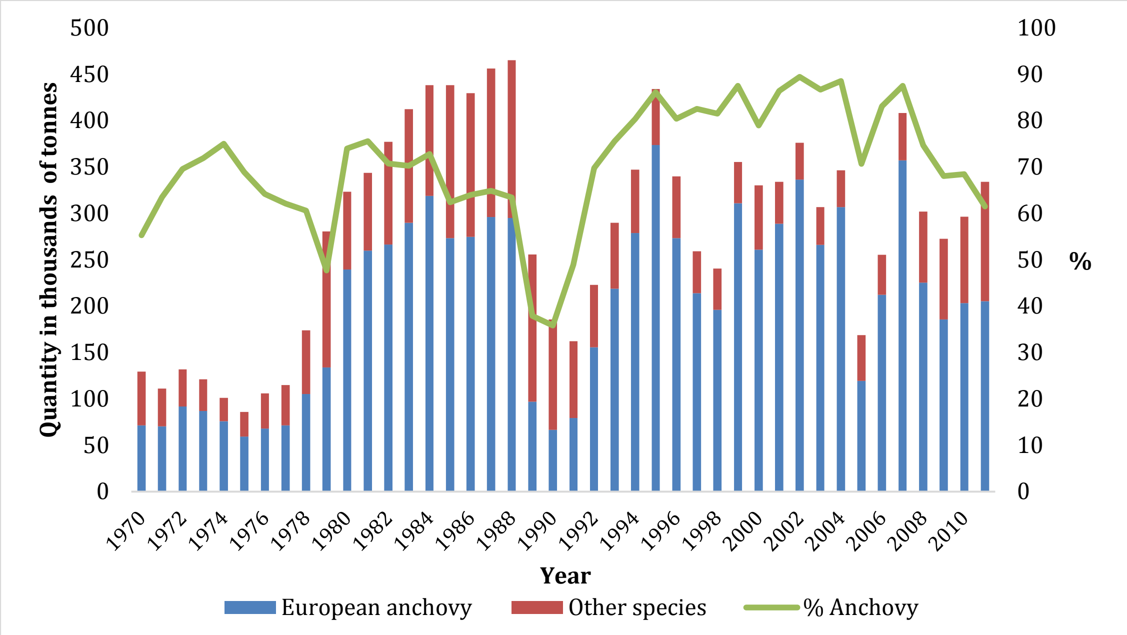


Figure 6.85: Distribution of Turkey's Black Sea catch between European anchovy and other species (Ref 1.1 and Ref 1.2)

The European anchovy is a migratory pelagic species and the most abundant species in the Black Sea (Ref. 6.45). Turkey is responsible for, on average, 92.8% (by weight) of all anchovy caught in the Black Sea (Ref 6.44 & Ref. 6.36) as shown in **Figure 6.86**. In 2011 European anchovy accounted for 61.5% of all marine fish caught by Turkish fleets in the Black Sea (Ref 6.43).

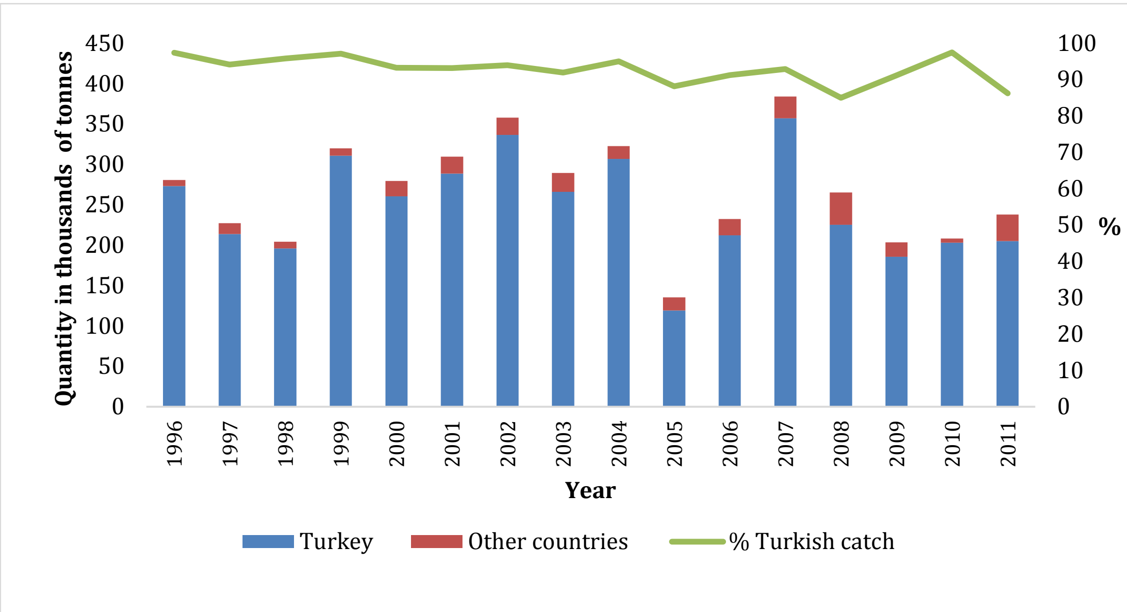


Figure 6.86: Distribution of anchovy catches between Turkey and other Black Sea countries, 1996 – 2011 (Ref 6.44 & Ref. 6.36)

Figure 6.87 shows the Turkish historical catch data of anchovy in the Black Sea from 1970 to 2012[1]. Anchovy catches were highest in the 1980s, but in the late 1980s the stock collapsed due to factors described in **Section 7.2.2** of this EIA Report. The Black Sea stock partially recovered from 1995 to 2005 (Ref. 6.46). In 2005 the Atlantic bonito catch reached a peak of over 70,000 tonnes which indicated that effort was directed to the Atlantic bonito fishery rather than the European anchovy fishery thereby resulting in a lower catch of European anchovy (Ref. 6.36). However, after 2007 catches dropped again and this could be the result of climatic changes, an increase in the abundance of predators or overfishing (Ref. 6.36). The exact cause of decreasing catches has not been established by the scientific community. However, the European anchovy is considered to be overfished and there are recommendations from the Expert Working Group on the Assessment of Black Sea Stocks (EWG) of the European Commission's Scientific, Technical and Economic Committee for Fisheries (STECF) to reduce anchovy catch by 41% in 2013 (Ref. 6.36).

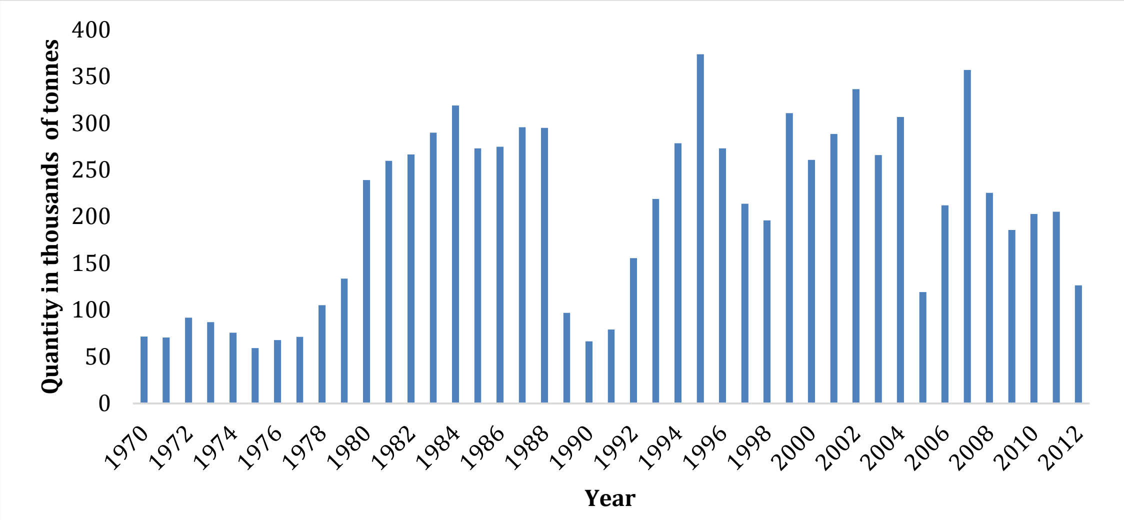


Figure 6.87: Black Sea anchovy catch 1970 – 2012 (Turkey) (Ref. 6.47 & Ref. 6.44)

Fishing for European anchovy takes place in the coastal waters of Turkey where anchovy form large concentrations in their wintering grounds. It is unlikely that fishing for anchovy takes place in the Project Area due to the distance from Turkey's coast, the effort required to reach this area and the temporary nature of the European anchovy's presence in these offshore waters, i.e. during migration only. The Turkey's Ministry of Food Agriculture and Livestock which have stated vessels do sometimes fish near or in the Project Area but exact locations are not available (see EIA Opinion letter in **Appendix 5.A**). Although statistical data on fishing activity in the Project Area was could not be sourced, qualitative data gathered during consultations with fisheries has confirmed the unlikelihood of fishing activity occurring over 110 km from the shore.

[1] Data for 2012 is provisional as stated by TUIK.

The fishing season for anchovy begins in October, although the exact date varies year to year, and lasts until April (Ref 6.36). Anchovy are caught predominately by commercial purse seiner[2] vessels which target wintering concentrations in Turkish coastal waters; although in recent years trawling in the open water for anchovy has begun (Ref. 6.36).

Sprat is a pelagic schooling species and the second most abundant species in the Black Sea (Ref. 6.46). In 2012, sprat was the second most valuable small pelagic species (in terms of total catch) caught in the Black Sea by Turkish vessels (Ref. 6.36).

Figure 6.88 presents the historical catch data for the Black Sea sprat fishery and shows Turkey's increasing dominance in recent years. Catches have increased in recent years, more than doubling since 2007 due mainly to the intensification of the Turkish sprat fishery, reaching an historical peak of 120,710 tonnes in 2011 (Ref. 6.36). The EWG of STECF considers that sprat is now exploited above a level that is sustainable (Ref. 6.36).

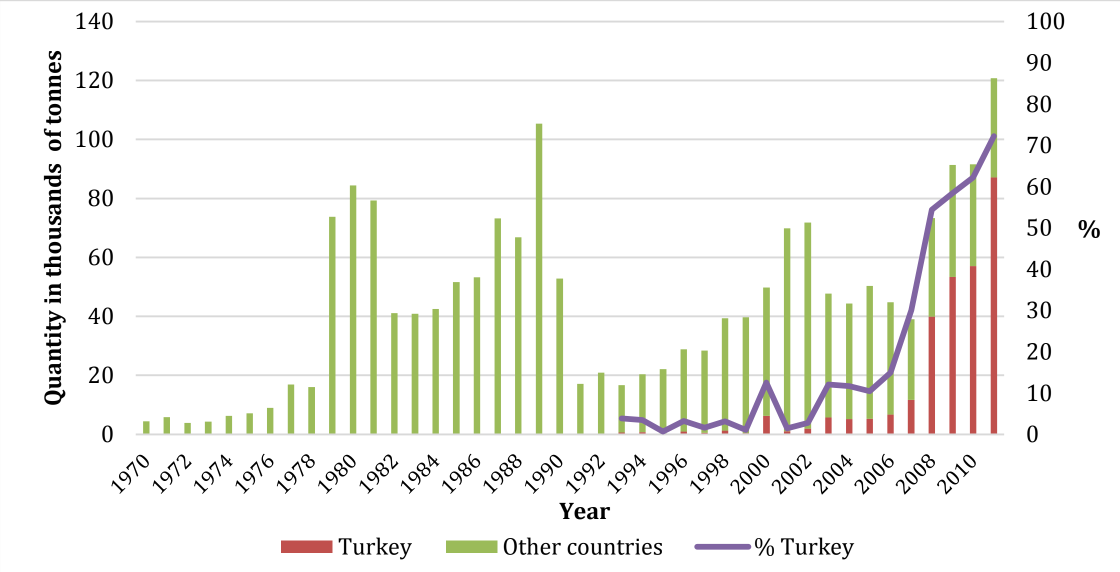


Figure 6.88: Distribution of catch for sprat between Turkey and other Black Sea countries between 1970 and 2011 (Ref 6.36)

Figure 6.89 presents the historical Turkish catch data and the number of vessels involved in the Turkish sprat fishery in the Black Sea from 1993 to 2012. The number of vessels has increased markedly from eight in 2008 to 82 in 2011 (Ref. 6.36), this indicates a surge in fishing effort and may be due to vessels switching from other fisheries or previously unused but registered vessels entering the sprat fishery.

2 A purse seine, has a line which passes through all the rings, and when pulled, draws the rings close to one another, preventing the fish from swimming down to escape the net

Sprat are targeted in Turkish waters, on the continental shelf between depths of 15 to 110 m. Fishing takes place during the day when aggregations are denser (Ref. 6.36). The fishing season begins in September and ends in May and is subject to depth restrictions between certain dates in order to protect spawning adults and juveniles in the coastal zone (Ref. 6.36). The main fishing gear used in the Turkish sprat fishery are pelagic pair trawls which work at depths of 20 to 40 m in the spring and 40 to 80 m in the autumn (Ref 6.36). Sprat fishing by pelagic trawls is only permitted along the Samsun Shelf and therefore there is no sprat fishing activity in the vicinity of the Project.

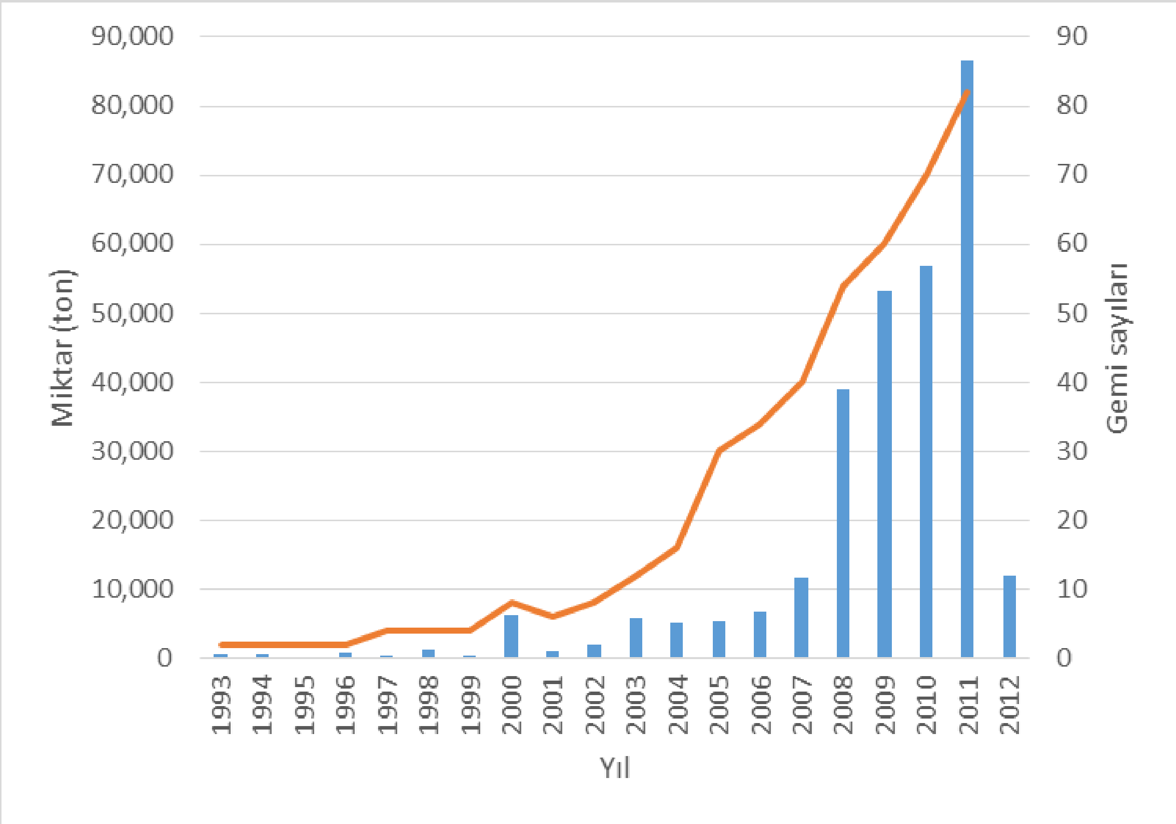


Figure 6.89: Black Sea sprat catch data 1993 – 2012 (Turkey) (Ref 6.44 & Ref 6.36)

The Black Sea horse mackerel is a sub species of the Mediterranean horse mackerel (*Trachurus mediterraneus*). It is a migratory pelagic species and until recently was the second most important pelagic catch along Turkey's Black Sea coast (Ref 6.36). Turkey is responsible for approximately 97% of Black Sea horse mackerel catches (Ref 6.40). **Figure 6.90** presents the historical Turkish catch data of Black Sea horse mackerel from 1970 to 2012. Black Sea horse mackerel stocks collapsed in the early 1990s due to factors described in **Section 7.2.2** of this EIA Report and the stock still remains in a depressed state (Ref 6.46).

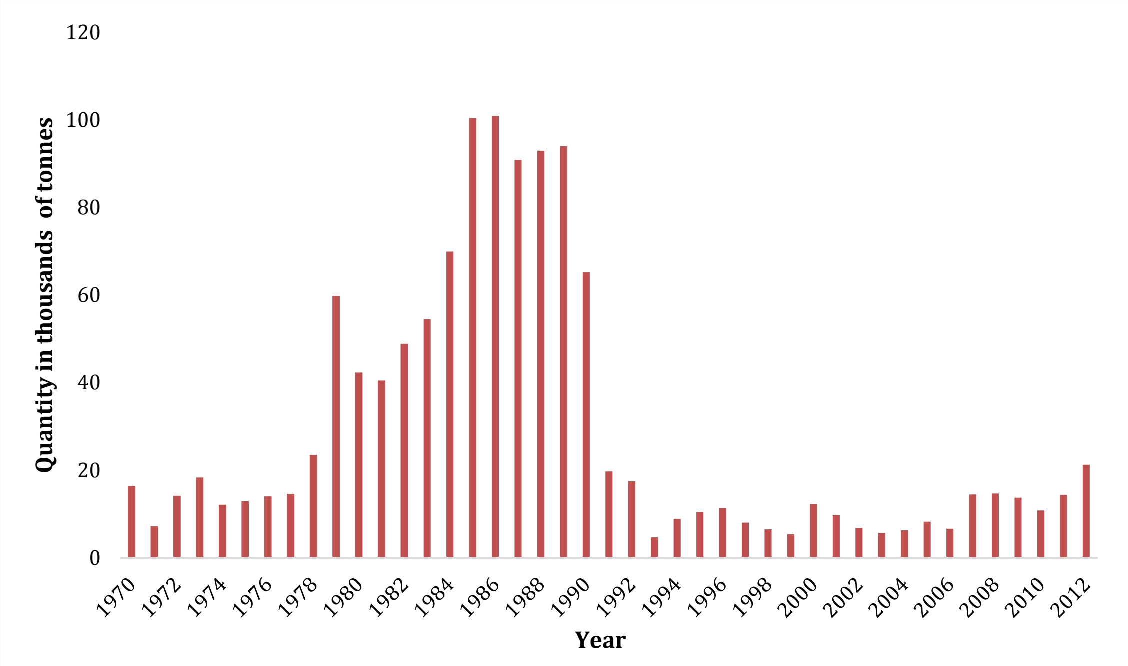


Figure 6.90: Horse mackerel catch by Turkey in the Black Sea from 1970 to 2012 (Ref 6.48 & Ref. 6.44)

Black Sea horse mackerel is caught in coastal Turkish waters where they form dense concentrations in their wintering grounds; there is no fishing activity in the vicinity of the Project. It is caught primarily in the winter and predominantly by purse seine nets although other gears including bottom trawls, pelagic trawls, gill nets and long-lines are used (Ref 6.36).

Atlantic bonito (*Sarda sarda*) has the second highest economic value per kg (8.05 TL/kg, among the pelagic fish species in the Black Sea (Ref. 6.43). Turkey accounts for most of the Atlantic bonito catch in the Black Sea (Ref 6.40). The cause of the fluctuations in Atlantic bonito catches have not been established by the scientific community but they could be linked to a combination of environmental factors and overfishing (Ref. 6.40). **Figure 6.91** presents the Turkish catch data of Atlantic bonito in the Black Sea from 1998 to 2012 (catch data prior to 1998 is not available).

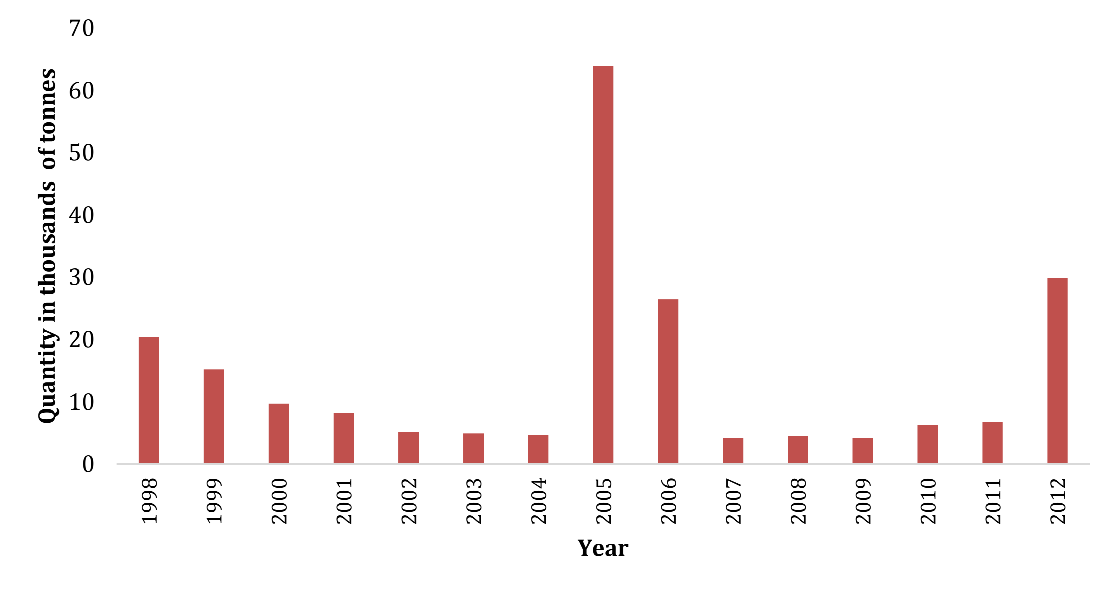


Figure 6.91: Atlantic bonito catch by Turkey in the Black Sea from 1998 to 2012 (Ref 6.47 & Ref. 6.44)

Atlantic bonito are caught in coastal Turkish waters where they form dense concentrations in their wintering grounds; it is unlikely that fishing for Atlantic bonito takes place in the Project Area due to the fact that their concentrations are greatest is coastal waters. Large scale and small scale Turkish vessels target Atlantic bonito using purse seines and gill nets respectively. Fishing for Atlantic bonito occurs between August and February, peaking in September and October (Ref 6.41).

6.4.3. Impacts which may arise during the Works and Procedures within the scope of Project and Measures to Control and Mitigate these Impacts (Construction, Operation and Decommissioning)

The potential impacts on marine fish species have been assessed based on the anticipated activities related to the Construction, Operational and Decommissioning Phases of the Project and are summarised in **Table 6.3**4.

The assessment of impacts on marine fish species and requisite impacts on commercial fisheries has been conducted in line with **Chapter 2: Environmental Impact Assessment Approach** of this EIA Report. An assessment of impacts compared to relevant national standards in national legislation is given in **Chapter 9: Assessment of Project Activities** of this EIA Report.

Table 6.34: Project Activities and Impacts

Phase	Activity	Impact
Construction & Pre-commissioning	Use of fresh water maker/desalination unit and vessel cooling water system. As is the case for all vessels, cooling water is the outcome of the heat of the vessel's engines, not arising from a thermal procedure and process.	Discharge of cooling water could cause negligible level injury to living organisms from increased water temperature and changes to water conditions. Intake of seawater could cause negligible level injury to fish larvae from impingement and entrainment. These impacts are anticipated not to be different from the impacts arising from the other vessels navigating in the Black Sea.
	Mobilisation of vessels to and from site and vessel movements within construction spread and use of Dynamic Positioning (DP) during pipe-lay.	Disturbance to fish from noise and vibration emissions from vessel engines and movements.
	Perform pre-laid and as-laid ROV surveys.	
	Delivery of fuel, pipe and other supplies including hazardous substances to pipe-lay vessel by supply vessel. Including line up of pipe with deck pipe transfer cranes.	
	Night time working.	Light pollution could cause attraction of fish.
	Welding, weld testing and coating of pipe sections.	Uncontrolled waste stored on-board could cause contamination of water and indirect impacts to living organisms. Waste disposal to sea could cause contamination of water and indirect impacts to living organisms.
	Waste generation from vessels operations.	
	Mobilisation of vessels to and from site and vessel movements within construction spread and use of Dynamic Positioning (DP) during pipe-lay.	Non-routine leaks and spills could cause contamination of water and sediments and potential for death / injury to living organisms.
	Delivery of fuel, pipe and other supplies including hazardous substances to pipe-lay vessel by supply vessel. Including line up of pipe with deck pipe transfer cranes.	

Phase	Activity	Impact
	Storage of fuel and other hazardous materials.	
	Refuelling of vessels, plant and machinery.	
	Use of power generation sets (for example diesel generator).	
	Maintenance of plant and machinery.	
	Welding, weld testing and coating of pipe sections.	
	Welding of recovery head to pipeline and lowering/raising of pipeline (Abandoned and Recovery Operations (if necessary due to weather or emergency conditions).	
	Helicopter operations for crew changes.	
	Perform pre-laid and as-laid ROV surveys.	Accidental damage to known / unknown existing services (pipelines, cables etc.) resulting in contamination of the marine environment.
	Mobilisation of vessels to and from site and vessel movements within construction spread and use of Dynamic Positioning (DP) during pipe-lay.	Unplanned or emergency events could lead to the introduction of invasive species which may cause injury / death or displacement to native species.
	Mobilisation of vessels to and from site and vessel movements within construction spread and use of Dynamic Positioning (DP) during pipe-lay.	Unplanned or emergency events leading to chemical or fuel spills could cause contamination of water and sediments and potential for death / injury to living organisms.
	Delivery of fuel, pipe and other supplies including hazardous substances to pipe-lay vessel by supply vessel. Including line up of pipe with deck pipe transfer cranes.	
	Refuelling of vessels, plant and machinery.	
Operation (including	Routine inspection and maintenance of pipelines. Pipeline condition survey and	Accidental damage to known / unknown existing services (pipelines,

Phase	Activity	Impact
Commissioning)	repairs.	cables etc.) resulting in contamination of the marine environment.
	Mobilisation of vessels to and from pipeline locations and vessel movements along pipeline (Pipeline condition survey and repairs).	Disturbance to sensitive receptors from noise and vibration emissions from vessel engines and movements.
	Routine inspection and maintenance of pipelines Pipeline condition survey and repairs.	Waste stored on-board could cause contamination of water and indirect impacts to living organisms. Waste disposal to sea could cause contamination of water and indirect impacts to living organisms.
	Mobilisation of vessels to and from pipeline locations and vessel movements along pipeline (Pipeline condition survey and repairs). Routine inspection and maintenance of pipelines. Pipeline condition survey and repairs.	Non-routine leaks and spills could cause contamination of water and sediments and potential for death / injury to living organisms.
	Routine inspection and maintenance of pipelines. Pipeline condition survey and repairs. Operation of pipeline.	Unplanned or emergency events could lead to loss of containment could cause major impact on water quality and injury / death of living organisms.
	Mobilisation of vessels to and from pipeline locations and vessel movements along pipeline (Pipeline condition survey and repairs).	Unplanned or emergency events leading to chemical or fuel spills could cause contamination of water and sediments and potential for death / injury to living organisms.
Decommissioning (Option 1 & 2)	Vessel operations associated with inspection surveys.	Waste disposal to see could cause contamination of water and indirect impacts to living organisms.
		Unplanned or emergency events leading to chemical or fuel spills could cause contamination of water and sediments and potential for death / injury to living organisms.

The main controls which have been built into the design to limit any potential impacts on fish species are listed in **Table 6.35**. As fish species can be indirectly impacted by changes in water quality; the design controls mentioned in **Section 6.3.3** of this EIA Report relating to water quality are also applicable here.

Table 6.35: Design controls for Fish

Design Controls
Use of screening and correctly angled lights.
Minimise use of lighting where possible. Appropriate lighting design during night-time works will be implemented.
On-going stakeholder engagement, including consultation with marine authorities and other marine area users regarding construction activities in the Project Area
Specification of low noise equipment.
Use of protective filters to prevent intake of fish and plankton.
Use of modern vessels and plant and undertaking of regular maintenance checks.
The Project will comply with the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM).
Develop Emergency Response Plan and Spill Response Plans.
All vessels will be compliant with the national regulations and International Convention for the Prevention of Pollution From Ships (MARPOL), cognisant of the Black Sea's status as an IMO special area with respect to oil and garbage. See Section 6.3.3 for more details on the design controls for waste discharges.
All bunkering activities will be undertaken in line with the contractor's Environmental Management Plan / Pollution Prevention and Control Plan and Oil Spill Prevention and Response Plan.

6.4.3.1 Impacts from Construction

There are two ways in which the construction phase of the Project could potentially impact fisheries in Turkey's EEZ: 1) the impact on fishing activities in the Project Area and 2) the impact on the migration route of the European anchovy through the Project Area which may indirectly impact on the catch levels achieved by, and / or revenues of, Turkish fisheries.

Impact on fishing activities

The main fishing grounds for pelagic fish species, and therefore the main areas of fishing activity, are contained within the 150 m depth contour, which can be used as a proxy boundary for fishing activity. Sprat fishing only takes place along the Samsun Shelf in depths of up to 80 m. European anchovy, Black Sea horse mackerel and Atlantic bonito are targeted in their wintering grounds which are located in the shallower coastal waters of Turkey. The Project Area is more than 110 km from Turkey's coastline and at depths of between 2,000 m to 2,200 m. It is unlikely that any significant commercial fishing activity is taking place in the Project Area and therefore the Project is unlikely to directly impact on fishing activity in Turkey's EEZ.

Impact on migration route of the European anchovy

The European anchovy migrates through the Black Sea between October and November from spawning and feeding grounds in the north west continental shelf area of the Black Sea to feeding grounds in the coastal waters of Turkey. A reverse migration takes place between April and June. The construction schedule indicates that there is potential for the pipe-laying activities of all four pipelines to coincide with the migration route of the European anchovy, as shown in Table 6.36.

Table 6.36: Construction Schedule and Fish Migration

Construction	Winter 2014	Spring 2015	Summer 2015	Autumn 2015	Winter 2015	Spring 2016	Summer 2016	Autumn 2016	Winter 2016	Spring 2017	Summer 2017
Pipeline 1											
Pipeline 2											
Pipeline 3											
Pipeline 4											

The source of the impact will come from the noise generated by the pipe-laying vessel spread. Underwater noise propagation from this source has been modelled and assessed (**Appendix-7.B**) (Ref. 6.49). European anchovy are categorised as hearing specialists[3] and are therefore sensitive to underwater noise. The most conservative limit is that the noise from the pipe-laying vessel spread might be sufficient to cause a mild avoidance response[4] in a hearing specialist (i.e. the European anchovy) over a radius of 2.1 km and a strong avoidance over a radius of around 436 m (Table 6.37). Avoidance responses typically involve startle behaviour but will not result in disorientation or cessation of migratory behaviour.

[3] Fish may be classed as hearing specialists or hearing generalists based on their sensitivity to underwater sound. Classification is determined by the internal physiology of the fish and relates to the presence or absence of a swim bladder, and its connection to the inner ear (Ref. 6.49)

[4] Mild and strong avoidance reactions generally relate to either a brief, minor behavioural change impacting a few individuals or a longer, larger behavioural change relating to the majority of individuals respectively. However, mild and strong avoidance is difficult to define and is discussed in more detail in Appendix 7-B.

Table 6.37: Summary of Underwater Noise Assessment Results (Ref. 6.49)

Fish Hearing Type	Mild Avoidance	Strong Avoidance	Mild Avoidance	Strong Avoidance
	Single Vessel		Multiple Vessels	
Hearing Generalist	2 m	N/A	330 m	55 m
Hearing Specialist	29 m	5 m	2.1 km	436 m

The Project Area within Turkey's EEZ is 470 km long and the pipe-laying vessel spread will be moving along at a rate of 2.5 km to 2.75 km per day and will therefore take approximately 6 months to complete its transit through the Turkish EEZ. The vessel spread will represent a moving point source of noise and a conservative estimate of the impact zone (based on a mild avoidance criteria) arising from this will be approximately 4.2 km in diameter around the pipe-laying vessel. This impact zone is transitory and is a very small part of the width of the European anchovy migration corridor, which is approximately 125 km (Ref. 6.38; Ref. 6.50 and Ref. 6.51). Therefore, any adverse impacts to fish on their migration as a result of underwater noise will be localised to 4.2 km in diameter around the pipe-laying vessel. As discussed above, even in the 872 m diameter where underwater noise generated from the pipe-lay vessel may result in strong avoidance behaviour in the European anchovy, this is unlikely to result in disorientation or cessation of migratory behaviour

A further mitigating feature is that fish readily become habituated to repetitive sound (Ref. 6.52). Thus, the slow transit of the vessel may allow some habituation before maximum exposure is achieved. The Black Sea has major vessel traffic routes across it much used by super-tankers and container vessels going to Russia's largest port of Novorossiysk. It is known that at least 800 tankers over 10,000 deadweight tonnage (DWT) cross the Project Area every year (Ref. 6.54) and there are a number of main shipping lanes from the Bosphorus, Romania and Bulgaria in the east to ports in Russia and Georgia in the west. It is known that the noise of a large tanker is around 177 dB, which is a little higher than that of the pipe-lay vessel where the maximum is 162 dB (Ref. 6.49; Ref. 6.53). There is a considerable probability therefore that the European anchovy stock will already be habituated to such sounds since habituation of fish to maritime traffic is known to occur (Ref. 6.55).

The pipe-laying vessel spread will also be a source of light which could act as an attractant to fish. However, the radius of its attractant effect will be much more limited than that of noise and, additionally, the attractant effect is only at night leaving the daytime free for movement. Possible effects will therefore be very limited and are highly unlikely to impact the European anchovy's migratory pattern.

In summary, it can be concluded from the above discussion that the impacts of pipe-laying activities in Turkey's EEZ on the migration route of the European anchovy will be negligible as it is localised (~4 km), infrequent (during spring and autumn migrations) and temporary (only 45 to 60 days during the migration). It is therefore highly unlikely that there will be an indirect impact on the catch levels achieved by Turkish fisheries or on the level of effort that they need to expend in order to maintain existing catch levels.

Some confirmation of this can be taken from the results of the Nord Stream Pipeline Project monitoring programme where an identical method of pipe-lying was used. Monitoring of the fish and fisheries showed that there were no significant effects on the population of various fish species along the pipeline construction route following construction and, equally, there were no changes to the regional fisheries in the Baltic over the period of construction, including small open water species such as sprat (Ref. 6.55).

South Stream Transport will continue a programme of stakeholder engagement and consultation throughout the Construction and Pre-Commissioning Phase. On-going stakeholder engagement will also serve as a means of monitoring impacts on potentially affected stakeholders, such as Turkish fisheries, to ensure that the actual level of impact is not greater than predicted. If additional significant impacts are identified and verified, these will be a priority for resolution through supplemental mitigation measures. Resolution will be developed in consultation with affected stakeholders.

More discussion on impacts to fish species from construction is given in Section 7.3.1.1 of this EIA Report.

6.4.3.2 Impacts from Operation

There will be no impact on fisheries from pipeline operation, as the pipeline will lie on the abyssal plain at a depth of below 2,000 m and at least 110 km from the Turkish coastline.

As planned activities associated with operation of the pipelines will be limited to periodic routine inspection and maintenance activities utilising few vessels, no impacts on fisheries are expected during operation.

6.4.3.3 Impacts from Decommissioning

There are no anticipated impacts if the pipelines are to be left in situ on the seabed. If the pipelines are removed from the seabed, impacts from decommissioning will involve the use of vessels and are likely to cause impacts similar to those experienced during the Construction Phase (Section 6.4.3.1). At the time of writing this EIA Report, the strategy for decommissioning is unknown but the Project will adopt GIIP.

6.4.3.4 Impacts from Unplanned / Emergency Events

Accidental oil spills associated with the vessels could potentially impact fish species. Probable consequences of such impacts include intoxication by ingestion of contaminated petroleum products or via prey species. Any pollutants would rapidly become diluted in the open waters of the central Black Sea and fish are highly mobile so that any impacts are likely to be direct or indirect, local and short-term.

The provisions of the Emergency Response Plan (**Chapter 11: Environmental and Social Management System**) should ensure that any accidental oil spill is managed before reaching Turkish coastal waters. Therefore it is unlikely that accidental oil spills will impact commercially important fish stocks or fishing activity in coastal waters. However an Emergency Response Plan will be prepared before the construction phase according to the Regulation on Implementation of Law Pertaining to Principles of Emergency Response and Compensation for Damages in Pollution of Marine Environment by Oil and Other Harmful Substances (No. 5312) by authorised firm. The plan will be approved by the relevant Ministry (Appendix 5.A).

Effects of rupture of the pipeline leading to a loss of containment are more relevant in coastal waters or in areas with slow water exchange. In the deep waters of the central Black Sea (around 2,000 m water depth) any released gas is likely to become dispersed over a wide area by the time it reaches the surface where it will then be released into the atmosphere. It is also unlikely that any H_2S in lower water layers and sediments that become disrupted by bubbling gas will significantly increase concentrations in surface waters. Any escape of gas should be short-lived as the pipeline will be closed off in the event of a rupture. Thus, the impact on fish species is likely to be short-term, localised and of limited impact to fish which could be present in the upper water column. It is unlikely therefore that the effects of a pipeline rupture will impact on commercially important fish stocks in coastal waters.

There is also the potential for the accidental introduction of non-native invasive species during vessel operations resulting from the release of ballast water or from organisms carried on vessel hulls. These can cause changes in the functioning of the food web in the marine ecosystem. The impact would be long-term and could potentially impact the entire Black Sea. The possibility of this occurring is, however, very unlikely given the design controls adopted for the Project (see Table 6.35).

6.5 Protected Areas

There are no sensitive or protected areas within the Project Area as listed within the scope of the EIA Regulation Annex-V and provided below. Furthermore, the list of the laws and regulations that need to be referred to during the studies for projects within the scope of this regulation is also given below.

1. Areas that have to be protected in compliance with the Laws and Regulations of the Republic of Turkey:

a) “National parks”, “Nature Parks” and “Natural Monuments” defined by Law for National Parks (Date: 9 August 1983 and No: 2873) and identified by Article 3 of the law;

b) “Wild Life Protection Areas and Wild Life Improvement Areas” determined by the Ministry of Environment and Forestry in line with Terrestrial Hunting Law (Date: 1 July 2003 and No: 4915);

c) Areas defined as “Cultural Assets”, “Natural “Assets”, “Protected area” and “Conservation Area” by the sub-paragraphs 1,2,3 and 5 of paragraph (a) titled as “definitions” of the 1st clause of the 3rd Article of the Law on the Conservation of Cultural and Natural Assets (Date: 21 July 1983 and No: 2863) and Areas determined and confirmed in line with

Law 3386 (Law on the amendments of some articles of the Law on Conservation of Cultural and Natural Assets and addition of some new articles to the law.);

d) “Aquatic Species’ Reproduction and Propagation sites” as per the scope of Law on Fisheries (Date: 22 March1971 and No: 1380);

e) Areas defined by articles 17, 18, 19 and 20 of the Regulation on Water Pollution Control (Published on Official Gazette with Date: 31 December 2004 and No: 25687);

f) “Sensitive Pollution Areas” defined by Article 49 of the Air Quality Protection Regulation (Published on Official Gazette with Date: 2 November 1986 and No: 19269);

g) Areas determined and announced as “Designated Nature Conservation Areas” by the Council of Ministers as per Article 9 of Environmental Law (Date: 9 August 1983 and No: 2872);

g) Protected Areas in line with Bosphorus Law (Date: 18 November 1983 and No: 2960);

ğ) Areas determined as forests in line with the Forest Law (Date: 31 August 1956 and No: 6831);

h) Areas where construction is prohibited in line with Coastal Law (Date: 4 April 1990 and No: 3621);

ı) Areas defined by the Law on Olive Improvement and Grafting of New Species (Date: 26 January 1939 and No: 3573);

i) Areas defined by Pasture Law (Date: 25 February 1998 and No: 4342); and

j) Areas defined by the Regulation on Conservation of Wetlands (Published on Official Gazette with Date: 17 May 2005 and No: 25818).

2. Areas under protection status in line with international conventions where Turkey is a signatory:

a) Conservation Areas I and II, as defined in the “Reproduction Areas of Significant Sea Turtles” and “Habitats and Reproduction Areas of Mediterranean Monk Seals” among the areas under protection in line with the “Convention on the Conservation of European Wildlife and Natural Habitats”. (Bern Convention), brought into effect by the Official Gazette dated 20 February 1984 and No: 18318;

b) Areas under protection in compliance with the “Convention for the Protection of the Mediterranean Sea against Pollution” (Barcelona Convention), brought into effect by the Official Gazette dated 12 June 1981 and No: 17368;

i) “Designated Protection Areas” in compliance with the “Protocol on the Protection of Specially Protected Areas in the Mediterranean”, brought into effect by the Official Gazette dated 23 October 1988 and No: 19968;

ii) Areas in the list of “the 100 Coastal Historic sites (100 HS) with international significance in the Mediterranean” selected as per the Geneva Declaration dated 13 September 1985 and published by the United Nations Environment Programme;

iii) Coastal areas identified as habitats and feeding areas of the "Endangered Marine Species Unique to the Mediterranean Sea” according to Article 17 of Geneva Declaration;

c) Cultural, historical and natural areas under the protection of the Ministry of Culture in compliance with the 1st and 2nd articles of the “Convention Concerning the Protection of the

World Cultural and Natural Heritage", brought into effect by the official gazette dated 14 February 1983 and No: 17959;

ç) Areas under protection in line with "The Convention on Wetlands of International Importance, especially as Waterfowl Habitat" (RAMSAR Convention), brought into effect by the Official Gazette dated 17 May 1994 and No: 21937; and

d) Areas in compliance with "European Landscape Convention" brought into effect by the Official Gazette dated 27 July 2003 and No: 25181.

3. Areas that have to be protected:

a) Areas which have been identified in the Approved Environmental Plans as areas where existing features should be preserved and development is prohibited. Areas where the natural character should be preserved, biogenetical reserves, geo-thermal sites and similar sites;

b) Agricultural Lands: Agricultural development areas, irrigated areas, areas where irrigation is possible and land use capability class is I, II, III and IV , areas of class I and II used for rain irrigation and the entire special product plantation areas;

c) Wetlands: All waters, marshes, turbaries which are natural or artificial, permanent or temporary, still or flowing, fresh, brackish or salty, reaching a depth of maximum 6 m. during the low tide of the ebb and flow in the sea and significant as habitats for living organisms, particularly for water birds, and the areas extending into the land from the shore edge lines of these wetlands, which are also considered ecologically to remain as wetlands;

ç) Lakes, rivers, groundwater operation sites; and

d) Areas considered being significant for scientific research and/or areas that are habitats for endangered species or species which may be endangered and which are endemic species for our country, areas of biosphere reserves, biotopes, and biogenetic reserves, areas of geological and geomorphologic formations with unique characteristics.

6.6 Areas under the Sovereignty and Use of Authorized State Offices (Forbidden Military Zones, Areas Allocated for Public Institutions and Organisations for Certain Objectives, "Restricted Zones" in accordance with the Decree of the Council of Ministers no: 7/16349, etc.)

The Turkish Naval Forces utilises the Turkish EEZ waters for a variety of purposes. It is known that the Turkish Naval Forces carries out military exercises in the Black Sea. In these instances, the designated areas in which military exercises will be carried out are temporarily closed and subsequently announced through the media so that the users of the EEZ are aware of these areas.

To inform the EIA Report, the Turkish Naval Forces were contacted to establish any locations or times during which access to the Turkish EEZ waters may be prohibited or considered to be potentially hazardous to pipe-laying operations. It is understood that there are no permanently designated military training areas close to the Project Area, with the exception of an area adjacent to the Bulgarian EEZ that is used for firing training exercises. The precise location of this area has not been disclosed. The Project will engage with the relevant Turkish authorities before and during construction to avoid interference with any military exercises undertaken in the Turkish EEZ during construction. In the letter of the Turkish Commander in Chief dated 30th December 2013, no. 1370, it was stated that "The realisation of the project will not lead to any adverse impacts on the activities of Turkish Naval forces". Furthermore, the letter of the Ministry of Interior Affairs, Turkish Coast Guard Command dated January 14,2014 and no: 3025-14, stated that the measures to avoid sea pollution as described in the report were deemed appropriate.

6.7 Impacts on Other Projects in the Region

The Turkish Petroleum Corporation (TPAO) is responsible for the exploration of petroleum and natural gas in Turkey. The TPAO has identified a large area of the Turkish EEZ in the Black Sea that could potentially be utilised for petroleum exploration and has defined several exploration license areas, some of which overlap with the Project Area (Figure 6.92).

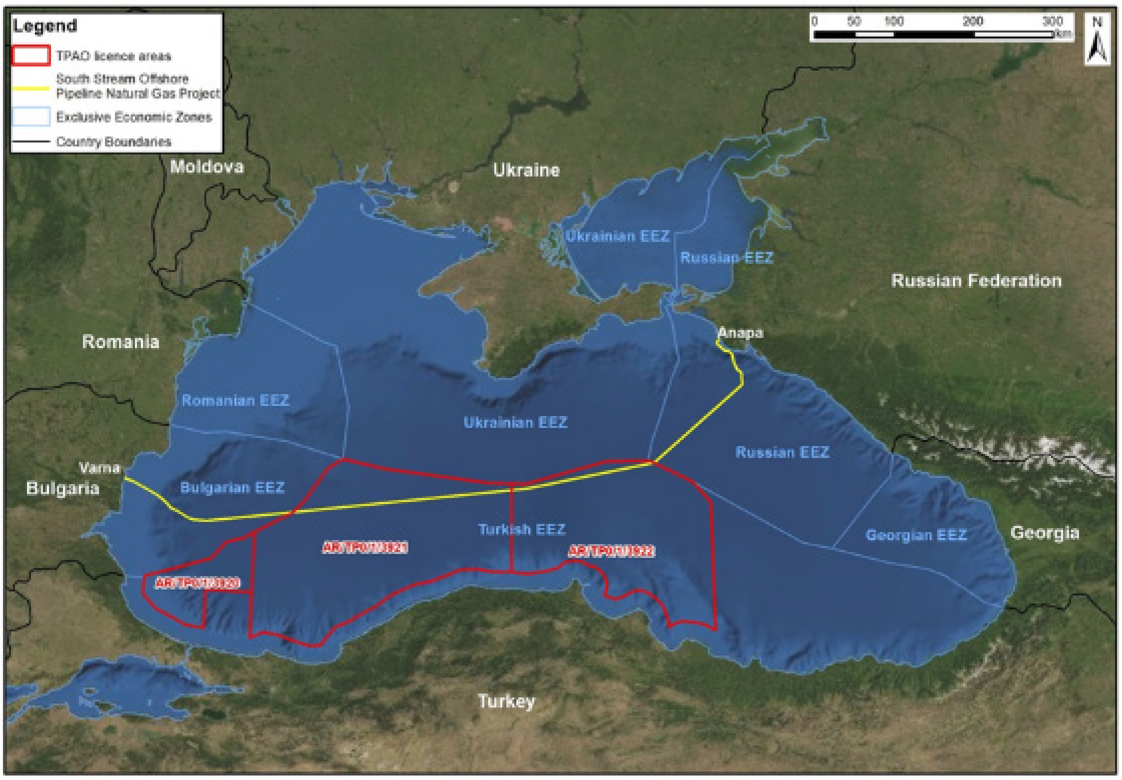


Figure 6.92: Exploration License Areas of TPAO

Further information on existing or proposed resource exploration activities within these license areas has been obtained from TPAO. There are no existing resource exploration or development activities occurring within or near to the Project Area. TPAO is planning to undertake 3D seismic surveys as part of the 'Tuna Prospect' project in the northwest of licence area 3921 which may begin at the end of the 2014. Further site surveys of this area may occur in 2015 or 2016. Depending on the findings of these surveys, an exploration well may be drilled in 2016.

Pre-drilling surveys may be conducted in the Şile formation, north of licence area 3920 and, depending on the results; an exploration well may be drilled in 2016. If a discovery is made in license areas 3920 and 3921, drilling of developmental wells may begin. The precise locations of the 3D seismic and site survey areas, or potential drilling locations has yet to be determined. If oil or gas is discovered in the potential well that is scheduled for drilling in 2016 in the 'Tuna Prospect' license area 3921, TPAO will plan to construct pipelines to carry the hydrocarbons south, thus intersecting the Project Area during the Operational Phase of the Project.

Construction activities are not anticipated to impact on TPAO's potential exploration activities in license areas 3920 and 3921. South Stream Transport B.V. will engage with TPAO prior to and during construction with regard to construction schedules and work progress reports to coordinate planned activities in the Turkish EEZ.

It is possible that future resource exploration or development activities in the Turkish EEZ could be impacted by the Project due to the permanent exclusion zone which will be in place during operation. The total area of impact of the operational exclusion zone is limited to a narrow corridor, encompassing the width of the four pipelines and the safety zone on either side of the outer pipelines, covering the 470 km distance of the Project across the Turkish EEZ.

In the event of potential future interactions with TPAO's oil and gas exploration or development activities or in the event of potential future intersections with TPAO's facilities (such as pipelines) during the operation of the Pipeline, South Stream Transport B.V. will collaborate with TPAO with regard to proximity and / or crossing agreements.

Close consultations with TPAO will be performed all the time. Simultaneous Operations (SIMOPs) and potential future collaboration will be agreed mutually for safe construction/operation of the interacting systems. SIMOPs, risk assessments and interfaces shall be managed prior to commencement of construction work. These interfaces / SIMOPS shall be managed with advance coordination meetings starting from the feasibility phase of any potential future pipeline crossing or exploration activity and on-going until completion. Therefore, potential impact on resource exploration, should it occur, due to pipeline operation is not considered to be a significant impact.

The letter of TPAO (Turkish Petroleum Corporation) sent to South Stream Transport B.V. dated 07 May 2014 and numbered 002542, stated that the assessment of the project demonstrated that, in relation with the exploration activities via drilling within TPAO's licenced blocks, there would be no inconvenience in the establishment of a corridor with a total width of 420 m, including the distances between the four pipelines as well as the operational safety exclusion zone.

During ROV surveys; the following cables crossing the South Stream Offshore Pipeline were detected:

- Cable "FOC BSFOCS Bulgaria-Ukraine-Russia (Rostelecom)";
- Cable "FOC ITUR Seg.4 (Italy-Turkey-Ukraine-Russia)"; and
- Cable "FOC ITUR Seg.E2 (Italy-Turkey-Ukraine-Russia)".

None of these cables cross the pipeline within the Project Area. Cables within the Turkish EEZ are shown in **Figure 6.93.**

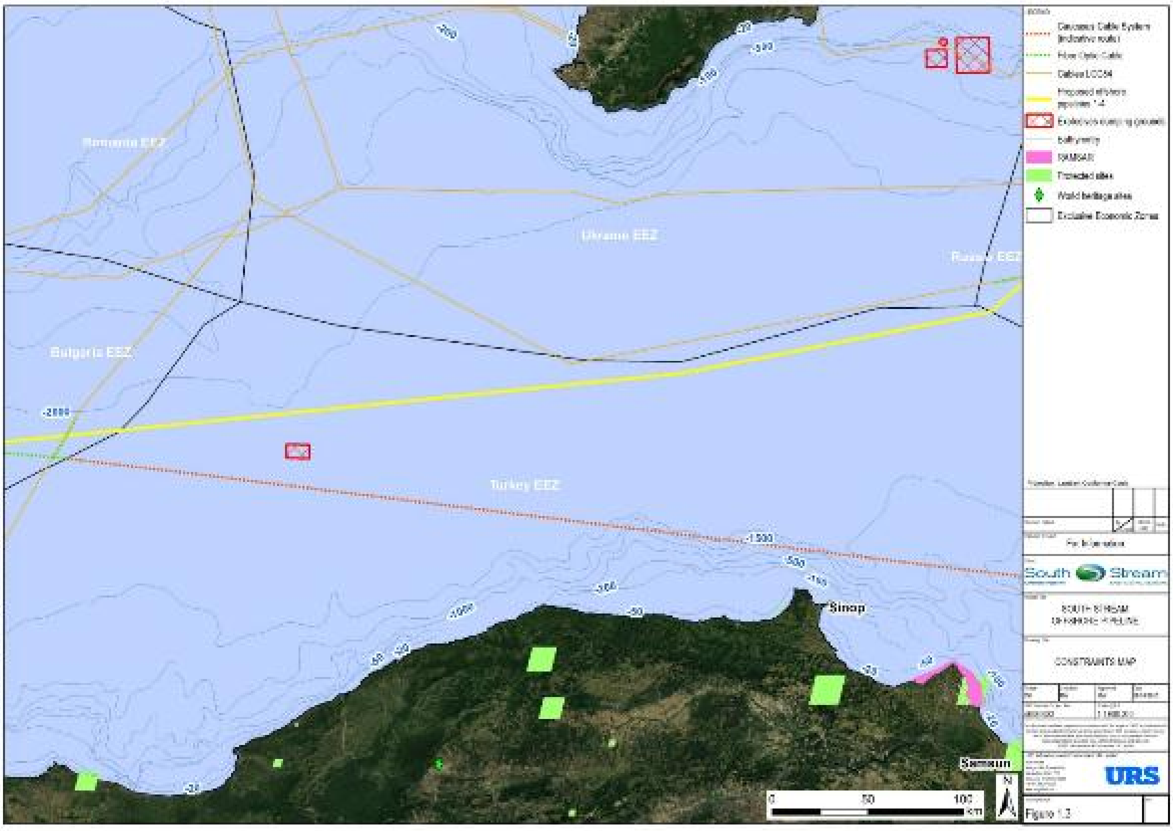


Figure 6.93: Cables Routes in the Turkish EEZ (note: this map is indicative only)

6.8 Exclusion Zone to be established in the Project Area

During the pipe-lay process, a navigation Safety Exclusion Zone is proposed of 2 km radius (1.1 NM) centred on the pipe-lay vessel. The Safety Exclusion Zone will be agreed with the relevant maritime authorities which will in turn ensure that it is communicated to vessels in passage in the vicinity of the pipe lay vessel.

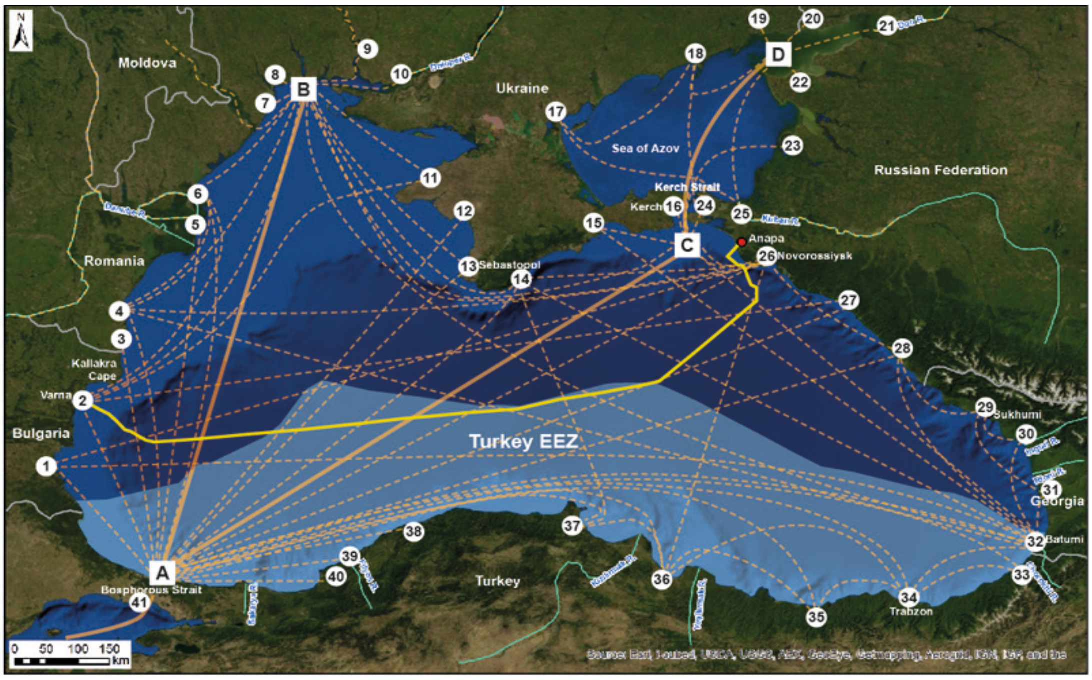
In addition, an operational safety zone of 420 m, extending either side of the outermost pipelines on the seabed across the entire pipeline route in the Turkish EEZ, has been determined in compliance with Turkish requirements and relevant industry and international standards prior to construction.

6.9 Sea Traffic

The Project is located in the Turkish EEZ in the Black Sea. At its closest point to Turkey it is located 110 km offshore (from Sinop, the nearest town on the Turkish Black Sea coast). The Black Sea is a major transport route for many of the Black Sea countries as shown in Figure 6.94. The majority of shipping traffic occurs between the following shipping hotspots:

- Bosphorus shipping junction (Istanbul);
- North-western harbour agglomeration (Odessa);
- Kerch Strait shipping junction; and
- North-eastern harbour agglomeration.

The key commercial shipping routes within the Turkish EEZ connect between the ports of Istanbul, Samsun and Trabzon and routes between neighbouring Black Sea countries (see Figure 6.94). Within the Black Sea, maritime cargo transportation includes transport of containers, general cargo, liquid and dry bulk, roll-on roll-off and rail ferry goods (Ref. 6.111). More information on the ports on the Turkish Black Sea coast is given in **Chapter 8 Assessment of Social-Economic Environment** of this EIA Report.



Key:

Pipeline

A: Bosporus shipping junction (Istanbul)
B: North western harbour agglomeration (Odessa)
C: Kerch Strait shipping junction
D: North eastern harbour agglomeration

1: Burgas	**12:** Evpatoria	**23:** Primorsko-Akhtarsk	**34:** Trabzon
2: Varna	**13:** Sevastopol	**24:** Port Kavkaz	**35:** Giresun
3: Mangala	**14:** Yalta	**25:** Temryuk	**36:** Samsun
4: Constantza	**15:** Feodosia	**26:** Novorossiysk	**37:** Sinop
5: Sulina	**16:** Kerch	**27:** Tuapse	**38:** Amasra (Bartin)
6: Ust'-dunayski	**17:** Genichesk	**28:** Sochi	**39:** Zonguldak
7: Illichivsk	**18:** Berdyansk	**29:** Sukhumi	**40:** Eregli
8: Odessa	**19:** Mariupol	**30:** Ochamchire	**41:** Istanbul
9: Nikolayev	**20:** Taganrog	**31:** Poti	
10: Kherson	**21:** Rostov-na-Donu	**32:** Batumi	
11: Chemomorskoye	**22:** Yeysk	**33:** Hopa	

Figure 6.94: Shipping and Navigation Routes in Black Sea (Ref.6.111)

A considerable share in the maritime transport within the Turkish EEZ is tankers which export crude oil and petroleum products from Russia (Novorossiysk, Tuapse), Georgia (Batumi) and Ukraine (Illichivsk), the volume of container and passenger traffic in recent years has significantly decreased.

Information on sea traffic within the Turkish EEZ was requested from the Ministry of Transport, Maritime Affairs and Communications – General Directorate of Coastal Security and the General Directorate of Maritime and Inland Waters Regulation. However neither department had statistic information on sea traffic types, volumes or cargos.

There are 13 port regions in the Black Sea resulting in 78 possible routes. Thirteen (13) of these routes intersect with the Project Area. Based on the 50,000 annual transit ship passages through the Strait of Istanbul, twice as much (100,000) is estimated as the number of total ship passages in the Black Sea. For each intersecting course, this would mean an average of 1281 ship passages per year, which is equivalent to a passage frequency of $\nu = 0.1464$ ships per hour. More information on the risk of vessel collisions within the Project Area is presented in **Appendix 9.A** of this EIA Report.

The Project may also involve the transport of pipes via cargo ships through the Bosphorus and Dardanelles Straits to the marshalling yards in Russia and Bulgaria (in the event that pipes are not delivered via rail). Information relating to the number of vessels using the Bosphorus Strait was collected from the Ministry of Transport, Maritime Affairs and Communications – General Directorate of Coastal Security. The number of vessels using the Bosphorus and Dardanelles Straits is shown in Table 6.38 (Ref. 6.112). This shows an annual decrease in the total number of vessels using this area from 2007 to 2012 and a forecasted decrease by the end of 2013. The number of tankers using this area is on average around 9,000 per year which is also decreasing on average by 2% per year.

Table 6.38: Vessel passage in the Bosphorus and Dardanelles Straits (2007 to 2013)

Years	Number of Vessels Passed	Number of Vessels Passing Larger Than 200 MT	Number of Tankers	Gross (Million Tons)	Dangerous Cargo Carried in Tanks (Million Tons)	Total Cargo (Million tons)	Rate of Increase Compared to 2007					
							Number of Vessels	Passes Larger than 200 MT	Number of Tankers	Gross Tons	Dangerous Cargo (Tanker)	Cargo Amount
2007	49,913	4,945	9,271	611.9	149.3	387.4	0%	0%	0%	0%	0%	0%
2008	48,978	5,223	8,758	657.4	149.1	397.2	-1.9%	5.6%	-5.5%	7.4%	-0.2%	2.5%
2009	49,453	5,176	9,567	667.4	152.1	373.6	-0.9%	4.7%	3.2%	9.1%	1.9%	-3.6%
2010	46,686	5,098	9,252	672.8	156.9	415.9	-6.5%	3.1%	-0.2%	10.0%	5.1%	7.3%
2011	45,379	5,494	8,818	705.4	154.6	434.1	-9.1%	11.1%	-4.9%	15.3%	3.5%	12.0%
2012	44,613	5,917	8,998	735.7	151.0	454.8	-10.6%	19.7%	-2.9%	20.2%	1.1%	17.4%
2008-2012 Average of Last Five Years	47,022	5,382	9,079	688	153	415	-5.8%	8.8%	-2.1%	12.4%	2.3%	7.1%
2013 / 1 Jan-31 July	*24,641*	*3,150*	*5,571*	*412*	*88*	*258*						
2013 / Annual Forecast	*42,405*	*5,565*	*9,503*	*721*	*149*	*442*	*-15.0%*	*12.5%*	*2.5%*	*17.8%*	*-0.2%*	*14.1%*
Average Per Month (based on 2008-2012 data)	*3,918*	*448*	*757*	*57*	*13*	*35*	*3,918*	*448*	*757*	*57*	*13*	*35*

The type of vessels passing through the Bosphorus (average of 2007-2012) is shown in Figure 6.95.

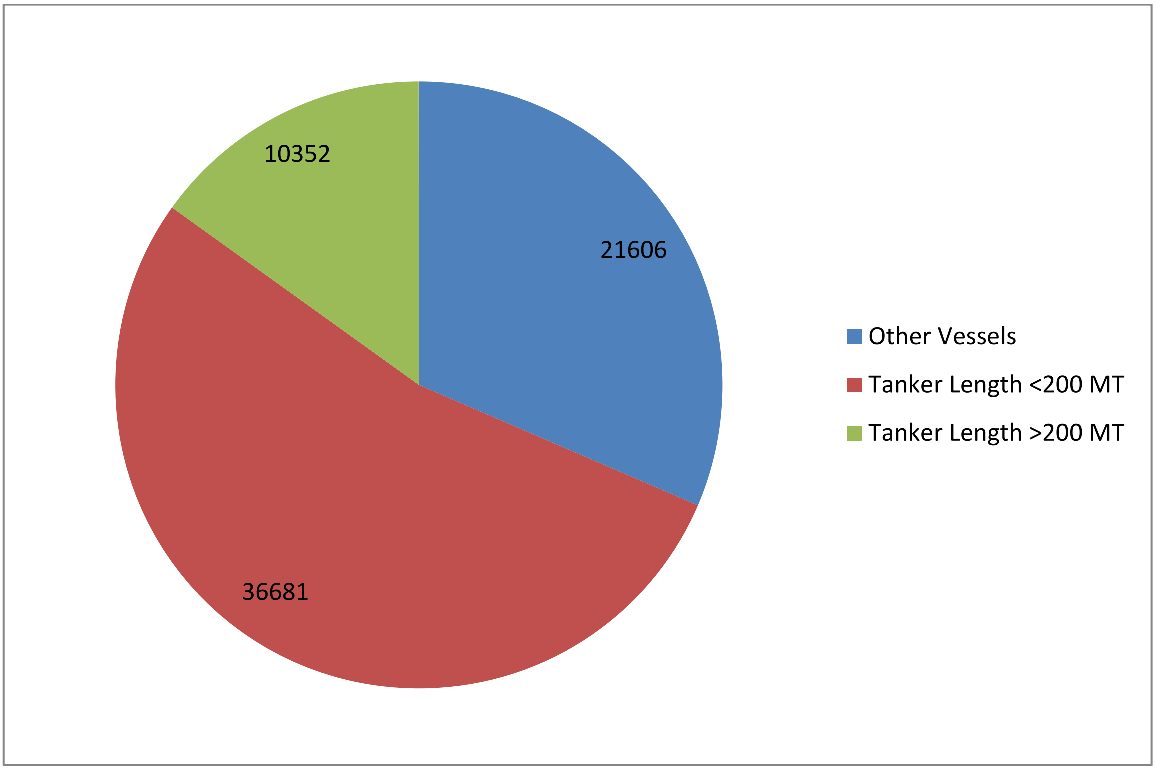


Figure 6.95: Type of Vessels using the Bosphorus and Dardanelles Straits (average for 2007 to 2012)

A risk analysis for the potential for collision within the Bosphorus and Dardanelles Straits is presented in **Appendix 9.A** of this EIA Report.

6.10 Cultural Assets

6.10.1 Context

The central Black Sea region is rich in archaeological material, primarily nautical finds and shipwreck material. In particular, as a result of the anoxic conditions within the Black Sea, which inhibits corrosion and microbial degradation, the preservation for any cultural heritage material is greatly enhanced below a water depth of 150 to 200 m. As such, any cultural heritage object (CHO) that exists within the offshore section of the Project below these depths are likely to be well preserved.

Virtually no archaeological fieldwork has been previously undertaken in the Project Area. Additionally, the Project Area is approximately 110 km from land and has always been a submerged environment, thereby significantly decreasing the potential for prehistoric archaeological material (e.g., settlements, shipwrecks). The timeline of the central Black Sea region is shown in Table 6.39.

Table 6.39: Timeline of the Central Black Sea Region

Epoch	Period		Description
Pleistocene Era	Lower Palaeolithic circa (c.) 2,000,000 – 200,000 BP		*Homo erectus*/*Homo ergaster* (1.4 to 1.6 Ma) European Neanderthal *Homo sapiens* (350,000 – 30,000 BP)
	Middle Palaeolithic c. 200,000 – 43,000 BP		European Neanderthal *Homo sapiens* (350,000 – 30,000 BP)
	Upper Palaeolithic c. 43,000 – 12,000 BP		European Neanderthal *Homo sapiens* (350,000 – 30,000 BP) European Early Modern Humans (43,000 BP+) Intermittent glaciations, hunting/gathering, cave art
Holocene Era	Mesolithic c. 12,000 BP – 6800 BC		Hunting and gathering in extensive temperate forests and on coastlines
	Neolithic c. 6800 – 5000 BC		Animal husbandry and agricultural cultivation, hunting wild animals, fishing and gathering wild foods
	Eneolithic/Chalcolithic c. 5000 – 3200 BC		Gold and copper metalworking developed and reached a peak c. 5000 – 4200 BC
	Bronze Age c. 3200 – 1200 BC		Early Bronze Age c. 3200 – 2500 BC Middle Bronze Age c. 2500 – 1600 BC Late Bronze Age c. 1600 – 1200 BC
	Iron Age c. 1200 BC – AD 200		Assyrians and Phrygians
	Antiquity c. 700 BC – AD 395	Archaic 700 – 480 BC	Persian Empire, 550 – 323 BC
		Classical 480 – 323 BC	Persian Empire, 550 – 323 BC
		Hellenistic 323 – 146 BC	Kingdom of Pergamon, 250 – 133 BC
		Roman 29 BC – AD 395	Entered Roman Republic
	Medieval 395 – 1475	330 – 1453	Byzantine Empire
		1071	Battle of Manzikert
		1243	Mongolian invasion
		1288 – 1878	Ottoman Empire
		1371 – 1479	Serbian-Ottoman Wars
		1453	Conquest of Constantinople, renamed Istanbul
	Post-medieval 1475 – 1922	1568 – 1829	Russo-Turkish Wars
		1683	Austro-Ottoman War
		1804 – 1813	First Serbian Uprising
		1815 – 1817	Second Serbian Uprising
		1853 – 1856	Crimean War
		1877 – 1878	Russo-Turkish War
		1914 – 1918	First World War
		1919 – 1922	Greco-Turkish War
	Modern 1922 – present	1923	Turkey becomes a republic, Atatürk declared president
		1939 – 1945	Second World War
		1946 – 1950	Institution of multi-party democracy
		1960	*Coup d'état*
		1965	Political system re-established
		1980	*Coup d'état*
		1983	Political system re-established after 1982 constitution

6.10.2 Mesolithic Period (c. 10,000 to 6800 BC)

The retreat of the ice sheets of the Würm glaciation marked the end of the Pleistocene epoch and the start of the Holocene (Ref. 6.56). The climate became more temperate, and ice-sheets retreated from the tops of Turkish mountains.

Mesolithic populations subsisted by semi-nomadic, seasonal hunting and gathering. Bows and arrows, slingshots, and composite tools made from small microliths were developed. Grinding stones were used to process plants. Harpoons and net-sinkers have been found, indicating a greater role of fish in the diet than in previous periods. A site discovered 6 km off Sinop on a gentle slope and beach terrace landform (in approximately 95 m of water) that featured a structure consisting of one apparently worked beam, tree branches, and a series of rough stones was initially dated to the Mesolithic; this site, which was thought one of the earliest coastal habitations along the Black Sea coast that predates the relinking of the Mediterranean Sea with the Black Sea, was later determined to be geological rather than archaeological in nature (Ref. 6.59, Ref. 6.60 to Ref. 6.61). While sea levels were considerably lower than those of present-day during this period, the Project Area was always submerged and never exposed dry land, thereby significantly decreasing the potential for Mesolithic marine sites.

6.10.3 Neolithic Period (c. 6800 to 5000 BC)

Several submerged marine beach sediments and estuarine peat layers have been found along the Black Sea coastline at depths that ranged from 8 m to 5 m below present-day sea levels (Ref. 6.59, Ref. 6.60, Ref. 6.62, Ref. 6.63 to Ref. 6.64). While sea levels were considerably lower than those of present-day during this period, the offshore section where the proposed pipeline corridor is to be laid was always submerged and never exposed dry land, thereby significantly decreasing the potential for Neolithic marine sites.

One of the most notable Neolithic sites on land is that of Çatalhöyük in south-central Turkey, a multi-component settlement site that shows clear evidence of agriculture and animal domestication (Ref. 6.65). Settlement sites have also been discovered on land at Çayönü, Nevlı Çori, and Köşk Höyük-Niğde, located in the southern region of Turkey, but very little material has been found along the Black Sea coast (Ref. 6.66, Ref. 6.67).

6.10.4 Eneolithic/Chalcolithic Period (c. 5000 to 3200 BC)

Analysis of sea level curves indicates that several transgressions/regressions episodes occurred during this period as a result of glacial melting and climatic instability (Ref. 6.59, Ref. 6.62, Ref. 6.68 to Ref. 6.64). While sea levels were considerably lower than those of present-day during this period, the Project Area is to be laid was always submerged and never exposed dry land, thereby significantly decreasing the potential for Neolithic marine sites.

A höyük site (on land) at Dündartepe (Öksürüktepe) (Samsun) along the Black Sea coast has been dated to the Eneolithic, as have sites on land at Demirci (Sinop), Kunşcular (Bafra), İkiztepe (Bafra), Gökçe Boğaz (Alaçam), and Maltepe (Sinop) based on analysis of painted pottery sherds (Ref. 6.67, Ref. 6.68, Ref. 6.70, Ref. 6.71, Ref. 6.72). Cultural development of the central Black Sea region before the Bronze Age has been studied by several researchers, who also mentioned several other cultural activity centres along the central coast of the Black Sea (Ref. 6.73).

6.10.5 Bronze Age (c. 3200 to 1200 BC)

It is not until the Late Chalcolithic to Early Bronze Age (c. 3800 to 3200 BC) that the sea levels stabilised across the Black Sea. By this time sea levels reached between 8 m and 5 m below present day sea levels. During the Bronze Age, farming and technology continued to develop and societies became more complex as social hierarchies emerged. Bronze metalworking developed and land and sea trade expanded.

The Chalcolithic settlements along the Black Sea coast continued on into the Early and Middle Bronze Ages (c. 3300 to 1600 BC), notably Kunşcular and İkiztepe (Ref. 6.69). There is scarce archaeological information concerning the prehistoric ages of the Black Sea. The only site which provides information, the Early Bronze Age site İkiztepe, is located on land in Samsun Province near Bafra. Researchers who have studied in Black Sea region have located other several Early Bronze Age sites on land such as Gökçeboğaz Tepe, Dede Tepe, Bağtepe, and Tekkeköy (Ref. 6.73).

Little is known of maritime activity along the Turkish Black Sea coast in the Bronze Age. There was extensive seafaring in the Aegean and eastern Mediterranean during this time, as evidenced by regional iconography and archaeological remains (Ref. 6.74). The Late Bronze Age *Uluburun* shipwreck, located off Kaş in the southwest, can serve as an appropriate comparative example, as it has the most complete hull remains of any Late Bronze Age shipwreck and dates between 1316 and 1305 BC (Ref. 6.75). Other Bronze Age shipwrecks in Turkish waters include those at Cape Gelidonya and Sheytan Deresi, also off the southwest coast (Ref. 6.76, Ref. 6.77).

6.10.6 Iron Age (c. 1200 BC to AD 200)

The collapse of the Hittite kingdom (1200 to 1180 BC) saw the arrival of the Phrygians and other Indo-European migrants from the west and the expansion of the Urartian kingdom in the east (Ref. 6.78). During this period there is a general shift from Black Sea coastal settlement sites to those on the inland plateaus, even though significant iron deposits and iron-bearing sands existed along this coastline (Ref. 6.69, Ref. 6.79, Ref. 6.80).

Archaeological evidence for Iron Age maritime activity along the Turkish Black Sea coast is scarce. No shipwrecks or associated nautical material have been discovered or published, but this should not discount the possibility that such material exists. In Bulgaria, for example, a dugout canoe was found in Mandrensko Lake near Burgas that dates to the 1st millennium BC (Ref. 6.81), and hundreds of stone anchors have been discovered along the western Black Sea coast (Ref. 6.82 to Ref. 6.85), indicating a strong maritime industry in the western Black Sea. After the Greeks arrived in the Black Sea during the 7th century BC, it is likely that local inhabitants adopted Greek shipbuilding techniques and expanded their sea-going endeavours.

6.10.7 Antiquity (c. 700 BC to AD 395)

Much is known historically and archaeologically of the Antiquity period, starting with Greek colonization of the Black Sea beginning c. 7th century BC (Ref. 6.86, Ref. 6.87). Mass colonisation began in the 6th century BC and continued until the late Archaic (c. 480 BC).

During this period, both the Greeks and the western Anatolian cities established new cities along the Black Sea coast. The first Milesian colony, Sinope (Sinop), was likely founded in the late 7th century BC based on archaeological data. Other notable Greek colony cities include Heraclea Pontica (Ereğli), Amisos (Samsun), Cotyora (Ordu), Cerasus (Giresun), and Trapezus (Trabzon), some of which served as major production and trade centres for the entire Black Sea region. Colonists engaged in fishing, agriculture and craft production, while trade and shipping were secondary sources of income (Ref. 6.88). Principal Turkish exports during this period included fish and processed fish, timber and wooden items, metal goods, gems, olive oil, and wine, while imports from the Mediterranean included oil, wine, and finished products (e.g. ceramics, metal goods, glassware) (Ref. 6.89, Ref. 6.90, Ref. 6.91).

The geographical division of Pontus into the coast and interior reflects a sharp cultural division between Greeks and native Anatolians (Ref. 6.92), and it is likely that the Greek colonies located on the coast did not intensively affect the hinterland. The Greek cities of the coast looked regularly towards the sea and their influence is not believed to have reached the interior. Relationship between colonists and local tribes was mainly peaceful until the late Archaic period.

Regarding seafaring, the Greeks brought with them an extensive knowledge of sea-based navigation and shipbuilding technology. The warship and merchant ship were the two main types of Greek vessels that existed during this period, but it the latter is the one that likely made it to the eastern Black Sea region. Merchant ships were deep, broad wooden vessels that used sails as the primary mode of propulsion (Ref. 6.80). The Romans, by contrast, were not a seafaring people and likely relied on Greek nautical traditions to design and build their vessels. While not much is known about their warships, extensive research has been conducted on the Roman merchant fleet.

Archaeological evidence for Antiquity maritime activity along the Turkish Black Sea coast is scarce. A number of Hellenistic and Roman settlements and production centres on land have been investigated in northern Turkey, which include Sinop, Demirci, Amasya, Maçka, and Ereğli (Ref. 6.65). Underwater archaeological surveys off Ereğli in 2011 discovered a shipwreck that dates to the late 4th century BC, and another shipwreck off Sinop has been dated to the 1st century AD (Ref. 6.93). Given the extensive maritime trade network that existed in the Black Sea and the Mediterranean during this period and the high preservation qualities of the anoxic waters, there is a high possibility that additional Antiquity-era shipwrecks exist in the Turkish waters of the Black Sea.

6.10.8 Medieval (AD 395 to 1475)

The Byzantine Empire began in 4th century AD after the Roman capital was moved to the city of Byzantium and renamed Constantinople (Ref. 6.90). Maritime activity continued to increase throughout the Black Sea given its strategic location between Europe and Asia. As the Byzantine Empire sought control over the eastern Mediterranean and Black Seas, many naval engagements resulted. There was much political unrest and naval warfare between the Byzantines, Germanic kingdoms, and Persians during this time (Ref. 6.74).

Regarding maritime trade, Sinop and Trabzon continued to be major port centres, and the grain trade from Alexandria to Byzantine ports was most notable. Long-distance commerce peaked during the 14th century, as the focus during this time was not so much on trade as it was preventing others from seizing the advantages from the region.

Underwater archaeological surveys off Sinop in 2000 and 2011 discovered six shipwrecks that date to the mid-5th century AD, and one shipwreck off Ereğli has been dated to the 6th century AD (Ref. 6.94, Ref. 6.61, Ref. 6.93 to Ref. 6.95). All but one of these wrecks is located in the oxic/anoxic interface at a depth from 100 m to 120 m below surface. Given the extensive maritime trade network that existed in the Black Sea and the Mediterranean during this period and the high preservation qualities of the anoxic waters, there is a high possibility that additional Medieval-era shipwrecks exist in the Turkish waters of the Black Sea.

6.10.9 Post-Medieval (AD 1475 to 1922)

Minimal changes in sea levels occurred during this period, with the last notable regression taking place during the "Little Ice Age" (c. AD 1350 to 1850) (Ref. 6.59, Ref. 6.62, Ref. 6.96 to Ref. 6.97, Ref. 6.98). Following this event, the sea level curve stabilised to its modern-day levels.

Maritime trade was controlled by the Ottoman Empire. Foreign merchant vessels were mostly prohibited from entering the Bosporus Straits, and all trade routes were redirected to Istanbul (formerly Constantinople) so that goods and resources could be taxed (Ref. 6.90).

Russian forces began to challenge the Ottomans starting in the 16th century AD. The following centuries saw a series of Russo-Turkish Wars and treaties that resulted from major engagements gave more maritime rights to Russia (Ref. 6.90). By 1774, Russian merchant vessels could freely navigate the Black Sea and in the following decades foreign merchantmen were allowed to do so as well, thereby re-establishing a pan-European maritime commercial network.

The Black Sea experienced 20th century AD naval warfare during World War I. Turkey and Bulgaria joined with the Central Powers between AD 1914-5, while Russia and Romania sided with the Allied forces. In response to bombing attacks by the Ottomans, Russia placed a series of sea-mines along the Anatolian coast and disrupted the transportation of coal, thereby crippling the Ottoman fleet (Ref. 6.90).

Archaeological remains on land from the post-medieval period can be found throughout Anatolia, especially at the site of Zeytinlik (Sinop) on the Black Sea coast and İznik on the Sea of Marmara, which consist primarily of Ottoman ceramics assemblages (Ref. 6.99, Ref. 6.100). Maritime archaeology finds have also has been discovered. Underwater archaeological surveys off Sinop and Ereğli in 2011 and 2012 located at least six shipwrecks that date from the 17th to 19th centuries AD (Ref. 6.93, Ref. 6.95). Cargoes could not be identified on the majority of these sites, but in one case cut timber was clearly determined to be cargo material. Given the extensive maritime trade network that existed in and around the Black Sea during this period and the high preservation qualities of its anoxic waters, there is a high possibility that additional post-medieval-era shipwrecks exist in the Turkish waters of the Black Sea.

6.10.10 Modern Period (1922 to present)

During the early 20th century AD, the political climate of Turkey changed with the creation of the Republic of Turkey in 1923. Turkey stayed largely neutral during World War II, but did join the Allied forces toward the end of the war. The refugee ship MV *Struma* was sunk by a Soviet submarine north of the Bosphorus Straits (Ref. 6.90). Following the war Turkey sought to keep the Black Sea an international waterway, whereas its neighbours preferred to see access restricted to vessels from littoral countries, but no actions were implemented to limit vessel traffic.

Shipbuilding changed radically in the modern period. In the early to mid-19th century AD, metal started to be used more regularly for structural elements and eventually the hull; by the end of the century the majority of ships were being built completely out of iron and steel. Another revolutionary change came with the advent of marine steam engines, and later combustion engines, which had a resounding effect on how ships were built, manned, and operated.

Naval warfare was directly affected by these changes. As vessels became more robust and resilient as a result of their metal hulls, weaponry and ordinance were also redesigned to be more effective. Torpedoes, sea mines, and submarines were used quite extensively in naval combat starting at the end of the 19th century AD. In the 20th century AD, aircraft were introduced in military campaigns. During both World War I and World War II, the nearshore area experienced significant naval activity from Russian forces (e.g. establishing minefields).

6.11 Cultural Asset Surveys in the Project Area (Appendix: Records of sonar surveys- significant sea wrecks, etc.)

The Project Area has a high potential for featuring archaeological remains such as shipwrecks; maritime structures such as; aircraft wrecks; and remains associated with 19th and 20th century conflict. As a result of the anoxic conditions, which inhibit corrosion and microbial degradation (see Section 6.3), the preservation potential for any cultural heritage object is greatly enhanced below a water depth of 120 m to 200 m.

Little previous archaeological research had been undertaken in the marine environment of the Project Area prior to the investigations undertaken as part of the Feasibility and Development Phase of the Project. This section describes both the results of previous studies (as part of the desk-based assessment) and the field surveys which were undertaken to further inform this EIA Report.

A desk-based assessment of secondary data sources was undertaken to enhance understanding of marine cultural heritage that may be present within the Project Area. These secondary data sources include:

- National and regional databases of the General Directorate for Cultural Heritage and Museums; the MoCT; and TAY Project: Archaeological Settlements of Turkey (Ref. 6.101 to 6.102);
- Bathymetric and shipwreck data of the Turkish Office of Navigation, Hydrography and Oceanography (Ref. 6.103);
- Relevant publications on offshore archaeology of the Black Sea (Ref. 6.103 to Ref. 6.104); and
- Information from relevant archaeological institutions and museums.

Information on marine cultural heritage draws on data gathered from previous studies carried out for the South Stream Offshore Natural Gas Pipeline, including extensive feasibility and engineering surveys between 2009 and 2012. These studies, which have focused on gathering information for geo-environmental, geotechnical, and engineering purposes, are detailed in Table 6.40. These surveys, extended to 1 km on either side of the initial pipeline route centre-line (Refs. 6.56 to 6.57). The marine surveys used the following equipment to investigate and create digital images of the seabed:

- Side-scan sonar,
- multi-beam echo sounder,
- sub-bottom profiler, magnetometer, and
- autonomous underwater vehicle (AUV).

During investigations, objects that exhibited anthropogenic features had their locations recorded and were briefly analysed to determine if further investigations were required.

Marine surveys undertaken in 2012 included a visual inspection of the initial pipeline route using a remotely operated vehicle (ROV) equipped with an underwater video camera, which enabled the identification and assessment of potential cultural heritage targets in the Project Area These surveys are also detailed in Table 6.40. Each marine cultural heritage site is identified by its original marine survey target designation to maintain consistency with previously issued reports (e.g. Abs_100). The geographical distributions of these targets are detailed in **Appendix 6.J** of this EIA Report and they are mapped in **Appendix 6.K**.

Table 6.40: Marine Cultural Heritage and Archaeology Surveys

Name of Survey	Month, Year	Surveyor	Location of Survey	Type of Survey
Offshore Geophysical Survey	May – July 2011	Peter Gaz	Turkish EEZ Waters	Multi-beam echo sounder, sub-bottom profiler
Offshore Geophysical Survey	January – March 2012	Peter Gaz	Turkish EEZ Waters	Side-scan sonar, multi-beam echo sounder, sub-bottom profiler
Offshore Geophysical Survey	March – April 2012	Peter Gaz	Turkish EEZ Waters	Side-scan sonar, multi-beam echo sounder, sub-bottom profiler
Offshore Geophysical Survey	September – October 2012	Peter Gaz	Turkish EEZ Waters	Geophysical survey (e.g. visual) using ROV

Geophysical field surveys conducted in 2011 and 2012 discovered a total of 76 potential CHO > 5 m within a 2 km area of the pipeline route, 1 km on either side of the initial pipeline route centre-line, (Refs. 6.105 to 6.106) in the Turkish EEZ. Table 6.41 shows the geographical distribution of these targets.

Table 6.41: Acoustic Targets and CHO within the Project Area

Oceanographic Region	Number of CHO and Potential CHO within 1 km of the initial pipeline route centre-line	Number of CHO within 150 m of any of the four pipelines
Abyssal Plain	76	2

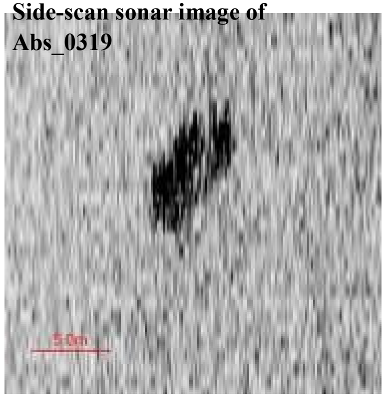
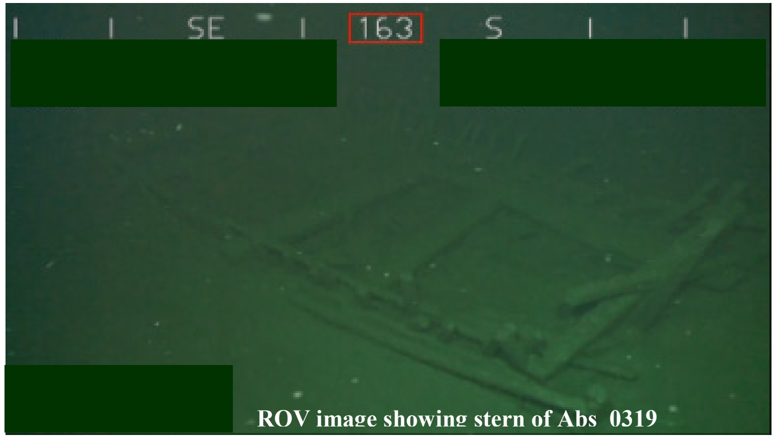
Of the anomalies identified within 150 m of any of the four initial pipeline routes, only two were preliminarily identified as cultural heritage objects (CHOs) in the form of shipwrecks that potentially date to the post-medieval or modern period (Table 6.42).

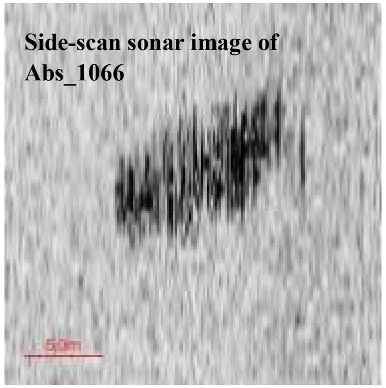
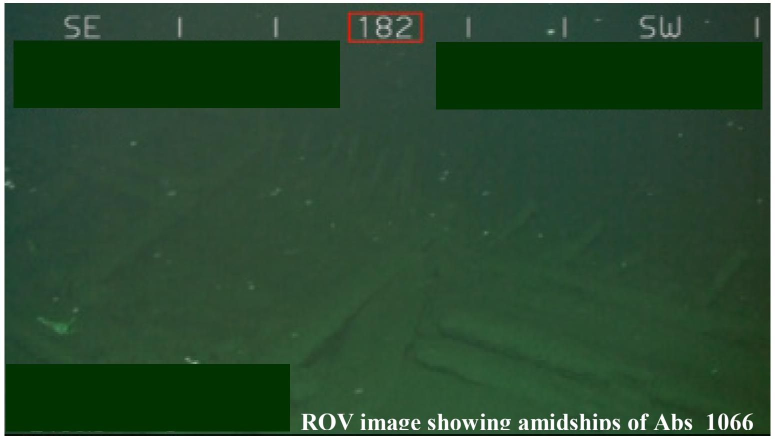
- Wooden shipwreck site on the abyssal plain, approximately 30 m north of the proposed Pipeline #4 route centreline (Abs_0319);
- Wooden shipwreck on the abyssal plain, approximately 5 m north of the proposed Pipeline #4 route centreline (Abs_1066).

Six additional objects of interests within this area were investigated via ROV, but these objects proved to be logs and trees of no cultural significance (thereby reducing the number of CHOs and Potential CHOs to 70) (Table 6.42).

No marine archaeological sites dating to the Iron Age (c.1200 BC to AD 200), Antiquity (c.700 BC to AD 395) and Medieval (AD 395 to 1475) have been identified within 150 m of any of the four proposed pipeline routes.

Table 6.42: Inventory of Marine Cultural Heritage and Archaeology Resources within 150 m of any of the four proposed pipeline route

Site No.	Dating	Description	Designation	Image
Abs_0319	Post-Medieval to Modern period (18th to 19th century)	Wooden shipwreck that lies approximately 30 m north of the initial Pipeline #4 route centre-line (prior to route optimisation). The wreck is partially buried beneath the seafloor, but has a good amount of exposed hull material. The tops of the frames, the stern post, and the stem are all visible. The transom is flat and composed of large, horizontal transom timbers, while four thwart timbers span the entire width of the vessel. Planking has come loose from the upper portion of the frames, and the bow consists of mostly disarticulated timbers. There is no clear evidence of cargo, but there are objects within the hull that are covered by a layer of sediment. The wreck site measures approximately 7.8 m long by 4.3 m wide and is at a depth of 2,170 m.	Presently unknown. Site not registered with MoCT.	**Side-scan sonar image of Abs_0319**   **ROV image showing stern of Abs_0319**

Site No.	Dating	Description	Designation	Image
Abs_1066	Post-Medieval to Modern period (18th to 19th century)	Wooden shipwreck that lies approximately 5 m north of the initial Pipeline #4 route centre-line (prior to route optimisation). The wreck is partially buried beneath the seafloor, but has a good amount of exposed hull material. Frames and gunwales are visible on both sides, which are mostly intact. At least six thwarts span the entire width of the vessel, and two short, longitudinal timbers rest upon the two centre-most thwarts, possibly a mast step. There is no clear evidence of cargo, but there are objects within the hull that are covered by a layer of sediment; these include stacked timbers at the stern of the vessel and a pile of debris near amidships. The wreck site measures approximately 11.8 m long by 5.6 m wide, and is at a depth of 2,190 m.	Presently unknown. Site not registered with MoCT.	**Side-scan sonar image of Abs_1066**   **ROV image showing amidships of Abs_1066**

6.11.1 Impacts on Cultural Heritage Objects

The potential impacts on the Cultural Heritage Objects have been assessed based on the anticipated activities related to the Construction, Operational and Decommissioning Phases of the Project and summarised in Table 6.43.

Table 6.43: Project Activities and Impacts to Cultural Heritage Objects

Phase	Activity	Impact
Construction	Perform pre-laid and as-laid ROV surveys.	Disturbance of or damage to offshore cultural assets
	Laying pipeline on the seabed	
Operation	Maintenance / repair to pipelines (e.g. span correction) Pipeline condition survey and repairs	
	Physical presence of pipeline on seabed	
Decommissioning	Removal of pipeline from seabed	

The assessment of impacts on cultural heritage receptors has been conducted in line with **Chapter 2: Environmental Impact Assessment Approach** of this EIA Report. An assessment of impacts compared to relevant national standards in national legislation is given in **Chapter 9: Assessment of Project Activities** of this EIA Report.

The main controls which have been built into the design to limit any potential impacts on cultural heritage receptors are listed in Table 6.44.

Table 6.44: Design controls for Cultural Heritage Objects

Design Controls
Avoidance was considered during the route selection process. The route was optimised to make sure that that a 150 m buffer is included around identified CHO (see below for more details).
Adoption by South Stream Transport of a comprehensive Cultural Heritage Stewardship programme. The objective of such programme is to ensure that all parties involved in the construction, operation and decommissioning of the pipeline are at all times aware of the importance of Cultural Heritage and that compliance with national legislation and international conventions is achieved during any activity associated with the Project. o Systematic stewardship of cultural heritage can be ensured throughout the Project life-cycle by developing and implementing a Cultural Heritage Management Plan (CHMP) including a chance find procedure. The Cultural Heritage Management Plan will be developed and implemented in collaboration with the Turkish Ministry of Culture and Tourism. o Any mitigation works will be agreed in consultation with the Ministry of Culture and Tourism, and designed and executed in line with the following national guidelines: o Law on the Conservation of Cultural and Natural Property (23 July 1983, Law No. 2863, last amended February 2008); o Regulation on the Collection and Control of Movable Cultural and Natural Property to be Protected (17 January 1984); o Regulation on Survey, Sounding and Excavation to be Performed in Relation to Cultural and Natural Property (10 August 1984); and

Design Controls
o Regulation on the Identification and Registration of Immovable Cultural and Natural Property to be Protected (10 December 1987); o UNESCO Convention on the Protection of the Underwater Cultural Heritage (2001).
Appropriate staff training in cultural heritage awareness will be undertaken by staff and subcontractors during all Phases of the Project to assist in the prevention of interference or accidental damage to cultural heritage. The approach to this training will be included within the Project CHMP.
Should chance finds of cultural heritage objects occur during Project construction activities (including UXO and pre-lay surveys undertaken prior to construction), the Chance Finds Procedure will be implemented to allow the monitoring archaeologist to record and assess the find, and carry out an appropriate avoidance or mitigation response. The Project CHMP will be discussed with the relevant Turkish authorities. The relevant authorities will be informed of all chance finds. A Chance Find Procedure appropriate to the Operational Phase of the Project will be developed in advance of the commencement of this Phase. The Chance Find Procedure for all Phases of the Project will be developed in consultation with the Turkish Ministry of Culture and Tourism.
Reducing the risk of looting, vandalism and damage to cultural heritage objects during the Construction and Pre-commissioning and Operational Phases of the Project will be achieved through implementation of the Cultural Heritage Management Plan, including staff cultural heritage awareness training.

During Construction specific measures will be taken:
o All known marine cultural heritage objects will be delineated on Project maps and in the Project GIS database, which will be available to the design team and construction contractors. Project mapping and GIS will be updated, as necessary, should any chance finds of cultural heritage objects occur.
o Real time monitoring of the pipe-laying process to ensure that the pipeline is installed at the stipulated distance from any CHOs.
o Potential impacts from the use of ROVs for monitoring and surveying will be minimised by limiting propeller or thruster washing, proper tether management and avoiding ROV strikes by careful piloting;
o During surveying and pipe-laying works, archaeological watching briefs will be undertaken to monitor surveying and construction activities. A qualified archaeologist will monitor during the pre-lay surveys and pipe-laying activities to determine the presence or absence of potential cultural heritage objects and to ensure that known cultural heritage sites are not impacted by surveying and pipe-laying activities. Archaeological watching briefs will be undertaken by appropriately qualified and experienced cultural heritage professionals approved and permitted by the competent authorities. Specifically, the watching briefs will be undertaken in order to ensure that:
  o The avoidance distance of 150 m for known CHOs is adhered to during pipelaying;
  o The agreed mitigation measures are appropriately implemented to ensure the prevention of damage to presently known CHOs Abs_0319 and Abs_1066 from the use of ROVs or other surveying and construction activities; and
  o The procedure for chance finds, as outlined in the Project Cultural Heritage Management Plan, is appropriately implemented.

6.11.1.1 Impacts from Construction

Pre-lay and as-laid route surveys have the potential to impact upon cultural heritage objects. There is the potential for damage from underwater vehicles (e.g. ROVs and AUVs) due to collision, improper tether management fouling/striking the shipwreck, and thruster/propeller washing during surveys. There is also the potential for un-authorised removal of artifacts during ROV examination as a result of increased human access to previously unknown sites. Although open circuit divers can descend to a depth of up to 100 m, and closed circuit divers with re-breather can reach over 140 m, artifacts and structural elements may also be moved or brought to the surface by remote operations (e.g. AUV, ROV).

Cultural heritage objects that are within 150 m of any of the four initial pipeline route are at a greater risk of being impacted by construction activities. Activities associated with pipe-laying within 150 m of an individual pipeline route could potentially disturb, damage, and/or destroy receptors:

- The area 100 m to 150 m from the pipeline is assessed as low risk;
- The area 50 m to 100 m from the pipeline is assessed as moderate risk; and
- The area 0 m to 50 m from the pipeline is assessed as high risk.

The pipeline route has been optimised to ensure a 150 m buffer around identified CHO; Abs_0319 and Abs_1066. Given the design controls described in Table 6.44 above, it is considered that the potential for impacts on these known CHOs is low. A review of already-collected marine data suggests that chance finds of cultural heritage objects are highly unlikely to occur during Project construction and operation activities. Should chance finds of cultural heritage objects occur during Project construction activities (including UXO and pre-lay surveys undertaken prior to construction), the Chance Finds Procedure will be implemented to allow the monitoring archaeologist to record and assess the find, and carry out an appropriate avoidance or mitigation response.

6.11.1.2 Impacts from Operation

As no significant intrusive work will be carried out on the pipelines during their operation no significant impacts are expected. There is the potential for ROV surveys undertaken as part of routine inspection and maintenance activities to disturb cultural assets in the same manner as mentioned in Section 6.11.1.1. In such cases, the mitigation measures will be as per the Construction Phase and will include the limitation of ROV propeller or thruster washing, proper tether management and avoidance of ROV strikes by careful piloting.

6.11.1.3 Impacts from Decommissioning

As decommissioning approaches may have changed by the time of the end of the operational life of the Project, at this time it understood that should the pipelines be removed from the seabed, potential impacts are likely to be similar to impacts during construction (Section 6.11.1.1). There will be no impacts if the pipelines are left in situ.

6.11.1.4 Impacts from Unplanned / Emergency Events

There are no anticipated impacts from unplanned or accidental events.

6.12 Other Issues

There are no other issues to be discussed in this Chapter.

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Acronyms

Term	Explanation
%	Percent
~	Approximately
<	Less Than
±	Plus or Minus
%	Percentage
‰	Parts per Thousand
MBSC	Main Black Sea Current
BWM	Ballast Water Management
cells/l	Cells per Litre
EEZ	Exclusive Economic Zone
g/m^2	Grams per Square Metre
H_2S	Hydrogen Sulphide
HSE	Health Safety and Environment
Hz	Hertz
IFC	International Finance Corporation
IMO	International Maritime Organisation
$ind./km^2$	Individuals per Square Kilometre
$ind./m^3$	Individuals per Cubic Metre
$ind./km^2$	Individuals per Square Kilometre
IUCN	International Union for Conservation of Nature
km	Kilometres
m	Metres
m^3	Cubic Metre
MARPOL	International Convention for the Prevention of Pollution from Ships
mg/l	Milligrams per Litre
mg/m^3	Milligrams per Cubic Metre
O_2	Oxygen
ROV	Remotely Operated Vehicle
NM	Nautical miles

7. Assessment of the Biological Environment

This Chapter presents an assessment of the Project's impacts on marine biological receptors within the Turkish EEZ of the Black Sea. The assessment considers impacts arising during all phases of the Project. There is also an assessment of the potential impact on marine biological receptors from unplanned / emergency events.

It is during the Construction Phase that the majority of impacts are expected to arise. Construction activities, including vessel movements and operations, have the potential to disturb species, particularly as a result of noise from vessels impacting fish and cetaceans.

Within the central Black Sea, faunal groups of particular interest, either due to their value or vulnerability, include a variety of commercial fish species (e.g. anchovy and sprat), marine mammals and seabirds. Plankton is vital to the functioning of the marine food web and as such are also considered important.

This Chapter provides a description of the baseline conditions, assessment methodology, mitigation measures required to avoid, reduce or offset any significant adverse effects.

The Project Area is defined in **Chapter 1 General Features of the Project** of this EIA Report. The Survey Area refers to the locations in which surveys were conducted for the Project during the feasibility phase from 2009 to 2011 (Ref. 7.1). These locations are shown in Figure 7.1.

A number of secondary data sources were consulted to inform the baseline of this Chapter, as described below:

- A thorough review of published scientific literature presented in survey reports produced for the Project by Peter Gaz (Ref. 7.1) has been incorporated into this baseline as appropriate;
- Recently published scientific literature which was identified through a British Library data search;
- The Black Sea Red Data Book was consulted in order to identify the potential presence of notable species within the Survey Area (Ref. 7.2) as well as international conventions such as the Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and contiguous Atlantic area (ACCOBAMS); and
- Information on fish and historic changes in the Black Sea flora and fauna are found in the Black Sea Commission "State of the Environment" reports (Ref. 7.3 to 7.6).

Taking into account the need to obtain reliable baseline data, the 2009 and 2011 surveys (Ref. 7.1) aimed to assess the status of plankton communities, birds and marine mammals within the Turkish waters of the Black Sea. Details of the sampling programme are provided in Table 7.1.

Table 7.1: Marine Ecology Surveys (2009 and 2011)

Month, Year	Species Surveyed	Sampling Locations
June, 2009	Plankton	10 Stations
	Birds	5 Stations, 6 Transects
	Mammals	5 Stations, 6 Transects
Sept – Oct, 2011	Plankton	15 Stations
	Birds	12 Stations, 11 Transects
	Mammals	12 Stations, 11 Transects

The survey methods used for each species are discussed under the relevant topic headings.

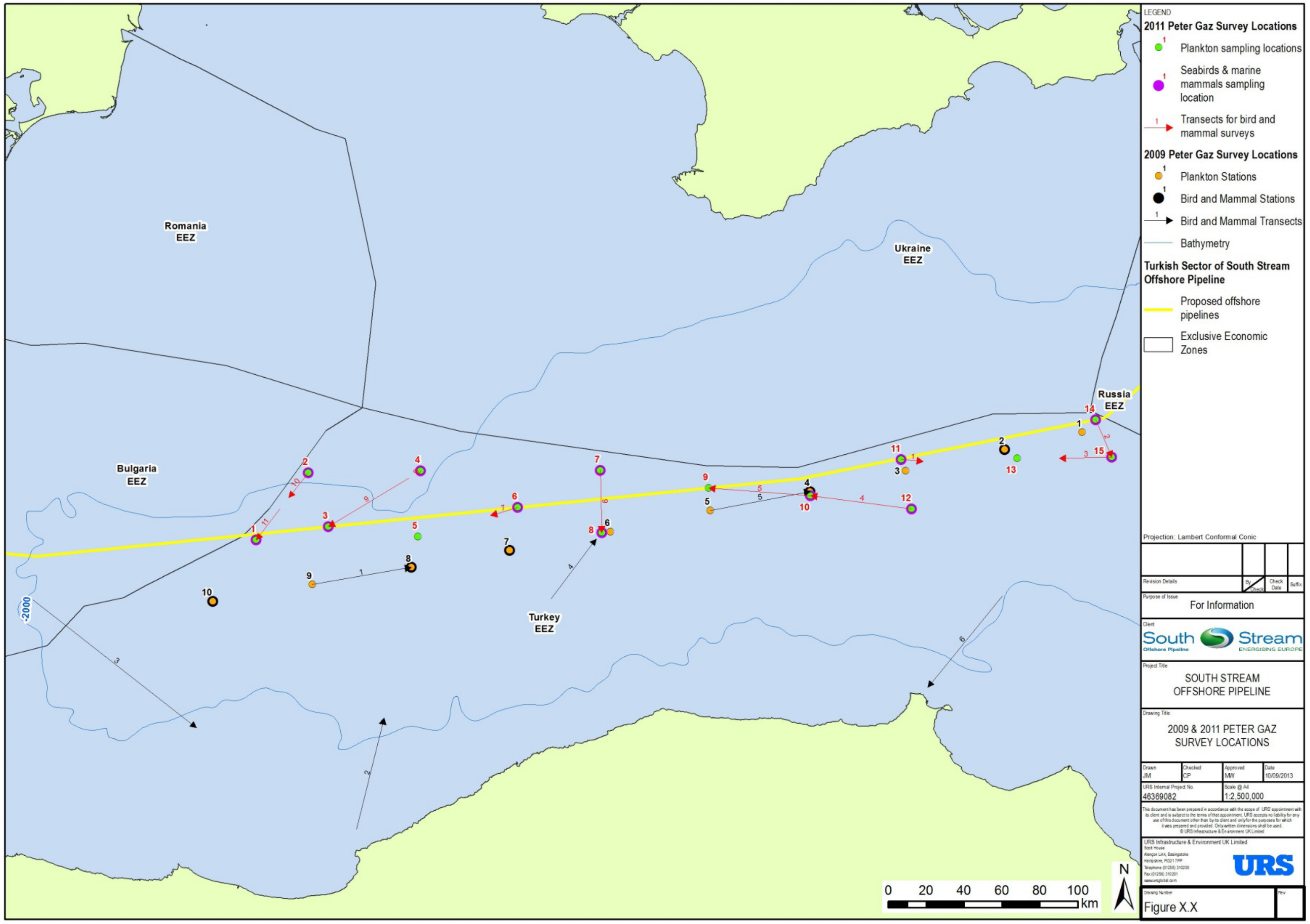


Figure 7.1: Sampling locations for 2009 and 2011 Surveys

After a review of the data including survey results and literature available, a data gap was identified relating to abyssal plain benthic communities, the presence of fish species and fish migration patterns. Therefore, a study of the abyssal plain (Ref. 7.7) along the Project Area was carried out, by reviewing side scan sonar data along with Remotely Operated Vehicle (ROV) footage obtained in 2011, to investigate conditions, including biological conditions, of the benthos. In addition, a fisheries study was commissioned by South Stream Transport (Ref. 7.8) to investigate the potential for fish species to use the waters of the Turkish EEZ for feeding, spawning and nursing grounds and migration (Ref. 7.8). The key findings are presented within this EIA Report.

7.1 Description of the Natural Environment of the Black Sea

7.1.1 Biodiversity of the Black Sea

There are two layers of water with different salinity in the Black Sea. An upper brackish layer, with an average salinity of 17‰, results from the massive freshwater influx from rivers including the Danube, Dnieper and Don via the Sea of Azov. Below this is a layer of higher salinity seawater (20-30‰), originating from the Mediterranean. This stratification, which creates a distinct and permanent pycnocline[1] around 150 to 200 m water depth, limits the vertical exchange of water between the surface and deeper waters creating a unique chemical and biological environment.

The upper water layers of the Black Sea provide a thin aerobic biotic layer. In undisturbed conditions, Black Sea faunal biodiversity in this biotic layer is approximately one third that of the Mediterranean because of the low salinity. However, the productivity of the Black Sea is much higher than the Mediterranean because of the high input of riverine nutrients (Ref. 7.1).

Over the entire Black Sea, there are the following broad marine habitat types:

- Surface waters (typically 0 to 50 m water depth) are well oxygenated and have a fairly low salinity (typically 17 ‰). Because this zone is photic[2], it is biologically productive and has historically supported large populations of pelagic fish. There are a number of different habitat types within these shallow waters:
  - Rocky substrates are present throughout the shallow area, including the supralittoral sea cliffs. Hard substrata are important as they allow the development of macroalgal beds that in turn support a highly diverse array of fauna;
  - Sandy sediments are also present in shallow areas where material has been deposited and wave energy has winnowed out fine material. These zones support a range of infaunal communities, typically bivalve dominated; and
  - Mud sediments are present in some low energy areas between 10 to 20 m water depth supporting infaunal communities
- Mid depth waters (approximately 50 to 100 m water depth) show decreasing oxygen concentrations and increasing salinity due to the influence of the bottom layer. This is typically referred to as the suboxic zone where the concentrations of both oxygen (O_2) and hydrogen sulphide (H_2S) are extremely low and do not exhibit any perceptible vertical or

[1] A pycnocline is the layer where the density gradient is greatest within a body of water. Formation of pycnocline may result from changes in salinity or temperature.

[2] Exposed to sufficient sunlight for photosynthesis to occur.

horizontal gradients (Ref. 7.1). Benthic habitats at these depths, where wave energy at the seabed is largely absent, are often muddy sediments;

- In deep waters (below about 150 to 200m) conditions are anoxic and there are increased H_2S concentrations restricting the vertical distribution of organisms, both pelagic and bottom-living organisms. Muddy sediments predominate in deeper waters and biota is restricted to microbial organisms. This lower water layer accounts for as much as 87% of the Black Sea by volume. Knowledge of life in the deep waters of the Black Sea is very limited but protozoa and bacteria do inhabit the benthos and deep-sea waters. For example, in the deep anoxic shelf of the northwestern Black Sea numerous gas seeps are populated by methanotrophic[3] microbial mats that can form tall reef-like structures (Ref. 7.9).

The seabed of the Black Sea is divided into the shelf, the continental slope and the abyssal plain. The Black Sea has a very large catchment area to surface area ratio and a densely populated coastal zone, making it highly vulnerable to pressure from land based human activity. Rapid economic development and a lack of adequate management of marine resources in the later decades of the 20th Century have resulted in major environmental and ecological changes in the Black Sea ecosystem. In particular, eutrophication due to excessive nitrogen from land based sources has caused a number of adverse processes that have changed the diversity and distribution of flora and fauna throughout the Black Sea ecosystem. Uncontrolled fisheries have also added to the change in the structure and dynamics of the biology of the Black Sea (Ref. 7.1).

Historically, eutrophication has given rise to massive increases in primary production and a shift in the abundance and composition of phytoplankton species in the Black Sea. Larger and more frequent algal blooms increased the flux of organic matter to the seabed inducing a sharp decline of dissolved oxygen and a silting of benthic communities in many areas. Increased incidence of harmful algal blooms (red tides) caused the death of many fish (Ref. 7.11).

Since the 1990s the governments of the Black Sea coastal states have adopted a basin wide approach to pollution reduction and enhancement of cooperation of coastal and non-coastal states towards strategic goal of achieving the ecological status of the Black Sea similar to the one observed in the 1960's. Pollution pressure from land based sources although still intense shows a decreasing trend and some improvements in ecological status have been observed. For example, some species that decreased are found to be recovering and the number and intensity of algal blooms is reported to be lower for all areas (Ref. 7.1).

7.1.2 Fish

Fish stocks in the Black Sea have been drastically reduced as a consequence of eutrophication, overfishing and plankton reduction associated with the population boom of *Mnemiopsis leidyi*. This species of ctenophore (comb jelly) is a voracious predator of copepods, which are important prey items for larval and juvenile fish (Ref. 7.12), and is a direct predator of fish eggs and larvae.

Additionally, the number of fish species sharply decreases with the increase in water depth as waters become anoxic below approximately 150 m depth restricting the vertical distribution of organisms, as well as bottom-living fish species (Ref. 7.11). Sprat (*Sprattus sprattus*), Black Sea horse mackerel (*Trachurus mediterraneus ponticus*), and the European anchovy (*Engraulis encrasicolus*)

[3] Able to metabolize methane as a source of carbon and energy

populations all collapsed in the 1990s though there have been some recent signs of recovery. Populations of larger pelagic fish such as tuna (*Thunnus thynnus*), swordfish (*Xiphias gladius*), and mackerel (*Scomber colias* and *S.scombrus*) have also substantially declined (Ref. 7.4).

A recent review of the Turkish Black Sea fish fauna (Ref. 7.15) showed that Atlanto-Mediterranean species comprised 62% of the total species, 7% were cosmopolitan or commonly found around the world, 29% were endemic to the Black Sea and 2% were introduced species such as haarder or so-iuy mullet *(Liza haematocheilus)*, barracuda *(Sphyraena obtusata)* and Atlantic salmon *(Salmo salar)*.

The most common species likely to be present in Turkish waters of the EEZ include sprat, anchovy, Black Sea garfish (*Belone belone euxini*), three-spined stickleback (*Gasterosteus aculeatus*), Black Sea pelagic pipefish (*Syngnathus schmidti*), golden grey mullet (*Liza aurata*), leaping mullet (*Liza saliens*), flathead mullet (*Mugil cephalus*), haarder or so-iuy mullet, bluefish (*Pomatomus saltatrix*), Black Sea horse mackerel, Atlantic bonito (*Sarda sarda*) and chub mackerel (*Scomber colias*). Of these species, the Black Sea garfish and Black Sea pelagic pipefish are endemic whilst all other species are cosmopolitan. The Black Sea garfish and Atlantic bonito are listed on the Red Data Book of the Black Sea as endangered and critically endangered respectively. The Atlantic bonito is critically endangered in the western Black Sea near Bulgaria only.

Pelagic spawners, such as mullets, are usually only present offshore during the breeding season (summer) and generally frequent shallower waters (Ref. 7.15). More information on spawning, feeding and wintering areas and migration routes of common Black Sea species are given in Section 6.4.1 and 7.2.2 of this EIA Report.

There is very limited data on the occurrence of fish in the waters of the central Black Sea. However, considering the lack of fisheries in these areas and the low levels of productivity of plankton; the density of fish is not likely to be particularly high and will be limited to pelagic species such as sprat, anchovy and horse mackerel. In the 2011 autumn survey (Ref. 7.1) covering ichthyoplankton, adults of sprat, Black Sea pelagic pipefish and sticklebacks were observed as by-catch in low numbers.

The commercial catch of the Turkish Black Sea indicates the typical species within Turkish waters. Turkey’s Black Sea catch is composed of pelagic and demersal species, of which some are migratory species, but is dominated by small pelagic species such as European anchovy and sprat. Turkey’s top 10 species (based on catch data from 2011) in the Black Sea are shown in Table 7.2. It is only those species designated as pelagic that could potentially occur in waters of the Turkish EEZ.

Table 7.2: Top 10 species caught in Turkish waters of the Black Sea (Ref 7.19)

Common Name	Scientific name	Type	Turkish name	% of 2011 catch
European anchovy	*Engraulis encrasicolus*	Pelagic Migratory	Hamsi	61.5
Sprat	*Sprattus sprattus*	Pelagic Migratory	Çaça	26.0
Black Sea horse mackerel	*Trachurus mediterraneus ponticus*	Pelagic Migratory	Istavrit (Kraça)	4.3
Whiting	*Merlangius merlangus*	Demersal Migratory	Mezgit	2.4
Atlantic bonito	*Sarda sarda*	Pelagic Migratory	Palamut-Torik	2.0

Common Name	Scientific name	Type	Turkish name	% of 2011 catch
Scad (Atlantic horse mackerel)	*Trachurus trachurus*	Pelagic Migratory	Istavrit (Karagöz)	1.0
Striped red Mullet	*Mullus surmuletus*	Demersal	Tekir	0.9
European pilchard	*Sardina pilchardus*	Pelagic	Sardalya	0.6
Bluefish	*Pomatomus saltator*	Pelagic Migratory	Lüfer	0.5
Grey mullet	*Mugil cephalus*	Demersal	Kefal	0.3

Turbot (*Scophthalmus maeticus*) is the most valuable commercial fish species caught all over the continental shelf in the countries bordering the Black Sea. Research has shown that the species are scattered throughout the continental shelf, with the highest concentration between 50 m to 75 m. Adult fish migrate to shallower waters and congregate during the spawning season in the spring, consequently moving on to deeper waters (100 m to 140 m).

Pursuant to the "Black Sea Economic Zone Agreement" signed between the countries bordering the Black Sea in 1982, each country expanded their fishing grounds up to 200 NM to include the offshore waters of the Black Sea, leading to the transfer of traditional fishing grounds of Turkey to the jurisdiction of Russia, Ukraine, Romania and Bulgaria. During the following period, production figures decreased steadily due to the restriction of turbot fishing to the coastline and increasing pressure from the growing fishing fleet, with Turkey's annual catch varying from year to year during the last 25 years.

7.1.3 Other Aquatic Products

Coastal benthic habitats in the Black Sea can be grouped by depth and seabed type. In shallow waters, generally below 20 m water depth, where there is bedrock, boulders or coarse sediments communities of algae dominate. These can be important habitats, supporting a highly diverse array of fauna. The diversity of algae in the Black Sea, which is an impoverished derivative of the Mediterranean one, has undergone significant changes in recent decades, primarily due to eutrophication. In particular, the diversity, density and zones of brown and red algae have diminished whilst the diversity and abundance of greens, often tolerant of high nutrient conditions, has increased (Ref. 7.1). Typical species observed in Black Sea algal communities are the brown algae *Cystoseira* spp., often present in a belt, reduced in extent since the 1960s, in water depths shallower that 10 m and more opportunistic green algae such as *Cladophora* spp. and *Ulva* species.

There is considerable variation in the number of algal species at different locations on the Turkish coast which is likely to be related to the nature of the seabed (Table 7.3). The highest diversity is in shallow waters with a seabed of bedrock and boulders.

Table 7.3: Benthic algae and macrophytes diversity from different areas in the Black Sea coast of Turkey (Ref. 7.20)

Region	Cyanophyta	Reds (Rhodophyta)	Browns (Phaeophyta)	Greens (Chlorophyta)	Seagrasses	Total Macrophytes
Kirklareli	23	71	24	30	3	151
Kocaeli, Sakarya, Dozce	30	126	50	46	3	255
Zonguldak	20	100	42	43	3	208

Region	Cyanophyta	Reds (Rhodophyta)	Browns (Phaeophyta)	Greens (Chlorophyta)	Seagrasses	Total Macrophytes
Bartin	12	116	43	39	3	213
Kastamonu	22	133	56	48	3	262
Sinop	22	136	52	55	3	268
Samsun	20	106	27	22	3	178
Ordu	14	93	27	26	4	164
Giresun	18	109	33	30	3	193
Trabzon	1	23	8	23	3	58
Rize, Artvin	3	43	15	27	3	91
Total	**30**	**142**	**57**	**58**	**4**	**291**

The remaining habitats are dominated by sediments and faunal organisms. Along the Turkish coast the depth range 10 to 25 m mostly consists of fine-to-medium sandy bottom sediments dominated by infaunal polychaetes such as *Melinna palmata* and the molluscs *Chamelea gallina*, *L. mediterraneum* and *L. divaricata*). At the 25 to 50 m depth range, the composition of bottom sediments slightly changes to sand-mud composition and the number of species declines. At 50-80 m depths, the bottom sediments consists of the combination of mud, clay and dead shells and the species diversity was the poorest. Abundance is dominated by polychaetes and some echinoderm species. Below these depths conditions become increasingly anoxic, restricting the distribution of organisms and species diversity and abundance declines until O_2 disappears completely (anoxic conditions) and no macrofauna are able to survive. This pattern in the distribution of benthic communities is very similar to that observed in Russian and Bulgarian coastal areas.

Aquaculture in Turkey is a relatively young industry; it started with rainbow trout culture (*Onchorhynchus mykiss*) in the early 1970s. This is an anadramous species which migrates from the sea into fresh water to spawn. The main aquaculture developments took place during the 1990s, production increasing from 16,000 tonnes (t) in 1996 to 129,000 t in 2006. The industry has developed to such an extent that Turkey is currently the third largest finfish aquaculture producer (i.e. excluding shellfish) in Europe, and the second largest producer of both seabass (*Dicentrarchus labrax*) and gilthead seabream (*Sparus aurata*) and of rainbow trout (after Norway).

Other important species for aquaculture include carp (*Cyprinus carpio*), bluefin tuna (*Thunnus thynnus*) and the Mediterranean mussel *Mytilus galloprovinciialis*. The Turkish bluefin tuna fattening business started in 2001, and has grown significantly since this time. There are currently thirteen companies with a total licensed production capacity of 9,460 t.

In recent years, great efforts have been directed to the commercial production of alternative fish species including several seabreams, groupers and meagre. Some trials have also been carried out for the commercial production of turbot *(Psetta maxima),* sturgeons *(Acipenser spp.)* and endemic anadromous trout *(Salmo trutta*) for the Black Sea region.

7.1.4 Sea Birds

A number of migration routes that stretch from the Arctic to South Africa occur around and over the Black Sea for birds that overwinter, nest and roost in coastal locations (Ref. 7.4). However, in the Turkish EEZ, there are no nesting sites and so the birds observed in this region are restricted to a small number of species that may be feeding in or migrating through the area. The central Black Sea is outside the main Mediterranean/Black Sea Flyway (see Figure 7.2) migration route, which connects Europe with Africa. This route is typical of many flyways, following mountain ranges and coastlines, sometimes rivers, often taking advantage of updrafts and other wind patterns to avoid geographical barriers such as large stretches of open water. Thus, the area is not important for large numbers of migrating birds although data on the occurrence of birds in the central Black Sea is scarce (Ref. 7.1).

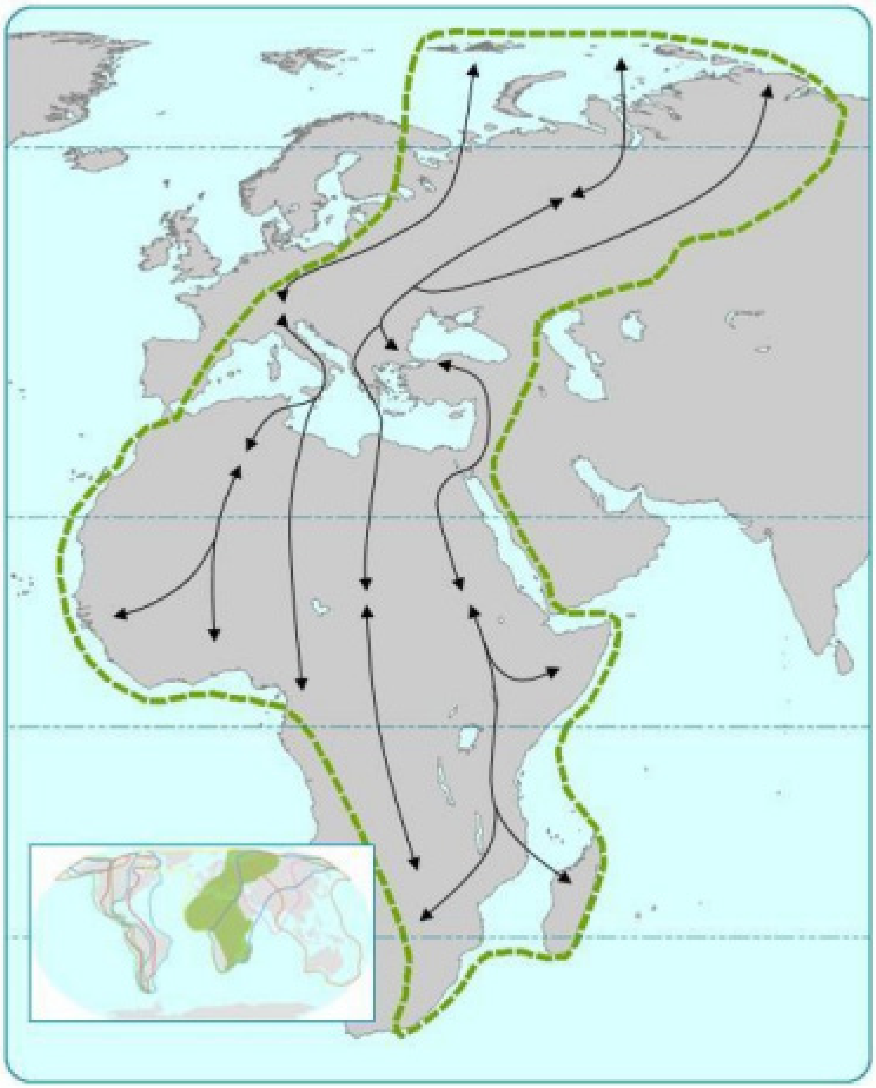


Figure 7.2: Mediterranean / Black Sea Flyway (Ref. 7.22)

Several species of seabird are found along the Turkish coast in significant numbers, including the Mediterranean shearwater, *Puffinus yelkouan* and gulls and these species were seen in the Survey Area (refer to Section 7.2.4). Whilst most feeding takes places in coastal regions there will be foraging offshore, such as when pelagic species such as mullet are spawning in open waters. The little gull, *Larus minutus* and the Mediterranean Gull *Larus melanocephalus* may also be seen offshore as they make regular migrations between feeding and breeding grounds around the Black Sea.

The Mediterranean or Yelkouan shearwater (*Puffinus yelkouan*) was formerly considered a subspecies of the Manx Shearwater (*P. puffinus*). It is a gregarious species, nesting in burrows which are only visited at night to avoid predation by large gulls. It breeds on islands and coastal cliffs in the eastern and central Mediterranean in spring and early summer, after which the birds disperse throughout their range.

Mediterranean shearwaters may range widely, with birds ringed in Malta having been observed in the Black Sea. Increasing numbers have been observed entering the Black Sea since the 1970s though there are no recent records of breeding birds there. Non breeding birds are mostly present in the Black Sea from February to October, though some are present all year. This species has been reported to make large scale clockwise movements around the Black Sea, with flocks of up to 20,000 gathering in the north during summer months (Ref. 7.22).

The Mediterranean shearwater is under some threat from coastal development in its breeding range as well as predation of eggs and young by rats and cats. Adult birds are frequently caught in long line fisheries, and may also suffer from depleted food stocks due to the overfishing of anchovy in some areas (Ref. 7.16). Genetic studies suggest that the Mediterranean Shearwater may have suffered a marked population decline historically and thus could be vulnerable to adverse effects of inbreeding (Ref. 7.23). It was formerly classified as a species of Least Concern by the IUCN but in 2012 this was changed to Vulnerable.

The Little gull can be found breeding in northern Scandinavia, the Baltic, western Russia and Siberia. Its distribution expands in winter to include most of the Mediterranean, Black Sea and Caspian Sea coastlines, as well as the Atlantic coast of Europe (Ref. 7.24). This species is fully migratory and usually arrives in its breeding areas from late-April to late-May and leaves in late-July (although its movements are poorly documented). The species is gregarious and breeds from late-June in mixed-species colonies and sub-colonies occasionally as large as 2,000 individuals, sometimes also in more solitary scattered pairs (Ref. 7.24).

The little gull has an extremely large range, the population trend appears to be increasing and population's sizes are very large. As such this species is evaluated as Least Concern on the IUCN Red List (Ref 7.16).

The Mediterranean gull breeds almost entirely in Europe, mainly on the Black Sea coast of Ukraine, with a recent spread to the northern Caucasian Plains (Ref. 7.16). Most populations of this species are fully migratory and travel along coastlines between their breeding and wintering areas, although some travel inland across Anatolia or follow major river valleys through Eastern and central Europe (Ref. 7.22). Outside the breeding season the species becomes entirely coastal, favouring estuaries, harbours, saline lagoons and other sheltered waters.

Mediterranean gulls migrate to breeding colonies at lagoons, estuaries and coastal saltmarshes from late-February to early-April, with most beginning to breed from early-May. A significant portion of the population also breeds on lakes and lowland marshes away from the coast (Ref. 7.22). It often breeds near but not among Sandwich terns (*Sterna sandvicensis*), or intermingling with black headed gulls (*Larus ridibundus*) (Ref. 7.16). The migration to the wintering grounds occurs from late-June onwards through to autumn. The gulls breed in colonies, usually of less than 1,000 pairs and occasionally in single pairs amidst colonies of other species.

Mediterranean gulls are susceptible to heavy losses as a result of tourist disturbance at breeding colonies. They may also be threatened by habitat loss resulting from coastal development and by marine pollution (e.g. oil spills and chemical discharges).

Surveys were conducted in 2009 for the Project which included the entire Turkish Black Sea (EEZ and territorial waters) (Figure 7.1). In summer 2009 surveys, 20 taxa were observed with 18 identified to species level. In total, 1,195 birds were seen; 299 at stations and 934 during transects. The greater number of birds observed in summer 2009 is due to two species recorded in great numbers; the Mediterranean shearwater, *Puffinus yelkouan*, and the Caspian gull, *Larus cachinnans*, which are resident species in the Black Sea. These two species accounted for 44% of all individuals observed during transects. Table 7.4 below lists the birds observed during the 2009 survey and their conservation status.

Table 7.4: List of species and total number of birds encountered during the 2009 surveys

Species Name	**Common Name**	**Red Data Book of the Black Sea**	**IUCN Red List Category**	**Number of observed species (2009)**		
				At stations	**At transects**	**Total**
Alauda arvensis	Eurasian Skylark	N/A	LC	3	2	5
Anas platyrhynchos	Mallard	N/A	LC	-	30	30
Anthus pratensis	Meadow Pipit	N/A	LC	7	-	7
Circus cyaneus	Northern Harrier	N/A	LC	1	-	1
Columba livia	Rock Pigeon	N/A	LC	-	2	2
Cygnus cygnus	Whooper Swan	N/A	LC	-	1	1
Egretta alba	Great Erget	N/A	N/A	-	2	2
Fulica atra	Eurasian Coot	N/A	LC	-	7	7
Gavia arctica	Black-throated loon	N/A	LC	11	50	61
Gavia sp.	Loon sp.	N/A	N/A	-	17	17
Larus cacchinans	Caspian Gull	N/A	N/A	178	273	451
Larus canus	Mew Gull	N/A	LC	2	3	5
Larus minutus	Little gull	N/A	LC	-	1	1
Larus ridibundus	Black-headed Gull	N/A	LC	4	2	6
Phalacrocorax carbo	Common cormorant	N/A	LC	1	70	71
Podiceps cristatus	Great-crested grebe	N/A	LC	-	9	9
Podiceps nigricollis	Black-necked Grebe	N/A	LC	-	2	2
Podiceps sp.	Grebe Sp.	N/A	N/A	-	5	5
Puffinus yelkouan	Mediterranean shearwater	N/A	VU	45	452	459
Sturnus vulgaris	Common Starling	N/A	N/A	47	6	53
Total				**299**	**934**	**1195**

IUCN Red List Category: NA no category yet, LC Least Concern, VU Vulnerable, EN Endangered, All, All categories for this genus (LC, VU, NT, EN). Red Data Book: N/A not listed, EN Endangered, VU Vulnerable.

Of particular relevance (given that they represent as many as 219 species of the total number of birds recorded in Turkey during the 2009 surveys (~500), are passerines.

7.1.5 Other Birds

In addition to seabirds, there are a number of species recorded in the Survey Area which are environmentally not linked to the sea, or generally not found in the open sea. These include Black-necked grebe (*Podiceps nigricollis*), whooper swan (*Cygnus cygnus*), common starling (*Sturnus* *vulgaris*) and skylark (*Alauda arvensis*). The encounter with such birds away from the coast is largely due to climatic effects associated with the onset of winter. These birds have a tendency to stay on the northern Black Sea coast before the arrival of cold weather when they are forced to migrate to the southern coast. In addition, there are three birds of prey which have been recorded including the Peregrine falcon (*Falco peregrinus*), the Saker falcon (*Falco cherrug*) (respectively listed in the Red Data Book of the Black Sea as endangered and vulnerable) and the goshawk (*Accipiter gentilis*). During migration some birds fly across the Black Sea from south to north so that even in the heart of the Black Sea there can be found entirely terrestrial birds such as larks, starlings, corncrake and snipe.

The bird species which are known to occur at different times of the year in the central Black Sea region can be divided into the Groups shown in Table 7.5.

Table 7.5: Bird Species Groups in Black Sea Region (Ref. 7.1)

Group	Information
Loons and Grebes (Gaviiformes & Podicipediformes)	Fish eating and typically water birds. They mainly nest in freshwater habitats. Nests are often floating. In the region, they are found only during migration and wintering, from mid-October to mid-May.
Tube-nosed (Procellariformes)	Typical sea birds. Only one type is known in the region; the Mediterranean shearwater. Shearwaters nest in colonies on sea islands in burrows or crevices of rocks. They feed on small fish, crustaceans and shellfish.
Cormorants (Pelicaniformes)	They are typical water birds, but they do use the land. They nest in colonies in inland waters and on the coast. The nearest known nesting areas are the south-eastern part of the Sea of Azov. They are present in the region generally from November to April. They feed exclusively on fish.
Waders (Charadriiformes)	Ground-nesting birds that nest near water. They feed on small invertebrates. In the described area, most species can occur only during the migrations - from September to late November and from early March to May.
Gulls (Charadriiformes)	This group includes ground-nesting colonial birds connected with different bodies of water. "Marine" gulls (e.g. the Caspian gull) are closely linked to marine waters and coasts. All species are found in marine waters primarily at non-breeding times. In the region, gulls are present in the region both during migration (from September to May) and in winter. Summer residence of some species is not connected with nesting and migrations. All gulls feed mainly on fish.
Terns (Charadriiformes)	Ground-nesting colonial birds. The Caspian tern is among them and its environmental requirements are most similar to those of gulls: it nests on the sandy shores of lakes and seas and it mainly feed on fish. A significant portion of their diet is small fish. Small quantities of terns may be encountered in the region during migrations.

Whilst representative species from all the bird groups in Table 7.2 are observed in Turkish coastal waters only a few species have been identified as nesting in the region. This is not within the Project Area. There are several Important Bird Areas (IBAs) where nesting species are found. The European shag (*Phalacrocorax aristotelis)*, nests on the Şile coast, the Kűre Mountains and Akkuş Island and on the Kizilirmak Delta there are breeding populations of the black stork (*Ciconia nigra)*, the great bittern (*Botaurus stellaris)* and the purple heron (*Ardea purpurea*). The squaco heron (*Ardeola ralloides*) nests in the Yeşilirmak Delta. Representative of all groups are observed in IBAs on the Turkish coast.

7.1.6 Marine Mammals

Three species of cetacean (other than occasional vagrant specimens) occur in the Black Sea and are represented by subspecies, namely Black Sea harbour porpoise (*Phocoena phocoena relicta*), Black Sea bottlenose dolphin (*Tursiops truncatus ponticus*) and Black Sea common dolphin (*Delphinus delphis ponticus*). These are listed in Table 7.6 along with their international and regional conservation status. All three species, not the sub specie, are listed in the Black Sea Red Data Book as Data Deficient.

Table 7.6: Marine Mammal Species within the Black Sea

<table>
<tr><th>Species</th><th>IUCN Red List[1]</th><th>Black Sea Convention[2]</th><th>Red Data Book of the Black Sea[3]</th></tr>
<tr><td>Black Sea harbour porpoise (Phocaena phocaena relicta)</td><td>En</td><td>E</td><td rowspan="2">DD (EN in Ukraine and Romania, VU in Bulgaria)</td></tr>
<tr><td>Black Sea common dolphin (Delphinus delphis ponticus)</td><td>Vu</td><td>E</td></tr>
<tr><td>Black Sea bottlenose dolphin (Tursiops truncatus ponticus)</td><td>En</td><td>E</td><td>DD (EN in Romania, VU in Bulgaria and Ukraine)</td></tr>
</table>

1 –Vu – vulnerable, En – Endangered, Ce – Critically Endangered; 2 – Species included in the Agreement on Conservation of Biodiversity and Landscapes of the Convention on the Protection of the Black Sea from Pollution (Ref. 12.30): E - endangered; 3 – DD – Data Deficient, EN – Endangered, VU – Vulnerable.

There is a considerable body of data on the marine mammals of the Black Sea including a basic summary by Kleinenberg published in 1956 (Ref. 7.1), several aerial surveys undertaken between 1967 and 1987, IUCN funded aircraft and ship based investigation on the status and distribution of cetaceans in the Black Sea presented at a working meeting in 2006 and the Agreement on the Conservation of Cetaceans in the Black Sea Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) website and a recent overview of the cetacean populations prepared by Birkun in 2008 (Ref. 7.25).

The Black Sea common dolphin is known to prefer the open sea but is sometimes spotted near shores if following shoals of pelagic fish. It has been recorded throughout the Black Sea including the Bosphorus Strait and the Sea of Marmara. Primary food sources include anchovy, sprat and pipefish. Although recorded across much of the Black Sea, there are no confirmed records of numbers which may range from tens to hundreds of thousands. The abundance of common dolphins according to ACCOBAMS is shown below in Table 7.7.

Table 7.7: Abundance of common dolphin in the Black Sea (Ref. 7.25)

The area surveyed area / length of the route	Observation type	Date	Abundance Assessment	Source
NW, N and NE parts of the Black Sea within the territorial waters of Russia and Ukraine 31,780 km^2/ 2,230 km	Vessel registration	September-October 2003	5 376 (2 898–9 972; 95% CI*)	Birkun *et al.*, 2004
SE part of the Black Sea within the territorial waters of Georgia, 2,320 km^2/211 km	Vessel registration	January 2005	9 708 (5 009–18 814; 95% CI*)	Birkun *et al.*, 2006
The central part of the sea outside the territorial waters of Russia and Turkey, 31,200 km^2/660 km	Vessel registration	September-October 2005	4 779 (1 433–15 945; 95% CI*)	Krivokhizhin *et al.*, 2006

* - CI – Confidence Interval, A range of values so defined that there is a specified probability that the value of a parameter lies within it.

The greatest threats to common dolphins include outbreaks of disease (such as morbillivirus epizootic), reduction in fish prey abundance, water pollution, ctenophore outbreaks and pelagic trawls.

As for the common dolphin, the Black Sea bottlenose dolphin is considered a subspecies and is considered endangered by the IUCN Red List. The total population is unknown but is believed to be a few thousands spread out across the whole of the Black Sea. Primary food items include flounder, stingray, mackerel, mullet and anchovy. Unlike the common dolphin, they prefer to stay in the shelf zone, but are occasionally found in the open sea. The most significant threats to this subspecies include by-catch in fishing nets and possibly parasitic infestations resulting in mass mortality events in 1990. The abundance of bottlenose dolphins to ACCOBAMS (Ref. 7.25) is shown in Table 7.8. Much of the recorded distribution of this subspecies has been recorded on the northern and eastern shores of the Black Sea.

Table 7.8: Abundance of bottlenose dolphins in the eastern Black Sea (Ref. 7.25)

The area surveyed area / length of the route	Observation type	Date	Abundance Assessment	Source
The Kerch Strait, 890 km^2/353 km	Aerial registration	August 2002	88 (31–243; 95% CI)	Birkun *et al.*, 2003
The Kerch Strait, 862 km^2/310 km	Vessel registration	August 2003	127 (67–238; 95% CI)	Birkun *et al.*, 2004
NE Black Sea shelf, 7,960 km^2/791 km	Aerial registration	August 2002	823 (329–2 057; 95% CI)	Birkun *et al.*, 2003
NW, N and NE of the Black Sea within the territorial waters of Russia and Ukraine, 31,780 km^2/2,230 km	Vessel registration	September-October 2003	4 193 (2 527–6 956; 95% CI)	Birkun *et al.*, 2004
SE part of the Black Sea within the territorial waters of Georgia, 2,320 km^2/211 km	Vessel registration	January 2005	0	Birkun *et al.*, 2006
SE part of the Black Sea within the territorial waters of Georgia, 2,320 км^2/211 km	Vessel registration	May 2005	0	Komakhidze, Goradze, 2005
SE part of the Black Sea within the territorial waters of Georgia, 2,320 km^2/211 km	Vessel registration	August 2005	0	Komakhidze, Goradze, 2005
The central part of the sea outside the territorial waters of Russia and Turkey, 31,200 km^2/660 km	Vessel registration	September-October 2005	0	Krivokhizhin *et al.*, 2006

The Black Sea populations of harbour porpoises, also a subspecies, are mainly located in coastal areas with water depths of less than 200 m where they feed on benthic and demersal species. They tend to be solitary animals but are sometimes seen in small groups. The exact size of the population is unknown.

According to ACCOBAMS (Ref. 7.25), it may now be as high as 10-12 thousand individuals. Main threats to this species of dolphin include:

Mortality in bottom gill nets, injuries and anxiety, contamination of the environment (Black Sea harbour porpoises accumulate in the subcutaneous fat, higher concentrations of organochlorine pesticides than porpoises in other oceans as well as other Black Sea species of dolphins) and reduction in food resources as a result of overfishing of prey species and the invasion of the Black and Azov seas by the predatory ctenophore *M. Leiydi*. Other population limiting factors include diseases and abnormal weather conditions.

The harbour porpoise inhabits mainly shallow waters (0 to 200 m deep) over the continental shelf around the entire perimeter of the Black Sea, although they also occur quite far offshore in deep water. Sizeable groups have been observed in the central Black Sea over 200 km from the nearest coast in waters of over 2,000 m depth (Ref. 7.17).

Common dolphins are distributed mainly offshore and visit shallow coastal waters following seasonal aggregations and regular mass migrations of their preferred prey, small pelagic fishes such as anchovy and sprat. Annual winter concentrations of anchovies in the south-eastern Black Sea and to a lesser degree, south of the Crimean peninsula, create favourable conditions for wintering concentrations of dolphins. Summer concentrations of sprats in the north-western, north-eastern and central Black Sea attract common dolphins to different feeding grounds in summer months (Ref. 7.17).

Bottlenose dolphins are distributed across the Black Sea shelf and may occur far offshore. In the northern Black Sea they form scattered communities of some tens to approximately 150 animals in different locations around the Crimean peninsula. Accumulations are also known to form close to the Turkish coast (Ref. 7.17).

7.1.7 Phytoplankton

Plankton forms the basis of marine food webs and are therefore essential to the structure and functioning of marine ecosystems. As phytoplankton are photosynthetic, they are generally confined to the euphotic zone of the open sea (the water layer exposed to sufficient sunlight for photosynthesis to occur which is typically up to 200 m depth in the open ocean, and in the order of up to 50 m depth in the Black Sea). However, vertical distribution of plankton in the Black Sea is also influenced by the decrease in oxygen below the pycnocline (Ref. 7.3).

Significant changes in the phytoplankton community were observed within the Black Sea between 1985 and 1994. The existing seasonal succession pattern of a spring diatom bloom followed by blooms of dinoflagellates and then phytoflagellates was seen to become disrupted, with a reduction in the diatom component of the spring bloom. This indicates a fundamental shift that still persists. The reasons for this are not clearly understood, but a variety of natural and anthropogenic causes have been postulated, including a cold period from 1985-1994 (Ref. 7.11), hot summers and early warming of the surface layer (Ref. 7.1), damming of the Danube river and a reduction in silicate inputs (Ref. 7.13) and a reduction in inorganic nutrients allowing coccolithophorids to more successfully compete with diatoms (Ref. 7.1).

The Main Black Sea Current (MBSC) causes a narrow jet of water to run along the continental slope of the Black Sea basin and leads to the increase of the abundance of plankton in this area with a corresponding reduction in abundance in the centre of the Black Sea (Ref. 7.1). See **Chapter 6 Assessment of the Physical Environment** of this report for more information on the Black Sea Currents and the MBSC.

The impact of anthropogenic nutrients observed in the Black Sea in the 1970s and 1980s, of increased primary production and changing phytoplankton community composition, were limited to coastal and shelf waters. No changes in phytoplankton communities were observed in the central basin of the Black Sea until the mid-1980s, coinciding with an onset of regional cold climatic conditions.

It is generally recognised that the phytoplankton regime shift observed in the central Black Sea is due to an increase in the bottom-up flux of nutrients into the euphotic layer during cold conditions and not the impact of anthropogenic nutrients. This effect is also observed in the occurrence of winter phytoplankton blooms in the central Black Sea (Mikaelyan et al., 2013 in Ref. 7.1). In general, however, the level of production in the central Black Sea is much lower than in coastal and shelf waters, a fact reflected in the lack of any major fisheries in the central basin.

Due to the man-made and natural factors mentioned above, phytoplankton blooms changed from being isolated incidents to becoming annual or inter-annual events. The diatom *Skeletonema costatum* undergoes a population explosion in the spring, when the number of cells may reach 1 x 10^8 cells per litre (cells/l), whereas in the 1960s the maximum did not exceed 1.8 x 10^6 cells per litre (Ref. 7.26). Initially, some authors believed that these phytoplankton blooms were positive, because they produced an increase in biological productivity which in turn increased catches of anchovy and sprat (plankton feeding fish species). But there were other factors which may have been equally responsible for the increase in anchovy and sprat catches, namely: the disappearance by that time of large pelagic predators (e.g. mackerel, bonito and bluefish); or the intensification of commercial fishing because of the greater number of fishing vessels and the use of trawls (refer to Section 7.1.2). It is likely that all of the above factors contributed to the temporary increase in the catches of small plankton-feeding fish (Ref. 7.26).

7.1.8 Zooplankton

Historical changes have also occurred in the zooplankton of the north-eastern shelf of the Black Sea, particularly through the accidental introduction of the predatory ctenophore (comb jelly), *Mnemiopsis leidyi*. *M. leidyi* preyed on the indigenous plankton of the Black Sea which led to a major decline in copepod (a type of planktonic crustacean) populations (Ref. 7.14). This situation persisted until 1997-1998, with another accidental introduction, possibly from ship ballast water, of the ctenophore *Beroe ovata* (Ref. 7.14). This species is the main predator of *M. leidyi* and subsequently the zooplankton community began to recover both in species composition and abundance (Ref. 7.11).

A large phytoplankton biomass provides a supply of food for the species of phytoplankton feeding zooplankton. In recent years there has been a sharp increase in the abundance of *Noctiluca scintillans*, infusoria such as *Mesodinium rubrum*, scyphozoan jellyfish and copepods such as *Oithona minuta* and *Acartia clausi* (Ref. 7.26). Many of these species are likely to be present in the waters of the Turkish EEZ and the survey Area (refer to Section 7.2.8).

There is little information on the specific species composition of zooplankton in the central Black Sea as most studies have concentrated on coastal areas. However, it is known that many species common in coastal waters such as the copepods *Calanus exinus* and *Pseudocalanus elongatus*, the arrow worm *Sagitta setosa,* the jellyfish *Aurelia aurita* and ctenophores such as *Pleurobranchia rhodopis* and *Mnemiopsis leidyi* are present in the central Black Sea.

The average zooplankton biomass in central areas is very similar to coastal areas, (excluding the northwestern shelf) in comparison with many other seas, including the neighbouring Mediterranean Sea. This is due to a fairly intensive vertical-exchange in central areas of this sea and horizontal water-exchange between central and coastal areas (Ref. 7.18). There is however, considerably less variability in spatial and temporal abundance in open waters compared to the coast.

The seasonal pattern in the open ocean is also different with a peak in the summer compared to spring and autumn in coastal areas. This is due to the differences in nutrient availability and hydrological conditions.

7.2 Description of the Natural Environment of the Project Area and Assessment of Baseline Conditions

7.2.1 Biodiversity of the Black Sea

Concentrations of H_2S increase rapidly past approximately 150 m water depth due to the restricted ventilation and increased anoxic conditions of deeper waters. As a consequence, the diversity and abundance of benthic fauna and flora decreases rapidly with increasing depth. The seabed of the deeper parts of the Black Sea is therefore unlikely to support significant macro- or meiofaunal communities due to the anoxic environment (Ref. 7.11). Microbial reefs associated with mud volcanoes or “gas seeps” are known to occur in waters deeper than 200 m in some western areas of the Black Sea (Ref. 7.9).

Expert analysis of extensive geophysical data collected for the Project did not observe any seeps or similar communities along the pipeline route. Large areas of the seabed are covered by a soft, sometimes jelly-like, layer of organic detritus but there was no indication of the presence of microbial communities (Ref. 7.7). The biodiversity of the Project Area is limited to plankton, fish and marine mammals occurring in surface waters.

7.2.2 Fish

A dedicated fisheries assessment was conducted for the Project based on existing literature and consultation with fisheries organisations within Turkey (Ref. 7.8). This section is also includes results of the ichthyoplankton survey conducted in autumn 2011.

Demersal fishing takes place along Turkey’s coastline in water depths of up to around 100 to 150 m, after which anoxic conditions prevent the occurrence of demersal species. Therefore, benthic or demersal species of fish will not occur within the Project Area.

The four small pelagic species of importance, both in terms of quantity caught and economic value, caught in Turkish waters of the Black Sea are European anchovy, sprat, Black Sea horse mackerel and Atlantic bonito as shown in Figure 7.3. Other pelagic species such as bluefish, scad and European pilchard are caught in quantities that represented less than 3% of the total catch in 2011 and are therefore considered less important for this assessment. Figure 7.3 illustrates the species composition of the Black Sea catch in 2011 (Ref. 7.8).

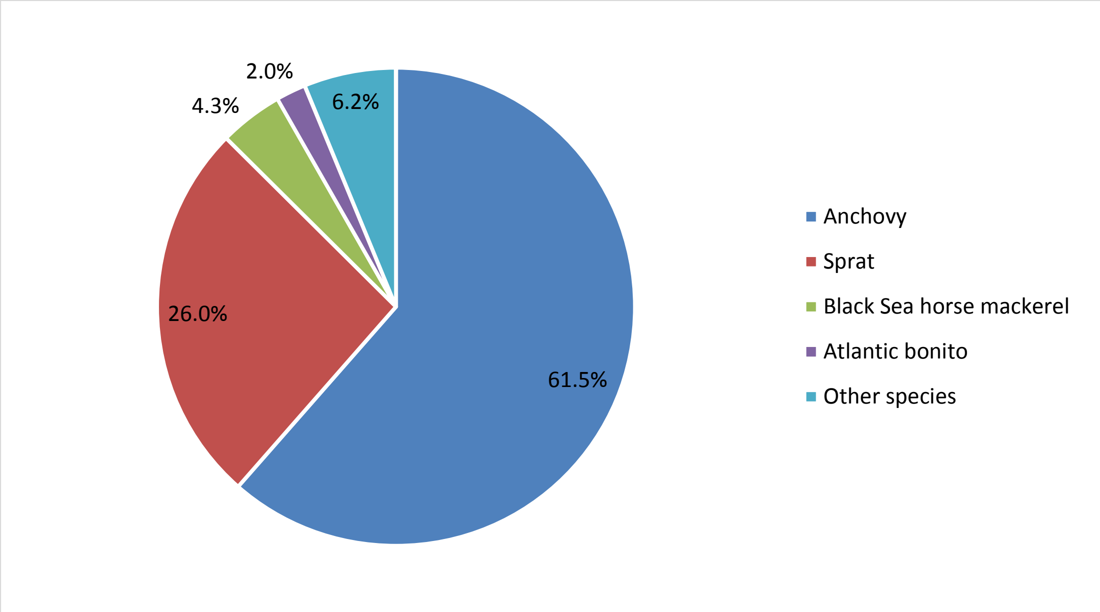


Figure 7.3: Species composition of Black Sea catch in 2011 (Ref. 7.19)

In December 2009 and September 2011, ichthyoplankton sampling was carried out using an ichthyoplankton net at 10 and 15 stations respectively (sampling locations are shown in Figure 7.1). Sampling was undertaken using the following techniques:

- Horizontal hauling in the course of the turning circle of the vessel for 10 minutes at a speed of 2.5 knots;
- Vertical hauling (from 150 m to 0 m). When the net reached the desired depth, it was hauled at a speed of no more than 1.25 m/sec.

In December 2009, catches at the 10 stations consisted of the eggs of one species; sprat (*Sprattus sprattus*). Sprat spawns from October to March in the northern shelf areas of the Black Sea, which coincides with the timing of the survey. Juvenile fish were represented by only one species; whiting (*Merlangius merlangus*), and were observed at two stations (4 and 7).

Some by-catch in plankton nets included yearlings and adults of Black Sea pelagic fish species. These are shown in Table 7.9. The Black Sea pelagic pipefish was the most numerous species caught during these trawls.

Table 7.9: Species composition of Black Sea Pelagic Fish Species caught in Ichthyoplankton Trawls (2009)

Trawl Number	Latin name	IUCN Red List (Black Sea Turkish Sector) (Ref. 7.31)	Common name	Number of individuals	Biological status (stage of maturity of the gonads)
1	*Gasterosteus aculeatus*	Endangered	Three spined stickleback	1	Sexually mature individual (♂IV)
	Syngnathus schmidti	Data Deficient	Black-Sea pelagic pipefish	1	Sexually mature individual
3	*Gasterosteus aculeatus*	Endangered	Three spined stickleback	1	Sexually mature individual (♀III)
	Syngnathus schmidti	Data Deficient	Black-Sea pelagic	5	Sexually mature

Trawl Number	Latin name	IUCN Red List (Black Sea Turkish Sector) (Ref. 7.31)	Common name	Number of individuals	Biological status (stage of maturity of the gonads)
			pipefish		individuals
4	*Merlangius merlangus*	Vulnerable	Whiting	1	Juveniles
6	*Sprattus sprattus*	Vulnerable	Sprat	2	Sexually mature individual (♂IV, V)
	Syngnathus schmidti	Data Deficient	Black-Sea pelagic pipefish	6	Sexually mature individuals
7	*Merlangius merlangus*	Vulnerable	Whiting	1	Juveniles
9	*Sprattus sprattus*	Vulnerable	Sprat	5	Sexually mature individuals(♂V; ♂V, VI-IV, VI)
	Syngnathus schmidti	Data Deficient	Black-Sea pelagic pipefish	1	Sexually mature individual
	Gasterosteus aculeatus	Endangered	Three spined stickleback	2	Sexually mature individuals (♂IV)
	Engraulis encrasicolus	Vulnerable	Anchovy	2	Yearling
	Mugil cephalus	Least Concern	Striped (flathead) mullet	1	Yearling

Although no dedicated fish surveys were completed, the ichthyoplankton surveys are a good indicator of fish species that may be present in the Turkish EEZ. In the autumn 2011 (September-October) ichthyoplankton survey in the Turkish EEZ (Ref.7.1), four species of fish were obtained using vertical and horizontal hauls from 15 stations. Eggs, larvae and juveniles of anchovy, sprat and Black Sea pelagic pipefish were observed in vertical hauls, and sprats, Black Sea pelagic pipefish and Black Sea horse mackerel in the horizontal hauls (Table 7.10 and Table 7.11). The distribution of these stages (eggs, larvae, juveniles), however, was very patchy with the stages of most species only observed at a few stations. Only the larvae of anchovy were widespread, being observed at 13 out of 15 stations sampled by horizontal hauls, albeit in low abundance. In these horizontal hauls anchovy larvae made up about 80% or more of the total abundance of ichthyoplankton (Ref. 7.1). The percentage composition of the horizontal and vertical trawls is shown in Figure 7.4.

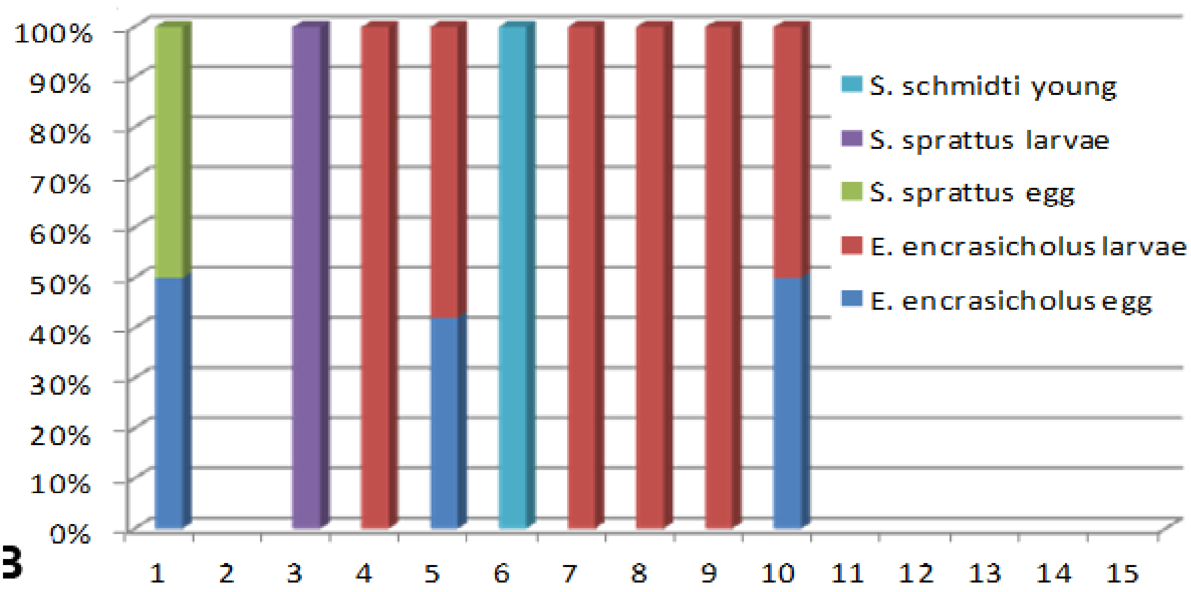
Table 7.10: Composition, frequency of occurrence and average abundance of ichthyoplankton from vertical hauls in the Turkish EEZ central Black Sea September-October 2011

Species	IUCN Red List (Black Sea Turkish Sector) (Ref. 7.31)	Eggs		Larvae		Juveniles	
		No. of Stations	Average Abundance (ind/m^3)	No. of Stations	Average Abundance (ind/m^3)	No. of Stations	Average Abundance (ind/m^3)
Anchovy	Vulnerable	2	0.0040	4	0.0120	0	0
Sprat	Vulnerable	1	0.0015	1	0.0013	0	0
Black Sea Pelagic	Data	1	0.0667	0	0	1	0.0012

Pipefish	Deficient						
Black Sea Horse Mackerel	Vulnerable	0	0	0	0	0	0
Average for survey	-	-	**0.0703**	-	**0.0135**	-	**0.0012**

Table 7.11: Composition, frequency of occurrence and average abundance of ichthyoplankton from horizontal hauls in the Turkish EEZ central Black Sea September-October 2011

Species	Eggs		Larvae		Juveniles	
	No. of Stations	**Average Abundance (ind/m³)**	**No. of Stations**	**Average Abundance (ind/m³)**	**No. of Stations**	**Average Abundance (ind/m³)**
Anchovy	4	0.0011	13	0.0369	3	0.0009
Sprat	0	0	0	0	0	0
Black Sea Pelagic Pipefish	0	0	1	0.0005	1	0.0002
Horse Mackerel	1	0.0002	0	<0.0001	1	0.0002
Average for survey	**-**	**0.0007**	**-**	**0.0277**	**-**	**0.0009**



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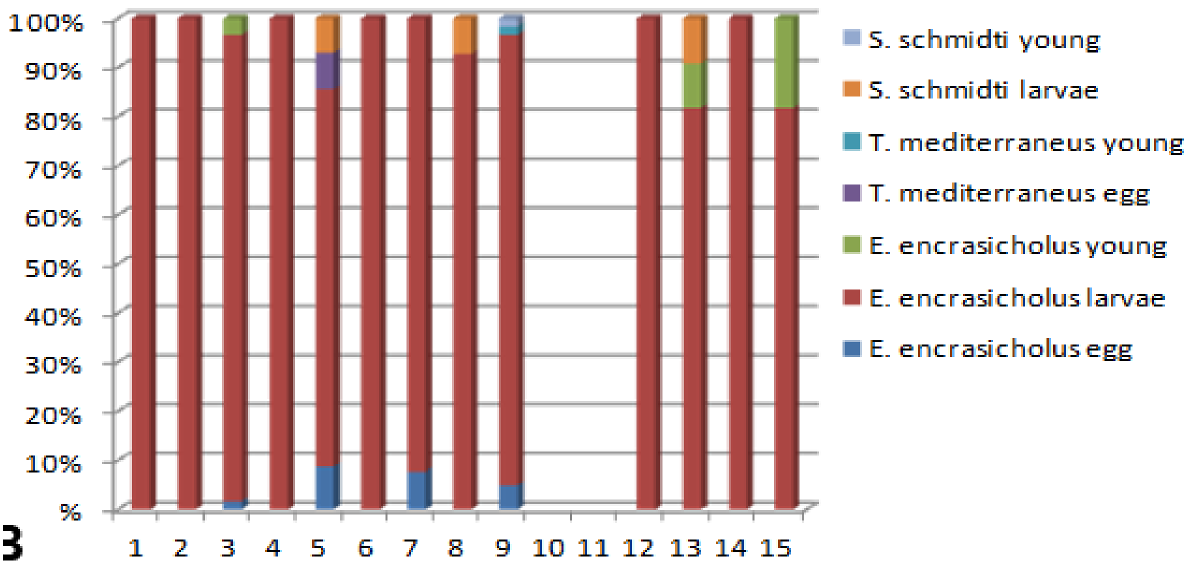

Figure 7.4: Total abundance of ichthyoplankton in vertical (top) and horizontal (bottom) trawls (%) from September 2011

In the composition of ichthyoplankton, fish larvae dominated both in numbers and biomass. Eggs and larvae of anchovy were dominant. The results of the 2009 and 2011 surveys (Ref. 7.1) indicate that the abundance and biomass of the ichthyoplankton is low, particularly when compared to data from coastal regions (Ref. 7.1). Whilst the larvae of anchovy were the most abundant ichthyoplankton, and the most widespread, being observed in most of the areas sampled, abundance across the area was very low. The main spawning and feeding grounds for anchovy occur in the north-western and western continental shelf of the Black Sea, along the coastal waters of Bulgaria, Romania and Ukraine (Ref 7.27). Information on migration and spawning in anchovy is provided in Section 6.4.1 and **Appendix 7-A** of this EIA Report. In addition to anchovy preference for shelf areas, the central Black Sea has much lower levels of productivity and consequently less availability of zooplankton prey for the developing larvae.

A dedicated study of fish and migration was commissioned for the Project (Ref. 7.8) which looked into the potential interaction of fish migration routes and spawning, feeding or wintering grounds with the Project activities. The majority of information related to this study is provided in Section 6.4.1 of this EIA Report and is summarised here. The migration route of the anchovy is of greatest relevance to the Project, as it passes through the Black Sea. The migratory routes, spawning and feeding areas of other pelagic species in the Black Sea do not occur near the Project Area in Turkey's EEZ.

European anchovy are distributed throughout the Black Sea with the main spawning and feeding grounds along the coastal waters of Bulgaria, Romania, Ukraine and the Russian Federation (Ref 7.27). Spawning occurs between May and August over continental shelf areas (Ref. 7.28) with the main spawning areas on the north-western and western shelf of the Black Sea (Ref. 7.27). The main feeding and growth seasons are also in the summer months. Anchovy winter in the coastal waters of Turkey and Georgia.

Anchovy display two seasonal migrations as shown in Figure 7.5. In the autumn a southward migration occurs between October and November through the Black Sea and along coastal waters to the Turkish and Georgian coasts (Ref. 7.27 and Ref. 7.29). In the spring, anchovy migrate from southern coastal wintering grounds to spawning areas in the north-western coast. These migration routes pass through the Black Sea from northern coasts to southern coasts, and back again, and therefore will pass through the Project Area. This migration corridor is thought to be approximately 125 km in width (Figure 7.5). However, the exact timings of these migrations vary year to year, and up-to-date information is not available.

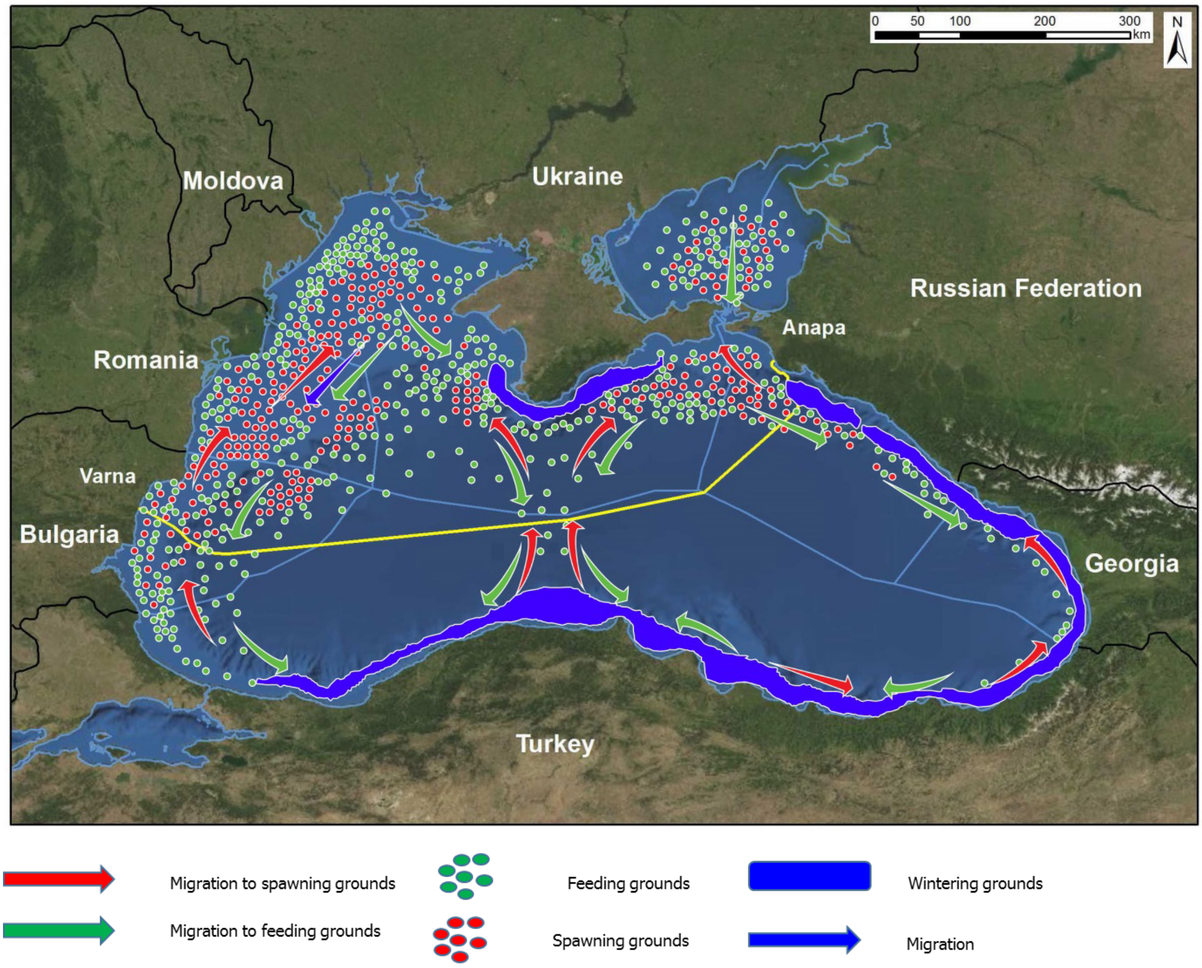

Figure 7.5: Migratory routes, spawning grounds and feeding grounds of anchovy (*Engraulis encrasicolus*) in the Black Sea (Ref. 7.27) Note: the proposed South Stream Offshore Natural Gas Pipeline is shown in yellow.

Other pelagic species which undergo migrations within the Black Sea are; sprat, Black Sea horse mackerel and Atlantic bonito. However, these species do not migrate through the Turkish EEZ or the Project Area. A summary of the biology of the main migratory species in the Turkish EEZ is given in Table 7.12.

Table 7.12: Summary of Fish Species Likely to be Present in the Turkish EEZ

Species	**Anchovy** (***Engraulis encrasicholus***)	**Sprat** (***Sprattus sprattus***)	**Black Sea horse mackerel** (***Trachurus mediterraneus ponticus***)	**Atlantic bonito** (***Sarda Sarda***)
Demersal/pelagic	Pelagic	Pelagic	Pelagic.	Pelagic
Preferred habitat	Coastal species, enters lagoons, estuaries and lakes for spawning.	Inshore, occasionally entering estuaries (especially juveniles).	Distributed across the whole Black Sea, usually near bottom in 50 – 100m depths, also in surface waters.	Epipelagic, neritic, occasionally enters estuaries.
Spawning season	May – August, peaks middle of June to end of July.	Mainly spring and summer	Summer	May - July
Spawning characteristics	Mainly in north west area but also to the South within Turkey's EEZ. Pelagic multiple spawners, temperature dependent. Females can spawn over 50 times per year.	Open sea, between depths of 10-20m. Eggs pelagic, juveniles distributed over larger area near the surface, young drifting inshore.	Spawning success negatively correlated to sea surface temperature. Eggs pelagic.	Enter from Sea of Marmara to spawn. Eggs and larvae pelagic.
Effects of noise	Moderate: probable hearing specialists[4].	Highly sensitive to low frequency sounds.	Moderate: hearing specialists.	Moderate: possible hearing specialist
Migration	October – November. Migrates through the Black Sea and along coasts from North western spawning and feeding grounds to wintering grounds along the Turkish and Georgian coasts. Reverse migration in the spring.	Seasonal migrations between winter feeding inshore and summer spawning offshore grounds.	Highly migratory species through Black Sea. Migrates north in mid-April, for reproduction and feeding. September - November migrates south along Bulgarian coast towards Anatolian and Caucasian coasts.	Highly migratory, enter Black Sea between April and August to spawn and feed, reverse migration on autumn. Juveniles migrate along southern coats of Black Sea and winter there.
Diet	One of the main consumers of zooplankton.	Feeds on planktonic crustaceans.	Other fish including sardine, anchovy and small crustaceans.	Cannibalistic, also feeds on small schooling fishes and invertebrates.
Notes	Most important stock in Turkish EEZ in terms of amount and value of annual landings.	Can tolerate wide range of salinities. Sprat fishing by pelagic trawls is only	All Black Sea horse mackerel treated as a unit stock but consists of four local sub-populations – south western	Preferred catch for most of the anchovy purse seiners due to high market value.

[4] Species which usually have large swim bladders and are sensitive to noise

Species	Anchovy (*Engraulis encrasicholus*)	Sprat (*Sprattus sprattus*)	Black Sea horse mackerel (*Trachurus mediterraneus ponticus*)	Atlantic bonito (*Sarda Sarda*)
	Important role as prey species. Tolerates high range of salinities.	permitted along the Samsun Shelf.	(Bosporic), northern (Crimean), eastern (Caucasian) and southern (Anatolian).	

7.2.3 Other Aquatic Products

The benthic habitat of the Project Area is entirely within the Black Sea abyssal plain, where water depth varies between 2,000 and 2,200 m and the seabed is generally uniform muddy sediments. The benthos and overlying waters are completely anoxic, with high levels of H_2S and so this habitat is unable to support the meio- and macrofauna that are observed in deep water habitats in other seas and oceans. However, microbial reefs associated with mud volcanoes or "gas seeps" are known to occur in waters deeper than 200 m in some western areas of the Black Sea (Treude et al., 2005 in Ref. 7.1).

Topography within the Project Area ranges from essentially flat (eastern section) to a complex of channel levee systems with an elevated ridge rising 50 m above the main abyssal plain. From a dedicated review of survey data (Ref. 7.7) focused on seabed features in the Survey Area: no carbonate mounds or mud volcanoes were observed. Possible active pockmarks were observed at certain locations (see **Chapter 6 Assessment of the Physical Environment**).

7.2.4 Sea Birds

In 2011, the observations of bird species were performed in the daytime from the survey vessel at stations and on transects between the stations (Figure 7.1). The observations were conducted along transects by the snapshot method (Gould & Forsell, 1989 in Ref. 7.1). Observations were undertaken in a forward and perpendicular direction from one side of the vessel and a visual plot 300 x 300 m was selected, within which all bird were counted within 10–15 seconds. The main attention was given to flying birds. During the time remaining until the end of the 300 m section, it was observed again, as some birds sitting on the water could be underestimated in the time of the 'snapshot'. Inspection was carried out with the naked eye although a binocular (15x) was used if needed to identify birds to species level.

At the stations, birds were accounted only at the first appearance in a radius of 300 m around the vessel. Birds accompanying the vessel were accounted only at the first occurrence. The bird species, gender and age were determined as possible.

During field studies conducted in autumn 2011 (Ref. 7.1), 30 taxa of birds were observed, 27 of which were identified to species level. In total, 339 individual birds were seen; including 156 recorded from observation stations and 183 from transect counts (Table 7.13).

Table 7.13: List of species and total number of birds encountered during the 2011 surveys

Species Name	Common Name	Red Data Book of the Black Sea	IUCN Red List Category	Number of observed species(2011)		
				At stations	At transects	Total
Accipiter gentilis	Eurasian or northern goshawk	N/A	LC	1	-	1
Ardea cinerea	Grey heron	N/A	LC	-	11	11
Delichon urbica	House Martin	N/A	N/A	7	3	10
Erithacus rubecula	European robin	N/A	LC	-	1	1
Falco cherrug	Saker falcon	VU	EN	-	1	1
Falco peregrinus	Peregrine falcon	EN	LC	2	-	2
Falco sp.	Falcon sp.	As per above	All	-	2	2

Species Name	Common Name	Red Data Book of the Black Sea	IUCN Red List Category	Number of observed species(2011)		
				At stations	At transects	Total
Ficedula parva	Red-breasted flycatcher	N/A	LC	4	-	4
Fringilla coelebs	Chaffinch	N/A	LC	1	-	1
Fulica atra	Eurasian Coot	N/A	LC	-	2	2
Gavia arctica	Black-throated loon	N/A	LC	1	1	2
Hirundo rustica	Barn swallow	N/A	LC	32	1	33
Larus cacchinans	Caspian Gull	N/A	N/A	20	23	43
Larus fuscus	Lesser black-backed gull	N/A	LC	4	2	6
Larus minutus	Little gull	N/A	LC	12	97	109
Larus sp.	Gull	N/A	All	-	2	2
Motacilla flava	Western yellow wagtail	N/A	LC	2	-	2
Motacilla alba	White wagtail	N/A	LC	38	7	45
Phalacrocorax carbo	Common cormorant	N/A	LC	-	1	1
Phoenicurus phoenicurus	Common redstart	N/A	LC	2	2	4
Phylloscopus collybita	Chiffchaff	N/A	LC	3	-	3
Phylloscopus sp.	Warbler	N/A	All	1	1	2
Podiceps cristatus	Great-crested grebe	N/A	LC	3	-	3
Podiceps grisegena	Red-necked grebe	N/A	LC	-	1	1
Puffinus yelkouan	Mediterranean shearwater	N/A	VU	14	19	33
Stercorarius parasiticus	Arctic skua	N/A	LC	3	6	9
Sterna sandvicensis	Sandwich tern	N/A	LC	3	-	3
Sylvia atricapilla	Eurasian blackcap	N/A	LC	1	-	1
Sylvia curruca	Lesser whitethroat	N/A	LC	1	-	1
Turdus philomelos	Song thrush	N/A	LC	1	-	1
Total				**156**	**183**	**339**

IUCN Red List Category: NA no category yet, LC Least Concern, VU Vulnerable, EN Endangered, All, All categories for this genus (LC, VU, NT, EN). Red Data Book: N/A not listed, EN Endangered, VU Vulnerable.

The Project Area had very low numbers of birds during the autumn 2011 survey with an average density of only 0.96 individuals/km^2 and a maximum of 3.2 individuals/km^2. This was probably due to the low levels of productivity in the central Black Sea, the large distance from coastal feeding areas and the preference of most migrating birds to avoid large expanses of open sea. During the main migration period (April to May) bird observations in the central Black Sea may be higher (Ref. 7.1).

Seabirds were the most common birds observed, accounting for well over half (60.7%) of all birds seen. The most common species was the little gull, *Larus minutus* (109 sightings), followed by the Caspian gull, *Larus cacchinans* (43 sightings), and the Mediterranean shearwater, *Puffinus yelkouan* (33 sightings) (Ref. 7.1).

The diversity of gulls in the Survey Area in 2011 was extremely low with only three species of the genus Larus observed: the little gull, the lesser black-backed gull, *Larus fuscus*, (Figure 7.6) and the Caspian gull. The little gull is a typical pelagic species and the least dependent on coastal food sources. It is known that this species migrates towards the Black Sea, Bulgaria and Georgia, and so it can be assumed that the Black Sea is a fairly traditional migration corridor of this species (Yudin and Firsova, 2002 in Ref. 7.1). During the counts, little gulls were observed mainly in small groups from two to six individuals with some concentrations of more than 10 birds, and single birds were also noted on several occasions.

Caspian gulls were present primarily as single individuals, sometimes in pairs, and in some cases up to five groups of individuals. About half of all Caspian gulls encountered were young birds of the first or second year. The density of populations of Caspian gulls was low, with a maximum of 0.53 individuals (ind.)/km^2 (Ref. 7.1).

Figure 7.6: Lesser Black-backed Gull (*Larus fuscus*) and the Black Throated Loon (*Gavia arctica)* Observed during Autumn 2011 Surveys

The Mediterranean shearwater, which is recorded as vulnerable in the IUCN Red List (Ref. 7.16), was present in low density (0.33 ind./km^2), in groups of no more than six (in other parts of the Black Sea, up to 28 individuals can be observed in a single group) in autumn 2011 but was recorded in great numbers in June 2009. The great density of this species in June is most likely associated with this species feeding in the Survey Area.

Also observed in 2011 were the Arctic skua, sandwich terns and a small number of other gulls, all in very low numbers (Table 7.13). Such low density of seabirds is probably due to the unfavourable feeding conditions. The number of Sandwich Tern observed was also extremely low. This species is one of the most common seabirds in Turkish coastal areas (Ref. 7.1). During the entire observation period there were only three individuals of this species registered.

In conclusion, the abundance and diversity of birds recorded in the central Black Sea were low. Two birds species included in the Red Data Book of the Black Sea (Ref 7.2) were observed during the autumn 2011 survey: the peregrine falcon which is listed as Endangered and the Saker falcon which is listed as Vulnerable. In addition, these species are listed by IUCN Red List as Endangered and Of Least Concern respectively (Table 7.13). This distribution of Red Data Book species observed over the Survey Area is shown in Figure 7.7.

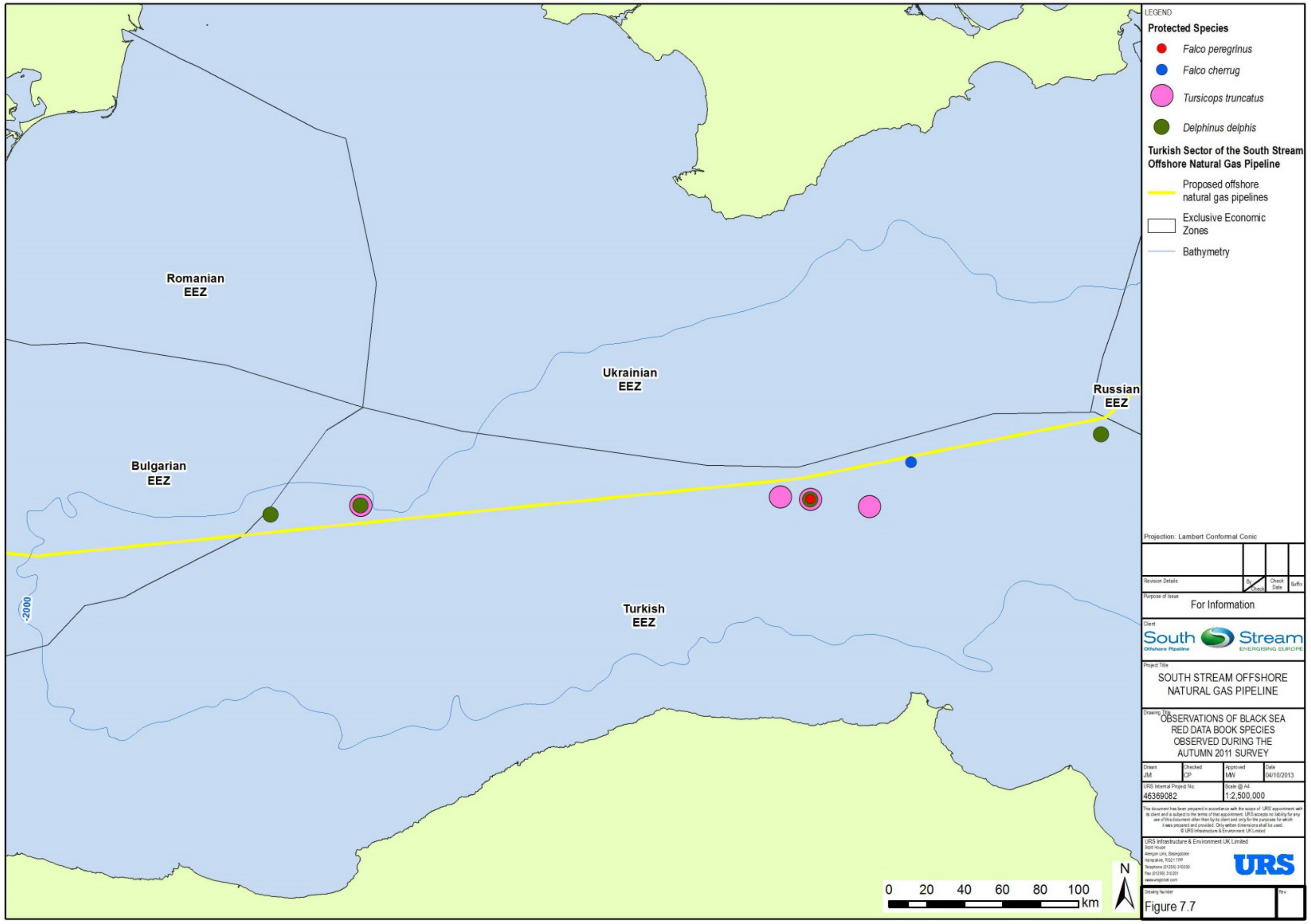

Figure 7.7: Observations of Black Sea Red Data Book Species Observed During the Autumn 2011 Survey

7.2.5 Other Birds

A tentative list of birds considerably as strictly non-seabird species is included in Table 7.14; some of these, such as for example the Eurasian blackcap, *Sylvia curruca*, are associated with freshwater environments as well as being terrestrial.

Table 7.14: Non-seabirds observed during 2009 and 2011 Surveys

Species Name	Common Name
Accipiter gentilis	Eurasian or northern goshawk
Alauda arvensis	Eurasian Skylark
Anas platyrhynchos	Mallard
Anthus pratensis	Meadow Pipit
Ardea cinerea	Grey heron
Circus cyaneus	Northern Harrier
Columba livia	Rock Pigeon
Cygnus cygnus	Whooper Swan
Delichon urbica	House Martin
Egretta alba	Great Erget
Erithacus rubecula	European robin
Falco cherrug	Saker falcon
Falco peregrinus	Peregrine falcon
Falco sp.	Falcon sp.
Ficedula parva	Red-breasted flycatcher
Hirundo rustica	Barn swallow
Motacilla flava	Western yellow wagtail
Motacilla alba	White wagtail
Phoenicurus phoenicurus	Common redstart
Phylloscopus collybita	Chiffchaff
Phylloscopus sp.	Warbler
Sturnus vulgaris	Common Starling
Sylvia atricapilla	Eurasian blackcap
Sylvia curruca	Lesser whitethroat
Turdus philomelos	Song thrush

A small number of birds (just over 5% of total observations) that spend time in freshwater and coastal areas but are not known to feed in the open sea were recorded. These included loons, grebes, the common coot and the grey heron. Several of these species are known to migrate between breeding and feeding grounds, but this is mostly to coastal areas and so are uncommon visitors to the central Black Sea (Ref. 7.1).

There were several other species of birds more commonly associated with inland habitats observed during the autumn 2011 survey. Some of these were in relatively high abundance, particularly relative to the abundance of seabirds. There were 45 sightings of the white wagtail, *Motacilla abla*, 33 of the barn swallow, *Hirundo rustica*, and 10 of the house martin, *Delichon urbicum*. There were sporadic sightings of birds like the robin, chaffinch and chiffchaff, birds that may have been blown off course from their normal inland habitat. The grey heron (*Ardea cinerea*), was seen in 2011.

There were also three birds of prey observed during the survey: the peregrine (*Falco peregrinus*), saker falcon (*Falco cherrug*) and goshawk (*Accipiter gentilis*). There was no available data on the migration of such birds of prey over the Black Sea, but this area is covered by the Mediterranean / Black Sea Flyway.

Surveys undertaken in 2011 registered 12 species of passerine birds, for a total of 108 individuals. Other birds regularly observed during 2011 include rural and urban swallows and white wagtails while small flycatchers, warblers and redstarts were scarce.

7.2.6 Marine Mammals

Specific observations of species and populations of marine mammals were carried out on stations and transects in June 2009 (Figure 7.1), along with bird-watching, in the daytime from the upper deck of the vessel. Results included a description of the observed marine mammals (size, species, and location of meeting places). A summary of observed marine mammals along transects and at stations are reported in the Table 7.15 and Table 7.16.

Table 7.15: Marine mammals along transects, 2009

Transect	Species	Number of individuals
1	Common dolphin	22
2	Common dolphin	13
3	Common dolphin	3
9	Common dolphin	10
Total		**48**

Table 7.16: Marine mammals at stations, 2009

Station	Species	Number of individuals
2	Common dolphin	2
7	Common dolphin	5
8	Common dolphin	2
Total		**9**

In 2009, only the common dolphin was recorded. The absence of other marine mammals may be due to a number of factors including:

- Bottlenose dolphins are quite rare in the open sea and do not always follow vessels;
- Harbour porpoises are a very inconspicuous small and typically can only be observed in calm weather and when they move out of the water, they exhibit a very small part of their back. There are also known to be very few individuals in the central part of the Black Sea, where surveys were undertaken; and
- The Survey Area is not a significant breeding or feeding area for all three species of dolphins as these areas are associated with coastal locations in the Black Sea.

The 2011 surveys on the other hand recorded both the common dolphin and the bottlenose dolphin as shown in Table 7.19 and Table 7.17. Only the common dolphin and the bottlenose dolphin were observed during surveys in autumn 2011. The total number of observations of these species was very low, with sightings at only one (Station 10) of the 15 stations and only five of the 15 transects surveyed. This suggests the occurrence of dolphins in the central Black Sea is both low and sporadic which probably reflects low prey availability in this part of the Black Sea (Ref. 7.1). The distribution of cetaceans observed during the 2011 survey is shown in Figure 7.7.

Table 7.17: Results of observations over marine mammals at stations in autumn 2011

Station Nr.	Species name	Abundance, individuals
10	Black Sea common dolphin	2
	Black Sea bottlenose dolphin	4
	Total	**6**

Table 7.18: Results of observations over marine mammals at transects in autumn 2011

Transect Nr.	Species name	Abundance, individuals
2	Black Sea common dolphin	8
4	Black Sea bottlenose dolphin	2
5	Black Sea bottlenose dolphin	4
	Black Sea common dolphin or Black Sea bottlenose dolphin	1
9	Black Sea common dolphin	4
	Black Sea bottlenose dolphin	4
11	Black Sea common dolphin	5
	Black Sea common dolphin or Black Sea bottlenose dolphin	1
	Total	**29**

The low numbers recorded are believed to be due to a number of factors including:

- Dolphin numbers are known to decrease with distance from shore; and
- Observations were made in the deepest parts of the central Black Sea

A comparison of the number of species observed in 2009 and 2001 is shown in Table 7.18. As only five stations and six transects were sampled in 2009 compared to 12 stations and 11 transects in 2011, the total number of mammals per station and transect is greater in 2009 than 2011. The greater number of individuals observed however, could be due to better conditions in June than October for observing marine mammals.

Table 7.19: A list of species and total number of marine mammals in 2009 and 2011

Name	Summer 2009			Autumn 2011		
	At stations	At transects	Total	At stations	At transects	Total
Common dolphin	9	48	57	2	17	19
Bottlenose dolphin	-	-	-	4	10	14
Common or bottlenose dolphin	-	-	-	-	2	2
Harbour porpoise	-	-	-	-	-	-
Total:	**9**	**48**	**57**	**6**	**29**	**35**
Total per transect / stations	**1.8**	**8**	**-**	**0.5**	**2.6**	**-**

It is plausible that all 3 species of dolphins are found in the Survey Area despite the results of the 2009 and 2011 investigations. Crucially, the Project Area is located at a considerable distance from the main feeding and breeding areas of these species.

7.2.7 Phytoplankton

The plankton community was sampled in the survey area in winter 2009 and autumn 2011 (Ref. 7.1). Table 7.20 outlines the sampling depths and the locations are given in Figure 7.1.

Table 7.20: Field Studies into plankton in 2009 and 2011

Month, Year	Station	Sampling Depths (m)		
		Surface	Mid-Level	Deep
September, 2011	1	0	50	87
	2	0	49	112
	3	0	49	101
	4	0	46	107
	5	0	42	109
	6	0	40	109
	7	0	47	108
	8	0	49	110
	9	0	45	108
	10	0	43	112
	11	0	35	111
	12	0	38	110
	13	0	44	104
	14	0	40	109
	15	0	38	110
December, 2009	1	0	40	65
	2	0	40	69
	3	0	40	70
	4	0	40	67
	5	0	40	65
	6	0	38	72
	7	0	38	70
	8	0	41	68
	9	0	40	69
	10	0	40	64

Overall, the 2011 results appear similar to those of 2009, especially with regard to the dominance of dinoflagellates (56.7% of species) and diatoms (21.4%). The breakdown of the 201 species and 11 classes recorded in 2011 can be seen in Figure 7.8. Of interest is the presence of the potentially toxic algae genus *Alexandrium* (5 species) and the first recording in open waters of the species *Chaetoceros aequatorialis* and Chaetoceros *ceratosporum*.

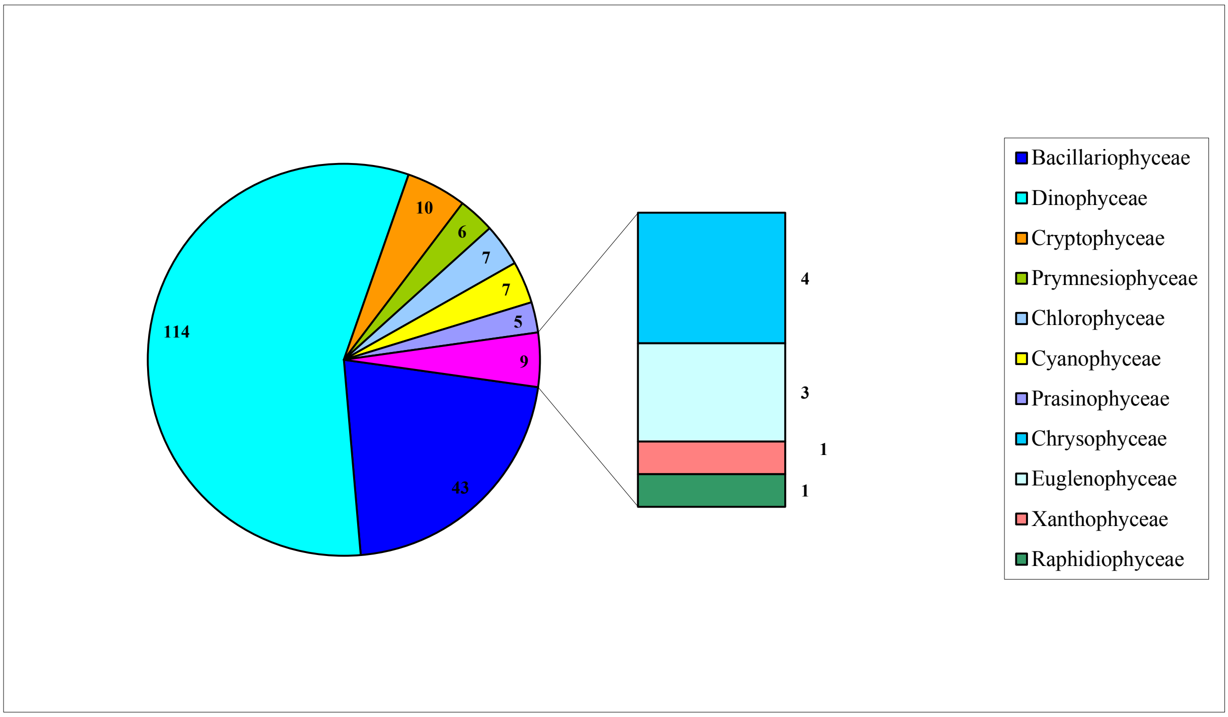

Figure 7.8: Taxonomic Characteristics of Phytoplankton in the Area Surveyed in Sept/Oct 2011

Species diversity was highest in surface layers (65-95) and pycnocline layer (35-75) and lowest in waters below 100 m (13-28). Species composition was fairly uniform throughout the Survey Area as shown by the dendrogram in Figure 7.9. Abundance and biomass was both highly heterogeneous and highest in surface waters with diatoms and dinoflagellates accounting for 50% and 30% of the total respectively. Photosynthetic pigments were low, as indicated by high water transparency, and pigment ratios, highest at 40 to 50 m, indicative of diatom biomass dominance.

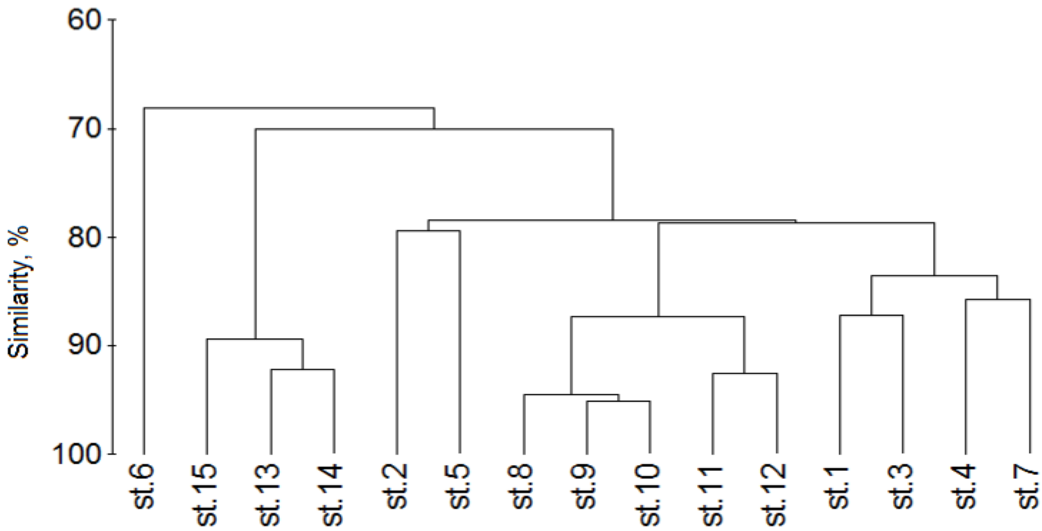

Figure 7.9: Results of Cluster Analysis of Phytoplankton Communities in Numbers (cells/l) and Biomass (mg/m^3) for Stations in Autumn 2011

7.2.8 Zooplankton

The limited data available for zooplankton in the central Black Sea shows a strong seasonal variability with biomass ranging from 2 to 4 g/m^2 in September to 16.5 g/m^2 in October (all data 1999). The surveys undertaken in 2009 recorded biomass values of between 2.2 and 6.8 g/m^2 and were dominated by copepods; other organisms included larvae of bivalves and polychaetes, chaetognaths (arrow worms), appendicularians (pelagic tunicates) and low numbers of ctenophores. Importantly, some individuals of the invasive ctenophores *Beroe ovata* and *Mnemiopsis leidyi* were also captured. Species composition of zooplankton in surveys undertaken in 2009 and 2011showed a highly variable total abundance and biomass of zooplankton with between 75 to 2,040 individuals per m^3 and 13.5 to 43 mg/m^3. This very patchy distribution is possibly linked to local water movements and currents and is similar to phytoplankton abundance described earlier.

The autumn 2011 survey (Ref 7.1) showed zooplankton biomass in the range 1.89 to 59.73 mg/m^3, a greater range than in 2009 and about half of that recorded in the Bulgarian sector of the Black Sea in September 2011. As in December 2009, the community was dominated by copepods (~85% of total animals present of which 50 to 85% were *Calanus exinus*) with few large animals such as jellyfish and chaetognaths recorded but contributing most to biomass (Figure 7.10). A total of 27 taxa belonging to eight phyla were recorded including crustaceans, cnidaria, ctenophora, chaetognatha and chordate and the greatest diversity exhibited by Crustacea (14 taxa). Overall abundance and biomass distribution was similar to that recorded in 2009.

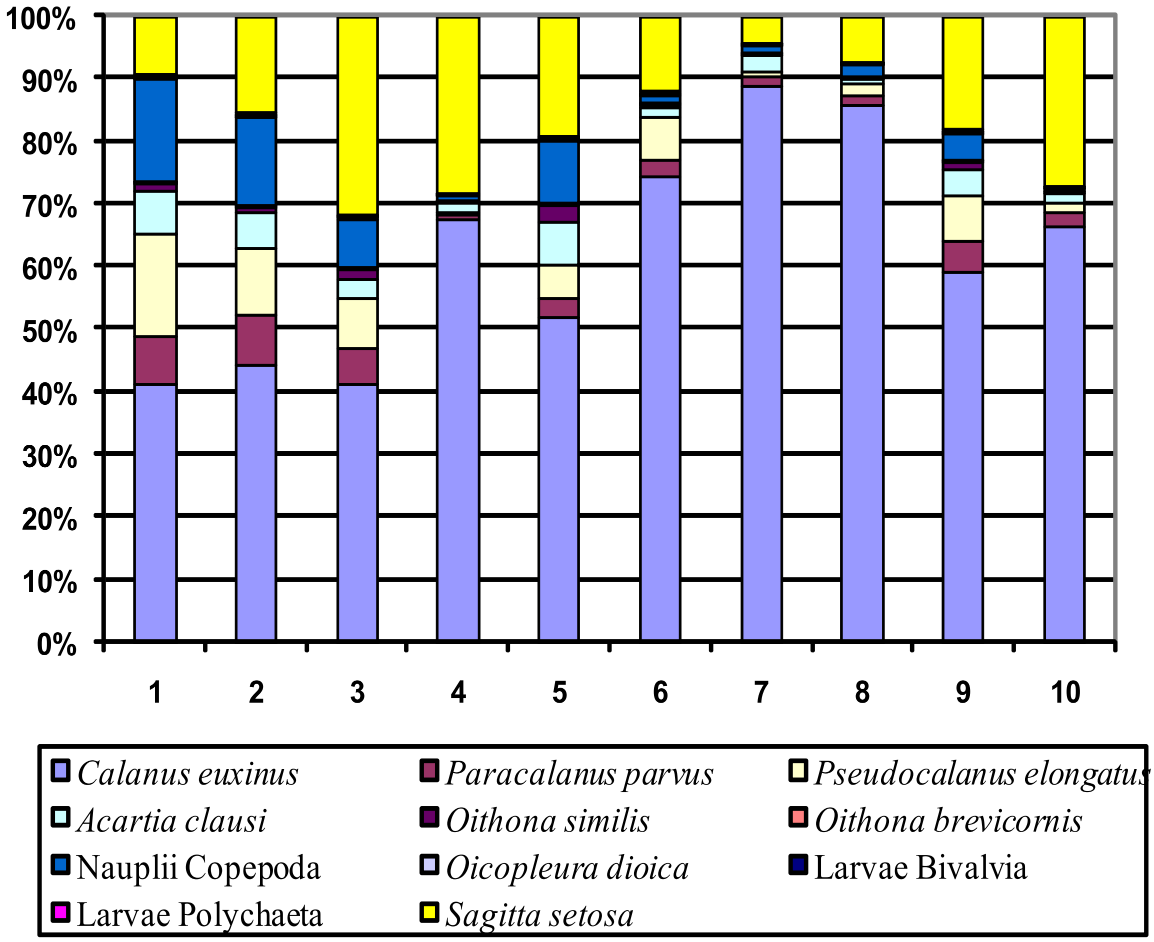

Figure 7.10: Percentage of Total Biomass of Dominant Species and Groups of Zooplankton in Autumn 2011

More detailed analysis of the autumn 2011 survey showed an overall dominance of cold water species (*Calanus euxinus, Pseudocalanus elongatus, Oithona similis*) and some eurythermic species (*Paracalanus parvus, Acartia clausi, Sagitta setosa, Oicopleura dioica*). Of note was a new invasive species (first discovered in large numbers in 2005 in Sevastopol Bay), *Oithona brevicornis* and the ecologically important dinoflagellate *Noctiluca scintillans* recorded in low numbers. A cluster analysis (Figure 7.11) of the data showed composition as similar at all stations (most stations with a similarity of over 70%); similar distribution amongst phytoplankton reflects the relatively uniform habitat available in the waters of the central area of the Black Sea.

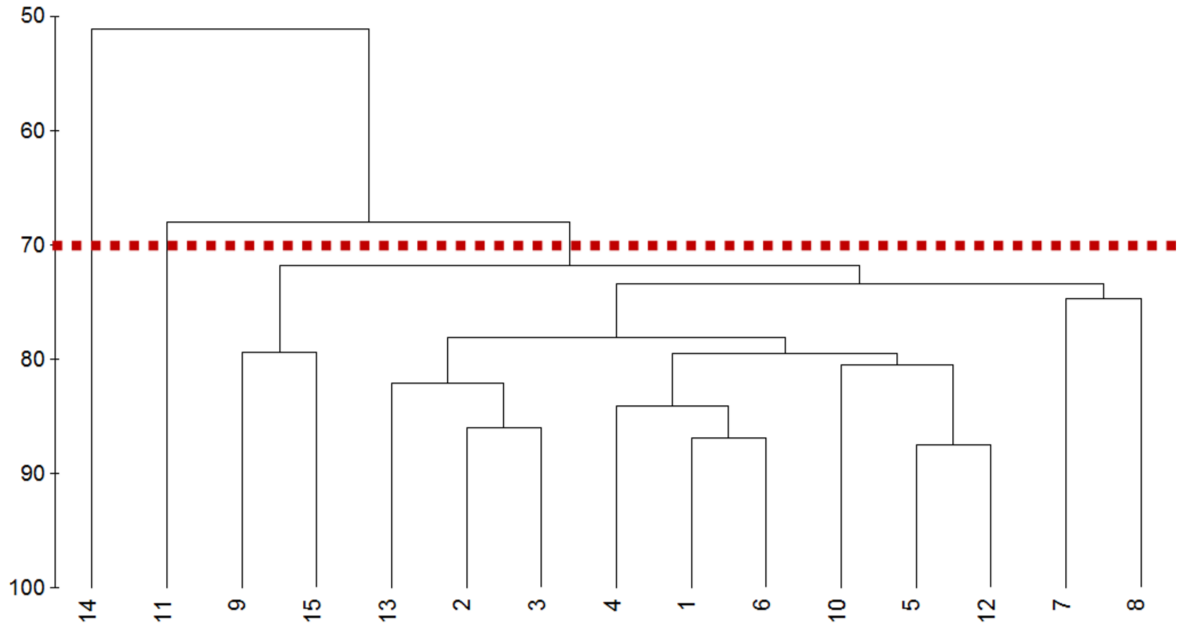

Figure 7.11: Bray-Curtis Dendrogram of cluster similarities of zooplankton, Autumn 2011

7.3 Impacts on the Biological Environment, which may arise during the Works and Procedures within the scope of Project and Measures to Control and Mitigate these Impacts (Construction, Operation and Decommissioning)

The potential impacts on the biological environment have been assessed based on the anticipated activities related to the Construction, Operational and Decommissioning Phases of the Project and summarised in Table 7.21.

The assessment of impacts on marine biological receptors (marine species) has been conducted in line with **Chapter 2: Environmental Impact Assessment Approach** of this EIA Report. An assessment of impacts compared to relevant national standards in national legislation is given in **Chapter 9: Assessment of Project Activities** of this EIA Report.

Table 7.21: Project Activities and Impacts

Phase	Activity	Impact
	Use of fresh water maker/desalination unit and vessel cooling water system. As is the case for all vessels, cooling water is the outcome of the heat of the vessel's engines, not arising from a thermal procedure and process.	Discharge of cooling water could cause negligible level injury to living organisms from increased water temperature and changes to water conditions. Intake of seawater by vessels that could cause negligible level injury to plankton and fish larvae from impingement and entrainment. These impacts are anticipated not to be different from the impacts arising from the other vessels navigating in the Black Sea.
	Mobilisation of vessels to and from site and vessel movements within construction spread and use of Dynamic Positioning (DP) during pipe-lay.	Disturbance to fish and marine mammals from noise and vibration emissions from vessel engines and movements.
	Perform as-laid, pre-laid and as-built survey ROV surveys.	
	Delivery of fuel, pipe and other supplies including hazardous substances to pipe-lay vessel by supply vessel. Including line up of pipe with deck pipe transfer cranes.	
Construction & Pre-commissioning	Night time working.	Light pollution could cause attraction of fish and marine mammals.
	Welding, weld testing and coating of pipe sections.	Uncontrolled waste stored on-board could cause contamination of water and indirect impacts to living organisms. Waste disposal to sea could cause contamination of water and indirect impacts to living organisms.
	Waste generation from vessels operations.	
	Mobilisation of vessels to and from site and vessel movements within construction spread and use of Dynamic Positioning (DP) during pipe-lay.	Non-routine leaks and spills could cause contamination of water and sediments and potential for death / injury to living organisms.
	Delivery of fuel, pipe and other supplies including hazardous substances to pipe-lay vessel by supply vessel. Including line up of pipe with deck pipe transfer cranes.	
	Storage of fuel and other hazardous materials.	
	Refuelling of vessels, plant and machinery.	
	Use of power generation sets (for example diesel generator).	
	Maintenance of plant and machinery.	

Phase	Activity	Impact
	Welding, weld testing and coating of pipe sections.	
	Welding of recovery head to pipeline and lowering/raising of pipeline (Abandoned and Recovery Operations (if necessary due to weather or emergency conditions).	
	Helicopter operations for crew changes.	
	Perform as-laid, pre-laid and as-built survey ROV surveys.	Accidental damage to known / unknown existing services (pipelines, cables etc.) resulting in contamination of the marine environment.
	Mobilisation of vessels to and from site and vessel movements within construction spread and use of Dynamic Positioning (DP) during pipe-lay.	Unplanned or emergency events could lead to the introduction of invasive species may cause injury / death or displacement to native species.
	Mobilisation of vessels to and from site and vessel movements within construction spread and use of Dynamic Positioning (DP) during pipe-lay.	Unplanned or emergency events leading to chemical or fuel spills could cause contamination of water and sediments and potential for death / injury to living organisms.
	Delivery of fuel, pipe and other supplies including hazardous substances to pipe-lay vessel by supply vessel. Including line up of pipe with deck pipe transfer cranes.	
	Refuelling of vessels, plant and machinery.	
Operation (including Commissioning)	Maintenance / repair to pipelines (e.g. span correction). Pipeline condition survey and repairs.	Accidental damage to known / unknown existing services (pipelines, cables etc.) resulting in contamination of the marine environment.
	Mobilisation of vessels to and from pipeline locations and vessel movements along pipeline (Pipeline condition survey and repairs).	Disturbance to sensitive receptors from noise and vibration emissions from vessel engines and movements.
	Maintenance / repair to pipelines (e.g. span correction). Pipeline condition survey and repairs.	Waste stored on-board could cause contamination of water and indirect impacts to living organisms. Waste disposal to sea could cause contamination of water and indirect impacts to living organisms.
	Mobilisation of vessels to and from pipeline locations and vessel movements along pipeline (Pipeline condition survey and repairs).	Non-routine leaks and spills could cause contamination of water and sediments and potential for death / injury to living organisms.
	Maintenance / repair to pipelines (e.g. span correction) Pipeline condition survey and repairs.	
	Maintenance / repair to pipelines (e.g. span correction) Pipeline condition survey and repairs.	Unplanned or emergency events could lead to loss of containment could cause major impact on water quality and injury / death of living

Phase	Activity	Impact
	Operation of pipeline.	organisms.
	Mobilisation of vessels to and from pipeline locations and vessel movements along pipeline (Pipeline condition survey and repairs).	Unplanned or emergency events leading to chemical or fuel spills could cause contamination of water and sediments and potential for death / injury to living organisms.
Decommissioning (Option 1 & 2)	Vessel operations associated with inspection surveys.	Waste disposal to sea could cause contamination of water and indirect impacts to living organisms.
		Unplanned or emergency events leading to chemical or fuel spills could cause contamination of water and sediments and potential for death / injury to living organisms.

The main controls which have been built into the design to limit any potential impacts on biological receptors are listed in Table 7.22. As marine biological receptors can be indirectly impacted by changes in water quality, the design controls mentioned in Section 6.3.3 of this EIA Report relating to water quality are also applicable here.

Table 7.22: Design controls

Design Controls	Receptor
Construction spread minimised as far as practical around vessels.	Birds and mammals
Use of screening and correctly angled lights.	Birds and fish
Minimise use of lighting where possible. Appropriate lighting design during night-time works will be implemented.	
Consultation with anticipated marine users.	
Use of protective filters to prevent intake of fish and plankton.	Plankton and fish
Use of modern vessels and plant and undertaking of regular maintenance checks.	Plankton, fish, birds and Mammals
All vessels will implement a voluntary ballast water and sediment management plan in compliance with the International Maritime Organisation (IMO) International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM). Plans will contain a detailed description of the actions to be taken to implement the Ballast Water Management requirements and supplemental Ballast Water Management practices of the Convention. Vessels that originate outside the Black Sea should continuously ballast en route to the Project Area to avoid translocation of invasive / non-native species.	
Develop Emergency Response Plan and Spill Response Plans.	
All vessels will be compliant with the national regulations and International Convention for the Prevention of Pollution From Ships (MARPOL), cognisant of the Black Sea's status as an IMO special area with respect to oil and garbage. See Section 6.3.3 for more details on the design controls for waste discharges.	
All bunkering activities will be undertaken in line with the contractor's Environmental Management Plan / Pollution Prevention and Control Plan and Oil Spill Prevention and Response Plan.	

Given that there are no benthic communities over the Project Area, as discussed in Section 7.2.3, the impact assessment will focus on fish, birds, marine mammals and plankton only.

7.3.1 Fish

The Project pipelines run across the abyssal plain of the Turkish EEZ, where there is an absence of fish because of the anoxic conditions. There are however, some potential impacts from associated activities that may affect fish fauna in the surface waters of the Project Area. Mobile animals such as fish are frequently able to avoid the source of impacts from Project activities. Of the fish species thought to occur in the Turkish EEZ, the Black Sea garfish (*Belone belone euxini*) and the Atlantic bonito (*Sarda sarda*) are listed on the Red Data Book of the Black Sea.

As mentioned in Section 6.4.1 and 7.2.2 of this EIA Report, there is the potential for migratory species, such as anchovy, to be present in the Turkish EEZ. Anchovy migrate through the Project Area to wintering grounds in the south and feeding grounds in the north.

7.3.1.1 Impact of Construction on Fish

There is the potential for impacts on the fish fauna within the Project Area from noise emissions and waste discharges from the vessels.

Fish may be either hearing specialists or hearing generalists; the former are usually species with large swim bladders and are more sensitive to noise. Hearing specialist species in the Survey Area include anchovy and sprat. An assessment of underwater noise (**Appendix 7-B**) was undertaken for the Project. This assessment looked at the effects of underwater noise on both hearing generalist and hearing specialist fish. The assessment considered noise from one vessel and multiple vessels in terms of mild and strong avoidance reactions. Mild and strong avoidance reactions generally relate to either a brief, minor behavioural change impacting a few individuals or a longer, larger behavioural change relating to the majority of individuals respectively. However, mild and strong avoidance is difficult to define and is discussed in more detail in **Appendix 7-B**. A summary of the results of this study is given in Section 9.5 of this EIA Report and Table 7.23.

Table 7.23: Summary of Underwater Noise Assessment Results - Fish

Fish Hearing Type	Mild Avoidance	Strong Avoidance	Mild Avoidance	Strong Avoidance
	Single Vessel		Multiple Vessels	
Hearing Generalist	2 m	N/A	330 m	55 m
Hearing Specialist	29 m	5 m	2.1 km	436 m

During construction, adult fish may avoid the immediate area of work resulting in short term, localised reductions in densities.

Migratory species, such as anchovy, could be impacted by either the physical presence of vessels or noise generation from vessels impacting migratory routes and/or patterns. Anchovy are the only species in the Black Sea known to migrate across the Project Area (see Section 6.4.1 of this EIA Report for more information on anchovy migration). Anchovy undertake two migrations annually; one southward in the autumn to the Turkish and Georgian coasts (Ref. 7.30) where they form dense wintering concentrations (Ref. 7.27) and one in the spring, to spawning areas in the northern Black Sea.

The exact months in which these migrations take place are not known. Impacts will be direct displacement from the immediate vicinity of the construction spread and could cause minor changes in the migration route of the anchovy.

However, as the construction spread will only be moving at around 2.75 km/ day it can be considered a stationary object and anchovy will be able to avoid this area. Only one construction spread will be present in Turkish waters at any one time (see Section 1.6.3 of this EIA Report for the construction schedule). Migrating schools of fish are fast moving and their presence at a particular point is temporary. The Turkish pipeline sector is 470 km long which suggests a total transit time of a maximum 170 days or around 6 months for construction vessels. The main migration corridor could extend around 125 km in width through the Turkish EEZ.

Although the presence and noise emitted during construction will be continuous, the impact of noise on migrating species is localised over the few (up to 2.1 km for mild avoidance reactions). Mild avoidance reactions will only cause limited behavioural changes in the anchovy and are unlikely to adversely impact the migration patterns of fish which will exhibit mild startle reactions to the noise source and could potentially alter the migration course but will not cause major disruptions to the anchovy's migration. It should be noted that these mild avoidance reactions are a worst case and based on all vessels in the construction spread, including supply and support vessels, operating in the area at the same time. The impacts of noise from just the pipe-lay vessel are much smaller; mild avoidance is seen out to 29 m for the noise source.

The construction of pipeline 2 and 4 could potential overlap with the spring migration period for the month of May where pipeline 3 could overlap with the autumn migration in the months of September and October. Pipeline 1 could impact the spring migration period but the area of impact for strong avoidance, as discussed above, is only a maximum of diameter of 4.2 km around the construction spread compared to the 125 km migration corridor for anchovy. Therefore, the area of impact for strong avoidance reactions is 13.85 km^2. Impacts (i.e., strong avoidance behaviour) are more likely to occur in the 436 m around the construction spread. Therefore covering a diameter of 872 m within the 125 km migration corridor could impact fish migration. The total impact area around the vessels is 0.597 km^2.

Noise emissions from vessels within the construction spread are also lower than noise emitted from super tankers and other cargo vessels which transverse the Black Sea along numerous shipping routes. In addition, fish can become habituated to noise emissions, are highly mobile and will be migrating over a wide area through the middle of the Black Sea. As such, it is likely that any impacts to fish migrations will be localised to around the construction spread, intermittent based on the number of vessels operating in the area and temporary.

Another adverse consequence of construction may be pollutants entering the aquatic environment from vessel discharges. Vessels will be discharging certain wastes infrequently during operations and all discharges will be in compliance with MARPOL as discussed in full in Section 9.7 of this EIA Report. Fish larvae have a small weight and volume, as well as a large surface area in contact with the environment and therefore have increased susceptibility to various toxicants. Any impact to fish is likely to be short-term, infrequent and localised.

As is the case for all vessels, cooling water is the outcome of the heat of the vessel's engines, not arising from a thermal procedure and process. Cooling water discharges may cause localised changes in water quality relating to excess heat. This may cause thermal and /or chemical stress to biota in the immediate vicinity (within a few metres of the source), though it will be a highly localised, infrequent and short-term effect.

Seawater abstraction may result in the entrainment of fish larvae. These will be subject to physical stresses and may result in mortality. However, as only a very limited number of localised individuals will be affected this is a localised, infrequent and short term impact.

These impacts are not anticipated to be different from the impacts arising from the other vessels navigating in the Black Sea.

7.3.1.2 Impacts of Operation on Fish

As the pipelines will be located in water depths of around 2,000 m normal operation of the pipeline will have no effect on fish species given the absence of fish species below waters of approximately 150 m depth (as discussed in Section 7.2.2). Maintenance vessels will be used for routine operations to inspect the pipeline. These inspection surveys will occur infrequently (every five years). Impacts from maintenance vessels will be similar to those mentioned during the Construction

Phase (Section 7.3.1.1) but far less frequently and will involve only one vessel, hence less noise emissions and waste discharges which could potentially impact fish species.

7.3.1.3 Impacts of Decommissioning on Fish

There are no anticipated impacts if the pipelines are to be left in situ on the seabed. If the pipelines are removed from the seabed, impacts from decommissioning will involve the use of vessels and will cause impacts similar to those during the Construction Phase (Section 7.3.1.1). At the time of writing this EIA Report, the strategy for decommissioning is unknown but the Project will adopt GIIP.

7.3.1.4 Impact in Unplanned / Emergency Events on Fish

The unlikely occurrence of accidental oil spills associated with the vessels could potentially impact fish species. Probable consequences of such impacts include intoxication by ingestion of contaminated petroleum products or via prey species. Any pollutants would rapidly become diluted in the open waters of the central Black Sea and fish are highly mobile so that any impacts are likely to be direct or indirect, local and short-term. Effects of rupture of the pipeline leading to a loss of containment are more relevant in coastal waters or in areas with slow water exchange. In the deep waters of the central Black Sea (around 2,000 m water depth) any released gas is likely to become dispersed over a wide area by the time it reaches the surface where it will then be released into the atmosphere. It is also unlikely that any H_2S in lower water layers and sediments that become disrupted by bubbling gas will significantly increase concentrations in surface waters. Any escape of gas should be short-lived as the pipeline will be closed off in the event of a rupture. Thus, the impact on fish species is likely to be short-term, localised and of limited impact to fish which could be present in the upper water column.

There is also the potential for the accidental introduction of non-native invasive species during vessel operations resulting from the release of ballast water or from organisms carried on vessel hulls. These can cause changes in the functioning of the food web in the marine ecosystem. The impact would be long-term and could potentially impact the entire Black Sea. The possibility of this occurring is, however, unlikely given the design controls adopted for the Project.

7.3.1.5 Mitigation Measures for Fish

The potential for interaction with migration routes is localised to up to 4.2 km around the construction spread. This is based on mild avoidance reactions only. Given the fact the area of mild avoidance impact as discussed above, is only a maximum of 4.2 km around the construction spread compared to the 125 km migration corridor for anchovy and considering uncertainties in the timing of anchovy migrations; no seasonal constraints have been suggested. Once the design controls mentioned in Table 7.22 are incorporated there are no mitigation measures envisaged for fish species.

7.3.2 Birds

A wide variety of birds inhabit the Black Sea at different times of year. Birds are most vulnerable to disturbance when nesting or moulting when their ability to avoid sources of impact is reduced. No birds will be nesting or moulting within the Project Area at any time of the year. The presence of birds in the Project Area is mostly associated with birds observed on their migrations. Two species observed in the Survey Area are listed in the Red Data Book of the Black Sea; peregrine falcon (*Falco peregrinus*) listed as endangered and saker falcon (*Falco cherrug*) listed as vulnerable. The Mediterranean shearwater is also listed as vulnerable on the IUCN Red List.

7.3.2.1 Impact of Construction on birds

The main impact on seabirds is likely to be disturbance from vessel movements during mobilisation and pipe-laying activities. However, these are highly mobile animals that can avoid areas of disturbance. The disturbance will be continuous but localised to around the construction spread. The number of birds present in the Project Area, as shown in Section 7.2.4 and 7.2.5, is expected to be low.

Assessment of the risk of collisions of birds with a variety of man-made structures is very complicated although the height of the vessel and any structures on the vessel is much lower than the flight path of most birds during their migration. Thus, a significant increase in bird deaths from collisions with ships and other structures is not anticipated.

Noise emissions from vessels may have some adverse impact on birds, acting mainly as a deterrent. However, given that the population density of birds in the Project Area is extremely low, noise will not introduce significant changes in the behaviour or structure of bird communities. Any changes that do occur are likely to be short-term and may result in localised changes in the spatial localisation of clusters of migratory birds (avoiding areas with high levels of noise pollution).

Lighting from night time works may affect migrating birds and could cause mortality due to bird strikes or displacement from migration routes. This impact will be localised to the immediate vicinity of the construction spread, infrequent and short-term and will affect only the low number of birds present in this part of the Black Sea.

There is the potential for indirect impacts of toxicity on seabirds from waste discharges causing changes in water quality. Vessels will be discharging wastes infrequently during operations and waste discharges to sea are discussed in full in Section 9.7 of this EIA Report. Changes in water quality can cause adverse effects, either directly (contact with water by ingestion or absorption) or indirectly (through effects on food resources). However, birds are unlikely to be feeding or resting on the water within the Project Area and as such, impacts will be indirect, short-term and localised.

7.3.2.2 Impact of Operation on birds

During normal operation of the pipeline there will no impact on birds because all operations will be taking place on the seabed in a water depth of approximately 2,000 m. Maintenance vessels will be used for routine operations to inspect the pipeline during its operational life (as discussed in Section 7.3.1.2). Impacts from maintenance vessels will be similar to those mentioned during the Construction Phase (Section 7.3.2.1) but will be less frequent and involve only one survey vessel hence, resulting in less waste discharges and noise emissions are lower likelihood of any impact.

7.3.2.3 Impacts of Decommissioning on birds

There are no anticipated impacts if the pipelines are to be left in situ on the seabed. If the pipelines are removed from the seabed, impacts from decommissioning will involve the use of vessels and will cause impacts similar to those during the Construction Phase (see Section 7.3.2.1). At the time of writing this EIA Report, the strategy for decommissioning is unknown but it will adopt GIIP.

7.3.2.4 Impact of Unplanned / Emergency Events on birds

In the event of an emergency such as the release of oil or fuel from the vessel, impacts on birds would be limited and either direct or indirect; associated with physical contact with the oil on the sea surface or contamination of their food supply. Most likely, the event would not limit the number and distribution of birds in the area. Any pollutants would rapidly become diluted in the open waters of the central Black Sea and birds are highly mobile and not completely reliant on the Turkish EEZ for food so that any losses are likely to be local, infrequent to rare and short-term.

The effects of loss of containment are discussed in Section 7.3.1.4. The impact on birds is likely to be limited as the gas needs to travel approximately 2,000 m to surface waters during which time it will become dispersed across a wider area by water movement. Impacts are therefore, local, short-term and infrequent to rare.

There is also the potential introduction of non-native invasive species as discussed in Section 7.3.1.4. These can cause changes in the functioning of the food web in the marine ecosystem. The impact would be long-term and could potentially impact the entire Black Sea. The possibility of this occurring is, however, unlikely given the design controls adopted.

7.3.2.5 Mitigation Measures for birds

The Project is located at a considerable distance from breeding and wintering areas which are more closely associated with coastal locations. Although birds were observed on their migration, the main migration corridors for birds over the Black Sea are along the coastlines and there are unlikely to be significant numbers of birds migrating over the central Black Sea; as such, no seasonal constraints for birds are suggested. There are no standards or limits in national legislation for impacts on birds at sea. Given the design controls mentioned in Table 7.22, there are no mitigation measures envisaged to be required for birds.

7.3.3 Marine Mammals

Whilst highly mobile and generally able to avoid areas of adverse impact, the sensory acuity of marine mammals generally makes them sensitive to noise disturbances. Two of the three cetacean species that occur in the Black Sea were observed in the Survey Area; the Black Sea bottlenose dolphin (*Tursiops truncatus ponticus*) and the Black Sea common dolphin (*Delphinus delphis ponticus*). These sub-species of the bottlenose dolphin and the common dolphin are listed in the IUCN Red List as endangered and vulnerable respectively. Both species are listed in the Black Sea (Bucharest) Convention as endangered.

7.3.3.1 Impact of Construction on Marine Mammals

Construction may have some impact on the populations of marine mammals including temporary disturbance by vessels, noise associated with vessels and pipe-laying activities and disposal of wastes to sea.

Vessel movements during pipe-laying activities have the potential to temporarily disturb marine mammals. Collision with vessels may also occur, the most vulnerable species being the common dolphin as it often accompanies moving boats. However, cetaceans are highly mobile animals, with acute sensory perception, and are generally able to avoid areas of disturbance and are unlikely to collide with vessels. Any disturbance due to vessel movements is likely to be localised and short-term and will only potentially impact a small number of marine mammals which are present in the Project Area.

Noise from vessel movements and from the use of thrusters during dynamic positioning can negatively impact marine mammals resulting in a number of possible behavioural responses. Noise can affect cetacean's ability to echolocate and communicate disrupting their ability to orientate which can affect swimming and speed of movement. Noise may also cause certain cetacean species to vacate feeding areas, as it interferes with acoustic prey location, and so individuals may avoid previously occupied territory (Richardson et al., 1995 in Ref. 7.1). Noise can also have indirect effects on behaviour by influencing the abundance of prey, its behaviour and distribution but these will also be temporary.

An assessment (including modelling) of underwater noise impacts on marine mammals was undertaken to inform this EIA Report (**Appendix 7-B**). The results of which are given in Section 9.5 of this EIA Report. The impact analysis showed that sound levels generated by pipe-laying are insufficient to cause mortality in the marine species local to the area (bottlenose and common dolphins). Modelling undertaken included a number of scenarios such as single and multiple vessels and well as animal-source scenarios to replicate an animal moving through a noise source over 30 minutes. The assessment looked at temporary and permanent hearing damage and mild and strong avoidance reactions. A summary of the results for marine mammals is given in Table 7.24.

Table 7.24: Summary of Underwater Noise Assessment Results - Mammals

Temporary Hearing Damage	Strong Avoidance	Mild Avoidance	Temporary Hearing Damage	Strong Avoidance	Mild Avoidance
Single Vessel			**Multiple Vessels**		
2 m	155 m	2.4 km	60 m	810 m	4.96 km

The acoustic impact modelling found that underwater noise levels arising from all of the vessels in the construction spread were insufficient to give rise to lethality (refer to **Appendix 7-B** for more information). Marine mammals are highly mobile species and not present in great numbers in the Survey Area. Strong avoidance from multiple vessels is seen out to 810 m, which equates to an area of 2,1 km^2. As such, the impact of noise on marine mammals will be potentially adverse, direct, long-term and localised.

Light from night-time works may affect marine mammals through alterations in the distribution of prey. However, impacts are likely to be temporary (night-time only), short term, localised to the immediate vicinity of the construction spread and will only affect very low numbers of marine mammals because of the low density of both marine mammals and prey species in the Project Area.

Discharges from vessels may cause localised changes in water quality. Changes in water quality can cause adverse effects, either directly (contact with water by ingestion or absorption) or indirectly (through effects on food resources). Vessels will be discharging wastes infrequently during operations and waste discharges to sea are discussed in full in Section 9.7 of this EIA Report. The impact of discharges on marine mammals will be potentially adverse, direct or indirect, short-term, localised to the immediate vicinity of the discharge and intermittent.

7.3.3.2 Impact of operation of pipeline on marine mammals

The operation of the pipeline under normal conditions will not have adverse effects on the populations of marine mammals as the pipeline will be in position on the seabed, in a water depth of approximately 2,000 m. Maintenance vessels will be used for routine operations to inspect the pipeline during its operational life (as discussed in Section 7.3.1.2). These inspection surveys will occur infrequently (every five years). Impacts from maintenance vessels will be similar to those mentioned during the Construction Phase (Section 7.3.3.1) but will be less frequent and involve only one survey vessel. This will result in less light and noise emissions and waste discharges and as such the magnitude of the impact will be reduced.

7.3.3.3 Impact of Decommissioning on marine mammals

There are no anticipated impacts if the pipelines are to be left in situ in the marine environment. If the pipelines are removed from the seabed, impacts from decommissioning will involve the use of vessels and will cause impacts similar to those during the Construction Phase (see Section 7.3.3.1). At the time of writing this EIA Report, the strategy for decommissioning is unknown but it will adopt GIIP.

7.3.3.4 Impact of Unplanned / Emergency Events on marine mammals

As discussed in Section 7.3.1.4, in the event of an accident (i.e. loss of pipeline containment), impacts on marine mammals are likely to be minimal because as the gas travels approximately 2,000 m to surface waters it will become dispersed across a wider area by water movement. Impacts are therefore, local, short-term and infrequent to rare.

Accidental oil spills associated with the vessels could potentially impact marine mammals. Probable consequences of such impacts include intoxication by ingestion of contaminated petroleum products (direct) or via prey species (indirect). Any pollutants would rapidly become diluted in the open waters of the central Black Sea and mammals are highly mobile so that any losses are likely to be direct or indirect, local and short-term. The results of the oil spill modelling undertaken for the Project are provided in Section 9.8 of this EIA Report. The Project specific oil spill modelling report is presented in **Appendix 7-C**.

There is also the potential introduction of non-native invasive species as discussed in Section 7.3.1.4. These can cause changes in the functioning of the food web in the marine ecosystem. The possibility of this occurring is, however, unlikely given the design controls adopted.

7.3.3.5 Mitigation measures on marine mammals

The Project is not located in a region of importance for marine mammals feeding and at a considerable distance from breeding areas associated with the coasts; as such, no seasonal constraints are suggested. There are no standards or limits in national legislation for impacts on marine mammals at sea. Given the design controls mentioned in Table 7.22, there are no mitigation measures envisaged to be required for mammals.

7.3.4 Plankton

Planktonic systems are not particularly sensitive to the impact of pipe-laying activities. Their dispersed nature, very high numbers and relatively short generation time means the populations themselves are resilient. The project activities also have relatively little scope to impact the water column.

7.3.4.1 Impacts of Construction on Plankton

The impact of the Construction Phase on plankton will be limited to the upper water column of the Project Area as such, impacts from pipe-laying on the seabed are not considered. There are potential impacts from vessel operations and the associated discharges to the water column. Vessel wastes may locally reduce light levels and affect phytoplankton photosynthesis. Particles in the waste may also interfere with the filter feeding mechanisms of some zooplankton species and affect the behaviour of visual predators that eat zooplankton. These impacts will be adverse, indirect and localised (within a few metres of the discharge). Vessels will be discharging wastes infrequently during operations and waste discharges to sea are discussed in full in Section 9.7 of this EIA Report. Cooling water discharges may cause localised changes in water quality relating to excess heat. This may cause thermal and /or chemical stress to biota in the immediate vicinity (within a few metres of the source), though it will be a highly localised, infrequent and short-term effect. These impacts are anticipated not to be different from the impacts arising from the other vessels navigating in the Black Sea.

Seawater abstraction may result in the entrainment of plankton. These will be subject to physical stresses and may result in mortality. However, as only a very limited number of localised individuals will be affected this is a localised, infrequent and short term impact.

Light from night-time works may affect the vertical distribution of plankton either by direct attraction of species or the attraction of prey. However, this impact is intermittent (during night-time), temporary and localised.

7.3.4.2 Impacts of Operation on Plankton

As the pipeline will be located in water depths of around 2,000 m, normal operation of the pipeline will have no effect on plankton communities. Maintenance vessels will be used for routine operations to inspect the pipeline during its operational life (as discussed in Section 7.3.2.1). Impacts from maintenance vessels will be similar to those mentioned during the Construction Phase (Section 7.3.2.1) but less frequent and will involve only one survey vessel; hence, less discharges will occur.

7.3.4.3 Impacts of Decommissioning on Plankton

There are no anticipated impacts if the pipelines are to be left in situ in the marine environment. If the pipelines are removed from the seabed, impacts from decommissioning will involve the use of vessels and will cause impacts similar to those during the Construction Phase (see Section 7.3.4.1). At the time of writing this EIA Report, the strategy for decommissioning is unknown but it will adopt GIIP.

7.3.4.4 Impact of Unplanned / Emergency Events on Plankton

There is the potential for adverse impacts on plankton from the release of fuel or chemicals from vessels during construction and operation. Some pollutants, such as hydrocarbons, can disrupt the biochemical processes of biota, particularly of plankton that are small with a large surface area to volume ratio which increases possible susceptibility to various toxicants. However, pollutants would rapidly become diluted in the open waters of the Turkish EEZ and as plankton have short-life cycles and a high rate of reproduction, any losses are likely to be local, infrequent to rare and short-term.

There is also the potential introduction of non-native invasive species during vessel operations as discussed in Section 7.3.1.4. These can cause changes in the functioning of the food web in the marine ecosystem as introduced plankton species can out-compete native species for space and food. The introduction of invasive species could have an impact on the entire Black Sea ecosystem; the possibility to this event is, however, unlikely given design controls adopted.

As discussed in Section 7.3.1.4, it is also unlikely that surface water will be impacted by loss of containment from the pipeline. Thus, the impact of a gas pipeline rupture is likely to be short-lived and of limited impact to plankton, which only occur within the upper layers <100 m of the Project Area.

7.3.4.5 Mitigation Measures for Plankton

The planktonic community within the Project Area is not of importance to the functioning of the Black Sea ecosystem. There are no standards or limits in national legislation for impacts on plankton. Given the design controls mentioned in Table 7.22, there are no mitigation measures envisaged to be required.

7.4 Other Issues

There are no other issues to be discussed in this Chapter.

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8. ASSESSMENT OF SOCIO-ECONOMIC ENVIRONMENT

The key characteristics of the Turkish Sector of the Project, as described in Chapter 1, of note to socio-economics are:

- There will be no landfall facilities in the Turkish Sector of the Project;
- Four pipelines, each approximately 470 km in length, will be laid directly on the sea bed below 2,000 m depth in the Turkish EEZ; and
- If materials and equipment are delivered to marshalling yards in Bulgaria and Russia by sea, Turkish territorial waters may be crossed by supply ships crossing the Turkish straits.

The Turkish Sector of the South Stream Offshore Pipeline (the Project) enters the Turkish EEZ in the Black Sea from the border with the Russian EEZ and exits across the Bulgarian EEZ border, passing no closer than 110 km to the Turkish Black Sea coastline. As a result, the potential for socio-economic impacts to arise, at either a national or regional level is strictly limited and needs to be considered in light of the nature and location of the Project on a national and regional scale as it crosses the Turkish EEZ.

This Chapter therefore presents an assessment of the socio-economic baseline environment with special emphasis on the fishing industry along the provinces of the Black Sea coastline. The Study Area was comprised of the fifteen provinces of Turkey that are located along the country's Black Sea coastline (Figure 8.1). Four of these Black Sea coastal provinces[1] are located within the Marmara Region of Turkey, namely (west to east) Kırklareli, İstanbul, Kocaeli and Sakarya. The remaining eleven Black Sea coastal provinces are located within the Black Sea Region of Turkey, namely (west to east) Düzce, Zonguldak, Bartın, Kastamonu, Sinop, Samsun, Ordu, Giresun, Trabzon, Rize and Artvin.

Figure 8.1: Map of Turkey (red: Marmara Region; green: Black Sea Region)

The Socio-Economic Environment in Turkey and particularly along the Black Sea coastline is presented under the following headings:

- Economic Baseline;

[1] The term 'Black Sea coastal provinces' is used consistently throughout this chapter to refer to all of the provinces of Turkey that border on the Black Sea coastline. It does not refer to the provinces of the Black Sea Coast Region.

- Economic Conditions in Fishing Activities;
- Employment Conditions in Fishing Activities;
- Impacts of the Project on Fishing;
- Cultural Heritage and Archaeology;
- Employment;
- Population;
- Education;
- Health;
- Industry;
- Economic Life of the Project; and
- Project's Benefit-Cost Analysis.

It should be noted that whilst this Chapter presents an overview of the socio-economic characteristics, this does not imply that there are anticipated Project impacts (positive or negative) for each of these socio-economic areas. Where Project impacts are not expected to occur, or are considered negligible, this is specified below.

8.1 Economic Baseline

The Turkish economy has experienced largely continuous economic growth over the ten year period from 2003 to 2012 except in 2008 and 2009 corresponding with the global economic crisis (Ref. 8.1). During this time, per capita Gross Domestic Product (GDP) expressed in fixed prices (using 1998 as a base year) has increased from 1,142 TL in 2003 to 1,573 TL in 2012 (Table 8.1). In 2012 this is equivalent to US $10,504 per capita using current prices (rather than fixed prices using a 1998 base year).

Table 8.1: Per capita GDP[2] growth in Turkey between 1998 and 2012

Year	Per capita gross domestic product (in fixed 1998 prices, Turkish Lira)	Real growthrate in per capita income (%)
1998	1,124	-
1999	1,071	-4.7
2000	1,127	5.3
2001	1,049	-7.0
2002	1,099	4.8
2003	1,142	3.9
2004	1,233	8.0
2005	1,320	7.1
2006	1,394	5.6
2007	1,442	3.4
2008	1,434	-0.6
2009	1,346	-6.1
2010	1,450	7.7
2011	1,557	7.4
2012	1,573	1.0

[2] Gross Domestic Product is a value which is equal to the sum of the values of all goods and services produced by residential institutional units engaged in domestic production activities in an economy in a given period of time, minus the total inputs which are used in the production of these goods and services.

The latest available data at provincial level (2001[3]) shows that the majority of the Black Sea coastal provinces in the Marmara Region have a GDP per capita above the Turkish average, while the majority of the Black Sea coastal provinces in the Black Sea Region have a lower GDP per capita in comparison to the Turkey average.

The three largest economic sectors in Turkey in 2012, as measured by their share of GDP, were manufacturing (24.4%), transportation and communication (14.9%) and wholesale and retail trade (12.7%)[4] (Ref. 8.1).

8.1.1 Shipping and Ports

Turkey straddles the Bosphorus, an important strait providing the only means of access for vessels between the Mediterranean and Black Seas.

The Bosphorus is a busy strait carrying, on average between approximately 3,000 and 4,500 ships (i.e., one ship equates to one trip north or south bound through the strait) per month. The number of ships sailing through the Bosphorus Strait displays considerable variance, although there is a tendency for the number of ships to be lower during winter (see Figure 8.2). For further information in relation to shipping, refer to **Section 6.9 Sea Traffic** and **Section 9.6 Sea Traffic**.

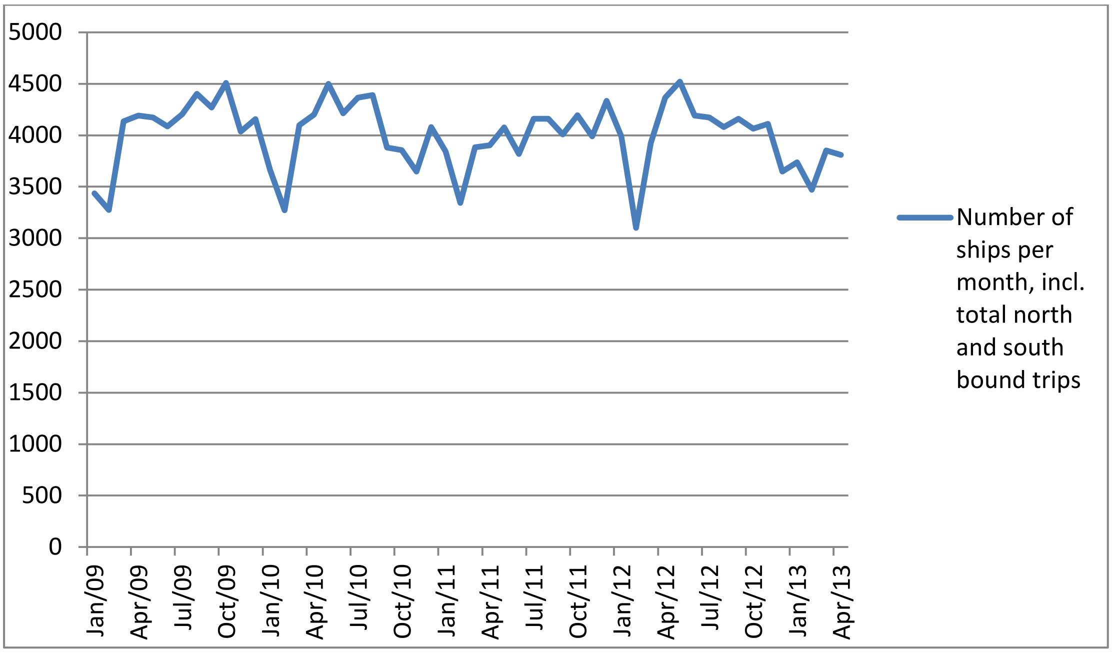
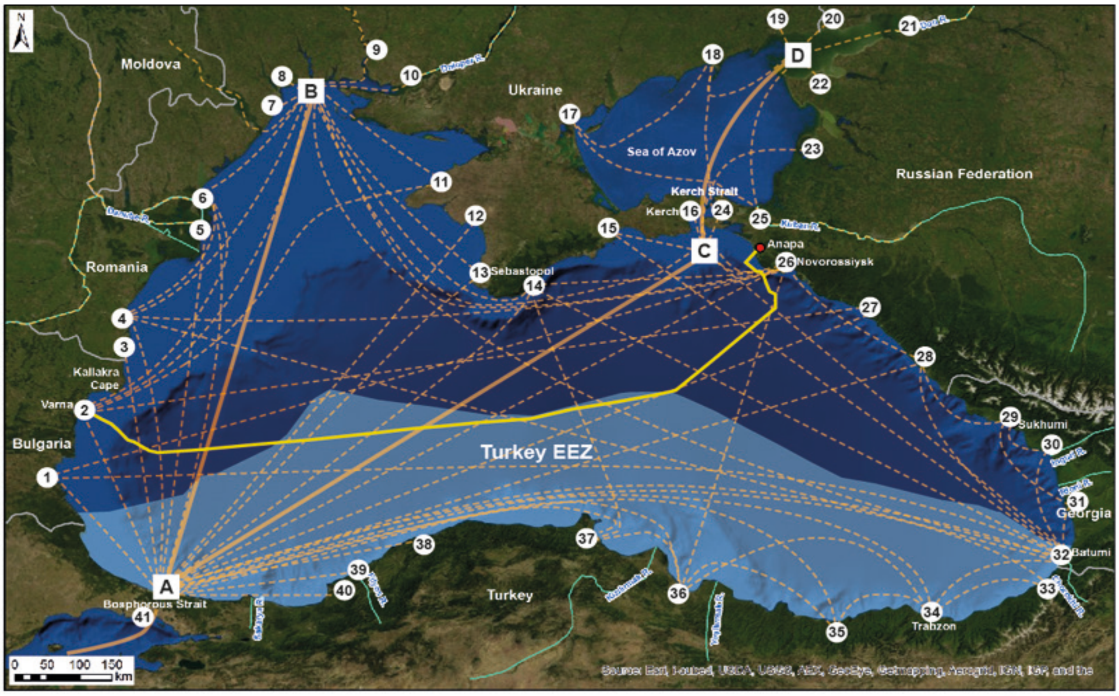


Figure 8.2: Shipping traffic through the Bosphorus Strait (January 2009 to April 2013) (Ref. 8.2)

There are several important port cities along Turkey's Black Sea coast including İstanbul, Zonguldak, Samsun, Trabzon and Rize. As illustrated in Figure 8.3, there are also a number of important ports in the neighbouring countries of the Black Sea. Within the Black Sea, maritime cargo transportation includes transport of containers, general cargo, liquid and dry bulk, roll-on roll-off (Ro-Ro) and rail ferry goods. (Ref. 8.3). The largest three ports along the Turkish Black Sea coast, measured in terms of total shipping capacity, are located in Giresun, Trabzon and Artvin.

[3]The Turkish Statistical Institute (TUIK) discontinued publishing data on provincial basis as of 2001. The latest statistics on GDP per capita dates back to 2001.
[4]Taxes-Subsidies presents third biggest share in GDP of Turkey. However, it has been ignored in the assessment as it is not an economic activity in its own right.



Key:

Pipeline

A: Bosporus shipping junction (Istanbul)
B: North western harbour agglomeration (Odessa)
C: Kerch Strait shipping junction
D: North eastern harbour agglomeration

1: Burgas
2: Varna
3: Mangala
4: Constantza
5: Sulina
6: Ust'-dunayski
7: Illichivsk
8: Odessa
9: Nikolayev
10: Kherson
11: Chemomorskoye
12: Evpatoria
13: Sevastopol
14: Yalta
15: Feodosia
16: Kerch
17: Genichesk
18: Berdyansk
19: Mariupol
20: Taganrog
21: Rostov-na-Donu
22: Yeysk
23: Primorsko-Akhtarsk
24: Port Kavkaz
25: Temryuk
26: Novorossiysk
27: Tuapse
28: Sochi
29: Sukhumi
30: Ochamchire
31: Poti
32: Batumi
33: Hopa
34: Trabzon
35: Giresun
36: Samsun
37: Sinop
38: Amasra (Bartin)
39: Zonguldak
40: Eregli
41: Istanbul

Figure 8.3: Shipping and Navigation Routes in Black Sea (Ref. 8.4)

Table 8.2: Major Ports along the Black Sea Coast in Turkey (Ref. 8.5)

Province	Port Name/Operator	Operator	Facility details/Services	Total Ship Capacity (ships/year)
Black Sea region coastal provinces				
Zonguldak	Erdemir Port (Kdz. Ereğli)	Ereğli Iron and Steel Factory Inc.	Bulk cargo ship, General cargo ship, Fuel tank, Chemical tanker, Container ship	1,100
Zonguldak	TTKZonguldak Port	TTK Port and Railway Operating Directorate	Bulk cargo ship, General cargo ship, Ro-Ro, Passenger ship	200
Zonguldak	KaradenizEreğli Municipality Port	Kdz. EreğliMunicipality	General cargo	60
Zonguldak	Erdem Cement Factory Port	Erdem Ereğli Cement Construction And Marine Industry Inc.	Bulk cargo	N.A.

Province	Port Name/Operator	Operator	Facility details/Services	Total Ship Capacity (ships/year)
Zonguldak	Eren Port	Eren Energy Electric Production Inc.	General cargo, Bulk cargo	N.A.
Bartin	Directorate of Bartin Port Operations	Public/Bartın Municipality	Cargo, Passenger transport, Bulk cargo, Container Waste reception facility: Domestic wastewater, bilge water, oily waste, slop disposal and domestic waste.	1,000
Bartin	Akkonak Pier (Amasra)	ALKAN Mining and Marble Industry	Bulk cargo, General cargo	N.A.
Kastamonu	İnebolu Port	Public/Inebolu Municipality	Bulk cargo, General cargo	720
Sinop	ÇakiroğluSinop Port	Çakıroğlu Sinop Port Management Inc.	Passenger / Express-passenger, Bulk cargo, General cargo, Ro-Ro Supply of potable water and electricity	400 ship/year
Sinop	Ayancik Pier(Sinop) (UstaburnuBarinaği)	Ayancık Municipality	Bulk cargo, general cargo	180
Samsun	Yeşilyurt Port	Yeşilyurt Iron and Steel Industry and Port Management Co. Ltd.	Bulk cargo, general cargo Supply of water and electric Waste reception facility: Domestic wastewater, bilge water, sludge, oily waste and domestic waste.	N.A.
Samsun	Samsunport	Samsun International Port Management	Passenger / Express-liners, Bulk cargo, General cargo, Ro-Ro Waste reception facility: Domestic wastewater, bilge water, oily waste and domestic waste.	N.A.
Samsun	Sürsan Port	Sürsan Aquatic Products Industry And Trade Inc.	Oil Tanker Wastewater reception facility	N.A.
Samsun	TorosTarim Samsun Port	Agriculture Industry and Trade Inc.	Bulk cargo, General cargo, Chemical tanker	N.A.
Ordu	ÇakiroğluOrdu Port	Private/Çakıroğlu Ordu Port Management Inc.	Bulk cargo, general cargo, chemical tanker Supply of potable water and electricity	365
Ordu	Ünye Port	Ünye Municipality	Bulk cargo, general cargo Waste reception facility: Domestic wastewater, bilge water, sludge, oily waste and domestic waste.	600
Ordu	Tügsaş Port	Turkey Fertilizer Ind. Inc.	Cargo	N.A.
Giresun	Çakiroğlu Giresun Port	Private/Çakıroğlu Giresun Port Management Inc.	Bulk cargo, general cargo, passenger ship Supply of potable water and electricity	1,400
Trabzon	Alport	Trabzon Port Management Inc.	Passenger / Express-passenger, Bulk cargo, General cargo, Ro-Ro, Container	2,300
Rize	Riport	Private/ Riport Rize Port Management Investment Inc.	Bulk cargo, general cargo, Ro-Ro, passenger ship, container Supply of water.	1,000

Province	Port Name/Operator	Operator	Facility details/Services	Total Ship Capacity (ships/year)
Artvin	Hopaport	Private/Park Maritime and Hopa Port Operations	Cargo, tank terminal, grain terminal, bulk cargo, general cargo, fuel tank. Waste reception facility: Domestic wastewater, bilge water, sludge, oily waste and domestic waste. Supply of potable and service water, electricity.	1,440

8.2 Economic Conditions in Fishing Activities

8.2.1 General Background

Black Sea fishery resources are shared by Bulgaria, Georgia, Romania, Russia, Ukraine and Turkey. The most populated country is Russia which is followed by Turkey and Ukraine. The total number of people living in the coastal cities of the Black Sea is approximately 16 million people, with the majority of these people living in the Ukraine and Turkey. These two countries each have a total Black Sea coastline length of 2,782 km and 1,329 km, respectively (Ref. 8.6).

As shown in Table 8.3, Turkey leads in the Black Sea fish production (296,519 tons), followed by Ukraine (40,416 tons) and Russia (18,555 tons) based on 2010 data (Ref. 8.7). Turkish fish production in the Black Sea represents 77.2 % of the overall Turkish sea fish production across the country.

Table 8.3: Comparison of Black Sea Countries Fish Catch

Data	Bulgaria	Georgia	Romania	Russia	Turkey	Ukraine
Total Population[1] (x 1,000)	7,389	4,389	21,861	143,618	72,138	46,050
Length of Black Sea Coast[2] (km)	354	310	225	800	1,329	2,782
Black Sea Fish Catch[3] (tons)	4,778	24,524	183	18,555	296,519	40,416
Black Sea Fish Catch (kg) per Capita (entire country population)	0.647	5.588	0.008	0.129	4.110	0.878

[1] Demographic data in 2010 (United Nations)

[2] Ref. 8.6

[3] 2010 data by General Fisheries Commission for the Mediterranean (GFCM)

As illustrated in Table 8.3, Turkish production accounts for the greatest share of fish production across all the Black Sea countries and this is due to a developed fisheries infrastructure, specific legal framework and a long tradition of fishing in that region. All fisheries and aquaculture activities are based on Fisheries Law No. 1380, enacted in 1971 and amended as Law No. 3288 in 1986. Foreigners are not allowed to take part in commercial fishing activities.

Both fishermen and their vessels must be licensed according to the Fisheries Laws. In 1997, all licensing was stopped for new fishing vessels. However, limited numbers of licenses were granted to fishing vessels for short periods in 1994, 1997 and 2001. Turkish fishing workers have not been authorised to expand their fleets since 2002, unless a vessel is being physically replaced by another. In this situation where a vessel is replaced, the maximum tolerated increase in length of vessel is 20%.

The Turkish Government has introduced several state aid measures to promote production in the fisheries sector including export refund for prepared and preserved fish, a tax relief scheme for diesel oil used in fishing vessels, aquaculture support scheme, and subsidised credit scheme for fishermen and fish farmers. Multilateral agreements and bilateral agreements have been signed to establish measures in relation to fisheries management (Table 8.4).

Table 8.4: Multilateral and bilateral agreements in relation to fisheries management

Commission/Country	Agreement
European Commission the Common Fisheries Policy (EU CFP)	COUNCIL REGULATION (EC) No 2371/2002 of 20 December 2002 on the Conservation and Sustainable Exploitation of Fisheries Resources Under The Common Fisheries Policy
Food and Agriculture Organization of the United Nations (FAO)	General Fisheries Commission for the Mediterranean (GFCM) European Inland Fisheries and Aquaculture Advisory Commission (EIFAAC)
General Fisheries Commission for the Mediterranean (GFCM)	Agreement For The Establishment Of The General Fisheries Commission For The Mediterranean
Organisation for Economic Co-operation and Development (OECD)	Introduction of Stock Assessment to the Fisheries Management System of Turkey
EUOROFISH International Organisation	Agreement For The Establishment Of The International Organisation For The Development Of Fisheries In Eastern & Central Europe
The International Commission for the Conservation of Atlantic Tunas (ICCAT)	The International Convention for the Conservation of Atlantic Tunas
European Inland Fisheries And Aquaculture Advisory Commission (EIFAAC)	EIFAAC Rules of Procedure as of 19 April 2012
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Convention on International Trade in Endangered Species
Ukraine	Agreement Between the Government of the Republic of Turkey and the Cabinet of Ministries of Ukraine on Cooperation in Fishery
Bulgaria	Agreement Between the Government of the Republic of Turkey and the Cabinet of Ministries of Bulgarian on accept and approve to commercial dispute
Romania	Agreement Between the Government of the Republic of Turkey and the Cabinet of Ministries of Romania on free trade agreement
Georgia	Central Asia and Caucasus Regional Fisheries and Aquaculture Commission Agreement
Yemen	Fisheries and Aquaculture Areas Technical, Scientific and Economic Co-operation: Memorandum of Understanding
Morocco	Agreement Between the Republic of Turkey and the Kingdom of Morocco on Cooperation in Marine Fisheries and Mariculture.

Under current Turkish fishing laws, Turkish fishermen can fish in all waters during the fishing season (between the months of September to April), for any species and can catch any quantity of fish. Exceptions to this apply within special closed sea areas and include restrictions on the use of certain fishing equipment in specific areas (as identified in the annual circular published by Ministry of Food, Agriculture and Livestock). Fishing is regulated based on the following criteria (Ref. 8.8):

- Minimum mesh size (i.e. trawl net 20 mm in the Black Sea and 22 mm other seas);
- Minimum fish size (length (cm) and/or weight (g));
- Closed area and terms for specified gears and/or vessels;

- Closed season and area;
- Species under full conservation (dolphin, seal, salmon, sea turtle, sponge, corals and sturgeons);
- Completely banned fishing methods and fishing gears;
- Gear restriction for identified species;
- Gear or fishing method restrictions; and
- Some restrictions concerning pollutants.

'Seasonal prohibition' is used to protect spawning stocks from the use of trawl and purse seiners between the months of May and August. In addition, 'zone restriction' refers at the prohibition of fishing within three miles from the coastline.

8.2.2 Fisheries Infrastructure

Information on the main fishing ports located along the Black Sea coast of Turkey is presented in Table 8.5.

Table 8.5: Fishing Ports along the Black Sea Coast of Turkey (Ref. 8.9)

Province	Fishery Port	Operator
Marmara Region coastal provinces		
İstanbul	Ağva Fishery Port	Public/Ağva Municipality (Ağva Fisheries Institution)
İstanbul	Şile Fishery Port	Public/Şile Municipality
İstanbul	Poyrazköy Fishery Port	Private/Örnek Fishery Cooperative
İstanbul	Karaburun Fishery Port	Public/Karaburun Village Mukhtar
Kırklareli	Kıyıköy Fishery Port	Private/Kıyıköy Fishery Cooperative
Kırklareli	İğneada Beğendikköyü Fishery Port	N.A.
Kocaeli	Kefken Fishery Port	Private/Kefken and Surrounding Villages Fishery Cooperative
Kocaeli	Bağırganlı Fishery Port	Private/Bağırganlı Village Fishery Cooperative
Black Sea region coastal provinces		
Düzce	Akçakoca Fishery Port	Private/Akçakoca Fishery Cooperative
Zonguldak	Hisarönü (Filyos) Fishery Port	Public/Ministry of Agriculture and Rural Affairs
Zonguldak	Kozlu Fishery Port	Public/Kozlu Municipality
Zonguldak	Ereğli (Bozhane) Fishery Port	Private/Bozhane Fishery Cooperative
Zonguldak	Alaplı Fishery Port	Private/Alaplı Fishery Cooperative
Bartın	Kurucaşile Fishery Port	Public/Kurucaşile Municipality
Bartın	Tarlaağzı Fishery Port	Private/Tarlaağzı and Gömü Villages Fishery Cooperative
Kastamonu	Çatalzeytin (Ginolu) Fishery Port	Public/Ministry of Agriculture and Rural Affairs
Kastamonu	Abana Fishery Port	Public/Abana Municipality
Kastamonu	Gemiciler (Evrenye) Fishery Port	Public/Gemiciler Village Mukhtar
Kastamonu	İneboluLimanı Fishery Port	Public/İnebolu Municipality
Kastamonu	Özlüce Fishery Port	Public/Ministry of Agriculture and Rural Affairs
Kastamonu	Doğanyurt Fishery Port	Public/Doğanyurt Municipality
Kastamonu	Cide Fishery Port	N.A.
Sinop	Gerze Fishery Port	Ministry of Agriculture and Rural Affairs
Sinop	Demirciköy Fishery Port	N.A.

Sinop	Ayancık-DenizcilerMahallesi (Çayiçi) Fishery Port	Public/Ayvancık Municipality
Sinop	Helaldı (Güzelkent) Fishery Port	Public/Ministry of Agriculture and Rural Affairs
Samsun	TermeYalıMahallesi Fishery Port	Private/Terme Fishery Cooperative
Samsun	DereköyBalıkçıBarınağı	Public/Ministry of Agriculture and Rural Affairs
Samsun	Samsun Fishery Port	Private/Ereğli-Çınarcık-Canik Town Fishery Cooperative
Samsun	Alaçam-Toplu-Göçkün Fishery Port	N.A.
Samsun	Yakakent Fishery Port	Private/Küplüağzı Village Fishery Cooperative
Ordu	Gülyalı Fishery Port	Public/Gülyalı Municipality
Ordu	EfirliKumbaşı Fishery Port	Private/BoztepeKumbaşıGüzelyalıKirazlimanıNeighborhood Fishery Cooperative
Ordu	Fatsa Fishery Port	Public/Fatsa Municipality
Ordu	Medreseönü Fishery Port	Private/Medreseönü Fishery Cooperative
Giresun	Görele Fishery Port	Public/Görele Municipality
Giresun	Tirebolu Fishery Port	N.A.
Giresun	Giresun LimanıMotorcu (Kumyalı) Fishery Port	Private/Giresun Fishery Cooperative
Giresun	Bulanacak Fishery Port	Individual Person
Trabzon	Of Fishery Port	Private/Of District Center and Eskipazar District Fishery Cooperative
Trabzon	Araklı Fishery Port	Private/Araklı Fishery Cooperative
Trabzon	Arsin Fishery Port	Arsin Municipality
Trabzon	Trabzon Motorcu (YüzüncüYıl) Fishery Port	N.A.
Trabzon	Akçaabat Fishery Port	Private/A. Merkez Fishery Cooperative
Trabzon	Yoroz Fishery Port	Private/Fener Village Fishery Cooperative
Trabzon	Vakfıkebir Fishery Port	Private/Büyükliman Fishery Cooperative
Rize	FındıklıYeniköy Fishery Port	Private/Fındıklı Fishery Cooperative
Rize	Ardeşen Fishery Port	Private/Ardeşen Fishery Cooperative
Rize	FındıklıYeniköy Fishery Port	Private/Fındıklı Fishery Cooperative
Rize	Pazar Kirazlık Fishery Port	Private/PazarKirazlık Fishery Cooperative
Rize	Çayeli Fishery Port	Individual person
Rize	İyidere Fishery Port	İyidere Municipality
Artvin	Hopa Fishery Port	Private/Park Maritime and Hopa Port Operations
Artvin	Kemalpaşa Fishery Port	Private/Hopa Fishery Cooperative
Artvin	Arhavi Fishery Port	Private/Arhavi Fishery Cooperative

N.A.: Not available

In 2012 there were 5,113 Turkish vessels operating in the Black Sea (Ref. 8.10). Artisanal vessels[5] accounted for approximately 86% and the remaining 14% are commercial vessels which include trawlers (6%), purse seiners (3%), multi-purpose vessels (3%) and carrier vessels (2%). A large proportion of the vessels is less than 10 m in length (80%) and under 10 Gross Tonnage (GT)

[5] A small-scale or artisanal fishery is usually understood to mean a fishery involving fishing households (as opposed to commercial companies), using relatively small amount of capital and energy, relatively small fishing vessels (if any), making short fishing trips, close to shore, with the catch being sold, bartered to traded mainly for local consumption (including that of the fishing households).

(83%). More than half (60%) of the vessels use engines less than 100 Horse Power (HP). A comparison of characteristics of the Black Sea fishing fleet is provided in Table 8.6 below.

Table 8.6: Comparison of Characteristics of the Black Sea Fishing Fleet in 2012 (Ref. 8.10)

Characteristic	Categories	No. of vessels	% of vessels
Operation type	Trawler (>12m)	289	5.7
	Trawl-purse seiner	158	3.1
	Purse Seiner (>12m)	181	3.5
	Carrier vessel	112	2.2
	Other vessel	4,373	85.5
Construction Material	Wood	4,638	90.7
	Metal	442	8.6
	Fiberglass	33	0.6
Tonnage (gross ton)	1-4	3,645	71.3
	5-9	610	11.9
	10-29	334	6.5
	30-49	146	2.9
	50-99	177	3.5
	100-199	119	2.3
	200+	82	1.6
Engine power (HP/kW)	1-9.9	1,367	26.7
	10-19.9	689	13.5
	20-49.9	979	19.1
	50-99.9	1,000	19.6
	100-199.9	489	9.6
	200-499.9	346	6.8
	500+	243	4.8
	Without engine	0	0.0
Length (m)	1 - 4.9	0	0.0
	5 - 7.9	2,758	53.9
	8-9.9	1,333	26.1
	10-11.9	217	4.2
	12-14.9	222	4.3
	15-1939	160	3.1
	20-29.9	276	5.4
	30-49.9	140	2.7
	50+	7	0.1
Total no. of vessels operating in the Black Sea	**5,113**		

Purse seiners, trawlers and carrier vessels constitute the majority of the total fish catch in Turkey. These vessels can be classified as industrial fishing vessels and main operation areas are the Black Sea and the Sea of Marmara whilst those in the Aegean Sea and the Mediterranean are small-scale types.

More than 90% of pelagic fish production in Turkish sea waters is performed by purse seiner[6] fishery. The purse seiner fishery is especially concentrated in the Black Sea and Marmara Sea. More than 90% of demersal fish production in Turkish sea waters is obtained from trawl fishery which is concentrated especially in Black Sea, Aegean Sea and Mediterranean in order of importance (Ref. 8.11).

8.2.3 Fishery Production Figures

Marine fisheries account for the largest proportion of fish production in Turkey. In 2011, total fishery production was reported as 703,545 tons, which consists of marine fisheries (61.4 %), aquaculture (26.8 %), inland fisheries (25.3 %) and other marine products such as crustaceans and molluscs (6.5 %) (Ref. 8.12).

Turkey's marine fishing regions are the Mediterranean Sea, the Black Sea, the Aegean Sea and the Sea of Marmara. Of these regions, the Black Sea accounts for the largest proportion of production. The fishing area of the Black Sea is divided into two sub-regions, the East and West Black Sea regions. The East Black Sea Region includes the coastal provinces from Artvin to Sinop, and the West Black Sea Region is comprised of coastal provinces from Kastamonu to Kırklareli.

Of the total marine catch (432,246 tons) in 2011, 77.2% was caught in the Black Sea (67.8% in the East Black Sea and 9.4 % in the West Black Sea), 8.4% in the Sea of Marmara, 7.2% in the Aegean Sea and 7.2% in the Mediterranean Sea (Ref. 8.12). In comparison to other Turkish seas, the East Black Sea is the most productive in terms of fisheries.

Turkey's Black Sea catch is composed of pelagic and demersal species, some of which are migratory species. The four small pelagic species of importance, both in terms of quantity caught and economic value, caught in the Turkish waters of the Black Sea are European anchovy, sprat, Black Sea horse mackerel and Atlantic bonito.

Turkey's Black Sea catch is dominated by European anchovy. In 2011, anchovy accounted for 52.9 % of the total catch of sea fish in Turkey and 61.5% of Turkey's total catch in the Black Sea (Ref. 8.12). Turkey's top 10 species (based on catch data from 2007 to 2011) in the Black Sea are shown in Table 8.7 below.

Table 8.7: Quantities of Fishery Products (Tons) Caught in the Black Sea Region, 2007 to 2011 (Ref. 8.12)

Common Name	Scientific name	Type	Turkish name	% of 2011 catch
European anchovy	*Engraulis encrasicolus*	Pelagic Migratory	Hamsi	61.5
Sprat	*Sprattus sprattus*	Pelagic Migratory	Çaça	26.0
Black Sea horse mackerel	*Trachurus mediterraneus ponticus*	Pelagic Migratory	Istavrit (Kraça)	4.3
Whiting	*Merlangius merlangus*	Demersal Migratory	Mezgit	2.4
Atlantic bonito	*Sarda sarda*	Pelagic Migratory	Palamut-Torik	2.0
Scad (Atlantic horse mackerel)	*Trachurus trachurus*	Pelagic Migratory	Istavrit (Karagöz)	1.0

[6]Purse seiners are used to capture large aggregations of pelagic fish that shoal in midwater or near the surface by surrounding these concentrations with a deep curtain of netting which is supported at the surface by floats. Small lead weights on the underside of the curtain ensure that the leadline quickly sinks and the net is then pursed under the shoal by heaving on a wire or purseline which runs through steel rings attached to the lower edge of the net.

Striped red Mullet	*Mullus surmuletus*	Demersal	Tekir	0.9
European pilchard	*Sardina pilchardus*	Pelagic	Sardalya	0.6
Bluefish	*Pomatomus saltator*	Pelagic Migratory	Lüfer	0.5
Grey mullet	*Mugil cephalus*	Demersal	Kefal	0.3

8.2.1 Economic Worth

In Turkey, the fisheries sector (including inland fisheries, aquaculture and secondary sectors such as processing and manufacturing) represents around 0.3% of Gross Domestic Product (GDP) and is not considered an important part of the national economy (Ref. 8.13). The contribution and importance of fisheries to the economies of the coastal provinces of the Black Sea is likely to be greater than that of the national economy. In 2011, the total value of marine fish products in Turkey was 927.9 million TL, of which marine fish products from the Black Sea accounted for approximately 57%. Table 8.8 presents the most valuable species caught in the Black Sea and their percentage of the total value of marine fisheries products in Turkey. European anchovy are the most important species in the Black Sea in terms of quantity caught and value of catch but despite this they represent less than 25% of the total value of marine fisheries products in Turkey.

Table 8.8: Top 10 species of the Black Sea by Economic Value (Ref. 8.12)

Species	Price (Turkish Lira (TL/Kg))	Value of species caught in Black Sea (TL)	% of total value of marine fisheries products in Turkey
European anchovy*	**	221.94 million***	23.9
Sprat	0.73	63.27 million	6.8
Atlantic bonito	8.05	54.14 million	5.8
Horse mackerel	3.75	53.97 million	5.8
Whiting	5.47	44.42 million	4.8
Striped red mullet	9.67	28.94 million	3.1
Bluefish	12.07	21.96 million	2.4
Scad (Atlantic horse mackerel)	4.65	15.58 million	1.7
Red mullet (*Mullus barbatus barbatus*)	17.46	5.69 million	0.6
Turbot (*Psetta maxima*)	35.23	5.09 million	0.5
Other species	-	13.69 million	44.6
Total value of Black Sea marine fish products		**528.83 million**	56.9
Total value of Turkey's marine fish products		**927.88 million**	

*Includes anchovy for fish meal and fish oil
** Price varies for anchovy and anchovy used for fish meal and fish oil
*** An approximate figure based on percentage of Anchovy caught in the Black Sea and total anchovy value

8.3 Employment Conditions in Fishing Activities

Fishing activities in the Turkish Black Sea involved 16,486 Turkish workers in 2011 which represents approximately 44% of the total workforce engaged in fisheries operations in Turkey as a whole (Ref 8.12). The workforce engaged in fisheries in these Black Sea coastal provinces (including

Istanbul) represents approximately 0.22% of total employment in this area. The national proportion of workers involved in fisheries is 0.16% (Ref. 8.10 and 8.12).

In Turkey, fishing is traditionally a profession passed down through the family, most commonly, from father to son. The majority of the fishery workers come from families that have traditionally worked in the fishing industry. The type of workers range from paid crew members on fishing vessels to partners and household members of fishers working without pay. Full time workers account for approximately 96% of fishers working in the Black Sea, 85% of which are between the ages of 20 and 55 years, 11% are above the age of 55 years and 4% are under the age of 20 years (Ref. 8.12). However, these employment figures do not necessarily include those involved in secondary activities such as processing, packaging, marketing and distribution, manufacturing of fish processing equipment, net and gear making, ice production and supply, boat construction and maintenance (Ref. 8.14). Approximately 17% of workers are unpaid household members or partners of the fishers and it is likely that some of these workers will be involved in secondary services such as cleaning and processing fish, but the exact numbers could not be determined. The Food and Agriculture Organisation of the United Nations assumes that for each person directly engaged in fisheries production globally in 2010 about three to four related jobs were generated in secondary activities (Ref. 8.14). Using this as a guide the number of workers involved in all aspects of the fishery sector in the Black Sea coastal provinces could be as many as approximately 65,000.

Information on employment conditions in fishing activities have been summarized in tables below, which show data obtained from Turkish Statistical Institute statistics for the year 2011. The information presented below includes:

- Number of fishery workers by sea products region (Table 8.9);
- Number of fishery workers by operating vessel type (Table 8.10);
- Distribution of fishery workers by age groups, working time and sea product (Table 8.11); and
- Distribution of fishery workers by age groups, working time and operating time (Table 8.12).

Table 8.9: Fisheries Workers by Productive (Sea) Region, 2011 (Ref. 8.12)

Fishery Workers	Total	East Black Sea	West Black Sea	Marmara	Aegean	Mediterranean
Total	***37,747***	***8,397***	***8,089***	***8,240***	***8,678***	***4,343***
Fisherman	12,271	2,287	1,846	2,295	4,188	1,655
Partners working unpaid	1,826	574	347	459	300	146
Household members working unpaid	3,594	698	596	799	1,217	284
Crew with payment	8,109	1,740	2,892	1,478	607	1,392
Crew working in exchange for share of fish caught	11,063	2,789	2,107	3,051	2,250	866
Partners household members working unpaid	726	298	200	133	95	-
Other	158	11	101	25	21	-

Table 8.10: Number of Fishery Workers by Operating Vessel Type, 2011 (Ref. 8.12)

Fishery Workers	Total	Trawler	Purseseiner	Trawler-Purseseiner	Carrier vessels	Other
Total	***37,747***	***3,996***	***8,720***	***2,752***	***288***	***21,991***
Fisherman	12,271	595	430	219	59	10,968

Fishery Workers	Total	Trawler	Purseseiner	Trawler-Purseseiner	Carrier vessels	Other
Partners working unpaid	1,826	198	333	93	18	1,184
Household members working unpaid	3,594	284	202	96	18	2,994
Crew with payment	8,109	1,264	3,751	1,232	94	1,768
Crew working in exchange for share of fish caught	11,063	1,535	3,629	995	94	4,810
Partners household members working unpaid	726	102	292	69	5	258
Other	158	18	83	48	-	9

Table 8.11: Distribution of Fishery Workers by Age Groups, Working Time and Sea Products Regions, 2011 (Ref. 8.12)

Regions of sea products	Total	Working time		Age groups					
				Under age 20		20-55		Over age 55	
		Full	Part	Full	Part	Full	Part	Full	Part
Total	***37,747***	***34,531***	***3,216***	***1,133***	***103***	***29,389***	***2,625***	***4,009***	***488***
East Black Sea	8,397	7,830	567	284	4	6,652	415	894	148
West Black Sea	8,089	7,910	179	354	10	6,691	108	865	61
Marmara	8,240	6,743	1,497	217	38	5,580	1,379	946	80
Aegean	8,678	7,751	927	125	51	6,477	677	1,149	199
Mediterranean	4,343	4,297	46	153	-	3,989	46	155	-

Table 8.12: Distribution of Fishery Workers by Age Groups, Working Time and Operating Type, 2011 (Ref. 8.12)

Operating Type	Total	Working time		Age groups					
				Under age 20		20-55		Over age 55	
		Full	Part	Full	Part	Full	Part	Full	Part
Total	***37,747***	***34,531***	***3,216***	***1,133***	***103***	***29,389***	***2,625***	***4,009***	***488***
Trawler	3,996	3,621	375	210	11	3,253	362	158	2
Purse Seiner	8,720	8,122	598	287	9	7,520	574	315	15
Trawler-Purse Seiner	2,752	2,715	37	113	-	2,458	36	144	1
Carrier vessels	288	217	71	4	-	199	61	14	10
Other	21.991	19,856	2,135	519	83	15,959	1,592	3,378	460

8.4 Impacts of the Project on Fishing

Due to the location and nature of the Project, the Turkish fishing industry is very unlikely to be impacted by the construction or operation of the Pipeline.

The Project Area of the Turkish Sector of the Pipeline is located in the far north of the Turkish EEZ and at a minimum distance of 110 km from the Turkish Black Sea coastline. Turkish fishing fleets, especially artisanal fishing fleets but also commercial fishing fleets, catch their target species almost exclusively between the coastline and the 200 m isobath and therefore 50 km or less off the Turkish coast. As such, Turkish fishing vessels will not intersect with the Project Area either during either the Construction or Operational Phases.

During the Construction and Pre-commissioning Phase, it is also very unlikely that the Project will impact on migration patterns of species targeted by the Turkish Black Sea fishing industry. For most species, the main feeding and spawning grounds are in the shallow water areas and seasonal migrations are either around the Black Sea, in these shallower waters, as for example in the case of horse mackerel and bonito, or inshore and offshore in the case of sprat. Thus the Construction and Pre-Commissioning Phases of the Project in the Turkish EEZ will not interfere with these seasonal migrations.

The one exception to this is the European anchovy whose migration intersects the Project Area twice per year. Firstly, the fish migrate from the north-western and western continental shelf of the Black Sea during October-November to wintering grounds off the coast of Anatolia and Georgia. Secondly, there is then a return migration across the sea to the north-west in the spring. Even if the timing of a migration by the European anchovy does intersect with construction activity, the physical extent of the construction activity (i.e. the construction vessel spread) and the degree to which fish might avoid the activity, is relatively narrow compared to the likely width of the migration corridor which may extend around 125 km in width across the Turkish EEZ. As such, it is unlikely that the migration would be disturbed. Any potential disturbance would be temporary and highly localised. As such, it is not expected that there will be any impact on the catch levels achieved by the Turkish fishing industry or on the level of effort that they need to expend in order to maintain existing catch levels. Therefore, fisheries are very unlikely to be impacted by construction of the Project. For further information on migratory patterns of fish species in the Turkish Black Sea and potential impacts of Project construction activities, refer to **Section 6.4 Fishing and Aquatic Products** and **Section 7.3.1.1 Impact of Construction on Fish.**

Appendix 7.A has confirmed that there will be no impact from the operation of the Project on fish migration patterns. As such, it is considered that there will be no impact on the Turkish fishing industry in the Operational Phase of the Project.

8.5 Cultural Heritage and Archaeology

The archaeology of the Black Sea basin reflects a mix of European, Anatolian and Eurasian steppe cultures. The Black Sea coast was occupied during the Middle and Upper Paleolithic when it served as a conduit for interactions between Eastern Europe and the Caucasus. The coastal plain of the Black Sea was believed to be significantly broader at that time since its water level was approximately 150 m below recent levels. It is believed that agricultural villages appeared along the southern and western coasts in the sixth or fifth millennium B.C. Ceramic and metals from the Bulgarian and Turkish coasts indicate coastal interaction, possibly through seafaring during the fourth millennium B.C. The Bronze Age followed this period and was a period of intense occupation of mainly agricultural villages and pastoral nomadic encampments along various parts of the Black Sea coast. The distribution of Bronze Age artefacts in the third and second millennium B.C. in regions surrounding the Black Sea basin suggests an active trade network (Ref. 8.15).

The Black Sea became a major crossroad of the ancient world with the advent of Greek colonisation in the period 800 to 700 B.C. Seafaring economies participated in trade from the central southern Black Sea coast to the Crimea. This north-south commerce is documented by finds of significant quantities of amphorae and tiles manufactured at Sinop, Turkey at settlements along the northern-central coast of the Turkish Black Sea (Ref. 8.15). The coastal geology and submerged cultural landscape of the Black Sea have documented numerous ancient shipwrecks off the coasts of Bulgaria, Turkey, and Ukraine, dating back as early as the Hellenistic period (Ref 8.16).

8.5.1 Cultural Heritage and Archaeology in the Turkish EEZ

As a result of the anoxic conditions in the Black Sea, which inhibit corrosion and microbial degradation, the preservation potential for any cultural heritage object is greatly enhanced below a water depth of 120-200 m. As such, it is likely that any remains from wooden vessels have been well preserved.

The potential cultural heritage objects within the Project Area and mitigation measures are discussed in **Section 6.10 Cultural Assets** and **Section 6.11 Cultural Asset Surveys in the Project Area** of this EIA Report.

8.6 Population

The total population of Turkey in 2012 was 75.63 million of which 50.2% were male and 49.8% were female (Ref. 8.18).

The Black Sea coastal provinces of Istanbul, Kocaeli and Samsun have the highest population of all the provinces on the Black Sea coast. Istanbul has a population of 13.85 million and also has the highest population of any province in Turkey, accounting for approximately 18% of the total Turkish population. The other three Black Sea coastal provinces in the Marmara Region (Kirklareli, Kocaeli and Sakarya) account for just under 4% of the total Turkish population, while the 11 Black Sea coastal provinces in the Black Sea Region constitute just over 7% of the total Turkish population. In total, the 15 Black Sea coastal provinces constitute just over 30% of the total population of Turkey. Between 2007 and 2012, the population density of Turkey has increased from 92 to 98 persons per km^2 (Ref. 8.18).

Population data for Turkey and the Black Sea coastal provinces for the year 2012, including density, are given in Table 8.13. In the Marmara Region, the provinces of Istanbul, Kocaeli, Sakarya, and in the Black Sea Region, the provinces of Düzce, Zonguldak, Samsun, Ordu, and Trabzon, have a population density that is greater than the average for Turkey. In Kastamonu, Sinop, and Artvin however, the population density is lower in comparison to the average for Turkey and other Black Sea coastal provinces. Sinop, the province closest to the Pipeline route, has the third lowest population density of all of the Black Sea coastal provinces.

Table 8.13: Population, 2012 (Ref. 8.18)

Province	Population	Proportion of total Turkish population (%)	Population density (person per km^2)
Marmara Region coastal provinces			
Kirklareli	341,218	0.5	54
Istanbul	13,854,740	18.3	2,666
Kocaeli	1,634,691	2.2	453
Sakarya	902,267	1.2	186
Black Sea Region coastal provinces			
Düzce	346,493	0.5	135
Zonguldak	606,527	0.8	184
Bartın	188,436	0.2	91
Kastamonu	359,808	0.5	27
Sinop	201,311	0.3	35
Samsun	1,251,722	1.7	138
Ordu	741,371	1.0	125
Giresun	419,555	0.6	61

Province	Population	Proportion of total Turkish population (%)	Population density (person per km²)
Trabzon	757,898	1.0	162
Rize	324,152	0.4	83
Artvin	167,082	0.2	23
Black Sea coastal provinces total	**22,949,592**	**30.3**	
TURKEY	**75,627,384**	**100**	**98**

Over the five year period to 2012, the national population has grown at an average of 1.39% per annum. There is however a distinct difference between the averages for the coastal provinces in the Marmara and Black Sea regions respectively, with the former displaying a cumulative population growth rate over the five year period more than five times higher than the latter (refer to Table 8.20). One notable exception is the province of Düzce, which borders on the Marmara Region, where the population has increased by a total of 6.97% over the same five year period (Ref. 8.18).

Table 8.14: Population Growth Rate Per Annum (Ref. 8.18)

Provincial Grouping	2008	2009	2010	2011	2012	Total 2008 to 2012
Marmara Region coastal provinces – average	1.29%	1.67%	2.49%	2.70%	1.69%	9.84%
Black Sea Region coastal provinces - average	0.70%	0.87%	-0.02%	-0.22%	0.51%	1.84%
Turkey (total)	**1.32%**	**1.46%**	**1.60%**	**1.36%**	**1.21%**	**6.95%**

One reason contributing to the slower overall rate of population growth in the Black Sea Region coastal provinces over the last five years is that most of the provinces have experienced a negative net migration, or only relatively low levels of positive net migration. This stands in contrast to the four Marmara Region coastal provinces, particularly Istanbul, Kocaeli and Sakarya provinces, which have experienced a consistently positive net in-migration. Once again, Düzce province stands out as an exception to this pattern. The net migration numbers of the Black Sea coastal provinces are presented in Table 8.15.

Table 8.15: Total Net Migration, 1975 to 2012[7] (Ref. 8.19)

Province	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	Total 2007-8 to 2011-12
Marmara Region coastal provinces						
İstanbul	26,675	39,481	102,583	121,782	30,461	877
Kırklareli	- 462	- 883	756	150	1,316	320,982
Kocaeli	23,018	12,033	15,124	13,244	11,405	74,824
Sakarya	3,434	3,711	1,621	3,904	4,670	17,340
Black Sea Region coastal provinces						
Düzce	1,810	2,706	927	574	-147	5,870

[7]Data covers migration between provinces in the Region that not provide overall migration of Provinces in Black Sea Coast

Province	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	Total 2007-8 to 2011-12
Zonguldak	- 1,891	- 4,443	- 7,555	- 7,836	-8,408	-30,133
Bartın	2,093	462	- 957	- 1,059	-185	354
Kastamonu	772	- 1,523	- 1,611	- 459	407	-2,414
Sinop	827	4	1,060	- 580	-2,094	-783
Samsun	- 5,229	- 707	- 9,407	- 8,305	-9,312	-32,960
Ordu	- 3,739	- 961	- 8,345	- 10,509	21,645	-1,909
Giresun	1,550	- 2,597	- 3,040	- 2,288	166	-6,209
Trabzon	- 1,109	10,394	- 7,416	- 13,588	-3,614	-15,333
Rize	- 572	- 2,147	- 1,749	- 2	-1,541	-6,011
Artvin	- 1,960	- 1,341	- 873	0	-326	-4,500

Due to the nature of the Project and its offshore location, no impacts on demographics are expected.

8.7 Employment

In Turkey the population aged 15 years and above constitutes 55.64 million. In 2011, the national labour force participation rate was 47.5% and the national unemployment rate was 7.9% (Ref. 8.20). One reason explaining the overall low labour force participation rate in Turkey is the low participation of the female population in the labour force.

The basic labour force indicators by province for the Black Sea coastal provinces in 2011 are provided in Table 8.16 below. The unemployment rate of eight Black Sea coastal provinces, namely Düzce, Zonguldak, Bartın, Kastamonu, Sinop, Ordu, Trabzon, and Artvin, is lower than the Turkey average unemployment rate of 7.9%. The remaining seven provinces: İstanbul, Kırklareli, Kocaeli, Sakarya, Samsun, Giresun, and Rize, are above the Turkey average. All four coastal provinces in the Marmara Region (İstanbul, Kırklareli, Kocaeli, Sakarya) have an unemployment rate above the average unemployment rate for Turkey.

Table 8.16: Basic labour force indicators by province, 2011 (Ref. 8.20)

Province (Ordered by unemployment rate, highest to lowest)	**Population 15 years of age and over**	**Labour force participation (%)**	**Unemployment rate (%)**
Rize	252,653	47.6	10.5
Kocaeli	1,208	45.9	9.5
Sakarya	678	45.5	8.8
Kırklareli	284	54.0	8.4
İstanbul	10,368	48.1	8.4
Giresun	335,802	49.6	8.3
Samsun	959,871	49.2	8.0
TURKEY total / average	**55,639,152**	**47.5**	**7.9**
Düzce	262,024	53.6	7.8
Trabzon	592,274	51.4	7.8
Zonguldak	488,275	48.7	7.3
Bartın	150,440	49.0	6.9
Artvin	133,984	58.3	6.0

Province (Ordered by unemployment rate, highest to lowest)	**Population 15 years of age and over**	**Labour force participation (%)**	**Unemployment rate (%)**
Ordu	550,570	54.2	5.4
Sinop	163,585	49.6	4.9
Kastamonu	292,054	55.2	3.5

In Turkey, of those who are employed, 23.7% are employed in agriculture, 27.2% are employed in industry and 50.1% are employed in the services sector. Similar to national trends, the services sector is the main line of work for most Black Sea coastal provinces including Istanbul. Agriculture, however, comprises a greater part of the employment activities with rates of 46.1%, 48.8% and 52.8% in Giresun, Ordu, Kastamonu, and provinces, respectively. The distribution of employed population and rates by economic activity in Turkey and the Black Sea coastal provinces is provided in Table 8.17. Nationally, workers in the fishery sector which is a subset of the agricultural sector figures given above, account for approximately 0.7% of those employed in the agriculture sector and 0.16% of the total employed population (Ref. 8.20). Full details are provided in Table 8.17.

Table 8.17: Employed population and rates by economic activity, 2011* (Ref. 8.20)

Province	**Employed**	**Agriculture**	**Industry**	**Services**	**Agriculture (%)**	**Industry (%)**	**Services (%)**
Marmara Region coastal provinces							
Istanbul	4,565,000	31,000	1,677,000	2,857,000	0.7	36.7	62.6
Kırklareli	140,000	35,000	43,000	62,000	25.0	31.0	44.0
Kocaeli	502,000	22,000	221,000	258,000	4.4	44.1	51.5
Sakarya	281,000	71,000	89,000	121,000	25.2	31.7	43.2
Black Sea Region coastal provinces							
Düzce	130,000	42,000	43,000	45,000	32.1	33.3	34.6
Zonguldak	220,000	58,000	67,000	96,000	26.2	30.4	43.5
Bartın	69,000	25.000	18,000	26,000	36.3	26.5	37.2
Kastamonu	156,000	82.000	20,000	54,000	52.8	12.7	34.5
Sinop	77,000	27.000	20,000	30,000	35.2	26.0	38.8
Samsun	434,000	169.000	90,000	175,000	38.9	20.8	40.3
Ordu	282,000	138.000	57,000	88,000	48.8	20.1	31.1
Giresun	153,000	70.000	26,000	56,000	46.1	17.0	37.0
Trabzon	281,000	103.000	55,000	123,000	36.7	19.5	43.8
Rize	108,000	39.000	26,000	43,000	36.3	23.8	39.9
Artvin	73,000	29.000	11,000	33,000	40.1	14.7	45.2
TURKEY	**24,320,000**	**5,531,000**	**6,605,000**	**12,184,000**	**22.7**	**27.2**	**50.1**

*Population 15 years of age and over.

The work in the Turkish Sector pertains to offshore pipe laying. Although the exact number of workers required for the Construction and Pre-Commissioning Phase of the Project is not known at the time of writing this EIA Report, the maximum number of workers anticipated to be working on the Project during the peak of construction activity is approximately 1000 people. Personnel employed during the Construction and Pre-Commissioning Phase will be supplied by the offshore construction contractor. Given this, and the specialised skills which will be required to perform the construction activities, Project employment benefits in Turkey are expected to be minimal.

8.8 Education

The national education system in Turkey consists of pre-primary education (preschools; age 3 to 5), primary education (primary schools and lower secondary schools; age 6 to 13), upper secondary education (high schools or vocational and technical schools; age 14 to 17) and higher education (age 18+). It is reported for the 2012 to 2013 education year that there are 27,197 preschools, 29,169 primary schools, 16,987 lower secondary schools, 4,214 high schools and 6,204 vocational and technical secondary education institutions in Turkey (Ref. 8.21).

Within the Black Sea coastal provinces, educational services are provided in a total of 5,817 preschools, 4,743 primary schools, 3,641 lower secondary school, 1,151 general secondary education institutions and 1.612 vocational and technical secondary education institutions (Ref. 8.21). Consequently, the Black Sea coastal provinces comprise 20% of the total number of education institutions in Turkey.

Schooling ratios[8], expressed as a percentage, for primary and secondary education in the Black Sea coastal provinces based on the 2012 to 2013 education year are shown in Table 8.18. The overall education levels in eight of the Black Sea coastal provinces, namely Istanbul, Kocaeli, Sakarya, Zonguldak, Kastamonu, Sinop, Samsun and Artvin, are higher than Turkey's national average of participation in school. The participation of primary school age students in these provinces is almost 100%, which is also higher than the national average. Furthermore, even though schooling rates fall as the education levels go higher, even in secondary education, the net participation rates of students in almost all Black Sea coastal provinces (except for Ordu) are higher than that national average, both across genders and in total.

Table 8.18: Schooling Ratios (%) of 2012-2013 education year (Ref. 8.21)

	Primary School		Lower Secondary School		Upper Secondary School	
Province	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
Marmara Region coastal provinces						
Istanbul	99.52	99.58	95.50	95.19	72.74	74.78
Kırklareli	97.66	98.81	95.19	95.72	86.87	83.64
Kocaeli	99.34	99.50	96.81	96.55	81.41	80.42
Sakarya	99.05	99.27	95.80	95.47	78.07	75.67
Black Sea Region coastal provinces						
Düzce	98.78	98.98	95.91	95.87	78.04	75.32
Zonguldak	99.51	99.98	98.10	98.25	82.98	78.12
Bartın	99.52	99.17	96.94	97.76	82.52	77.11
Kastamonu	99.33	99.72	96.55	95.90	79.56	73.38
Sinop	99.20	99.61	95.29	94.49	80.17	76.97
Samsun	99.84	99.88	96.47	96.11	73.73	73.58
Ordu	94.78	94.86	91.34	91.72	69.58	69.52
Giresun	98.76	98.81	94.93	94.98	88.30	82.19
Trabzon	98.74	99.06	96.09	95.40	83.93	83.22
Rize	98.30	98.68	97.21	96.14	94.74	90.05
Artvin	99.91	99.73	96.49	95.75	86.90	86.55

[8] That is, the percentage of children of a given age that are enrolled in school.

	Primary School		Lower Secondary School		Upper Secondary School	
Province	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
TURKEY	**98.81**	**98.92**	**93.19**	**92.98**	**70.77**	**69.31**

The educational levels in the Black Sea coastal provinces are generally parallel to the education levels across Turkey, with the exception of İstanbul province. In İstanbul, the illiteracy rate is lower and the proportion of the workforce with a higher education qualification is higher than the average across Turkey. Figure 8.4 shows the education levels for Turkey, İstanbul and the other Black Sea coastal provinces.

Every Black Sea coastal province has at least one university. There are a total of 69 state and private universities in the Black Sea coastal provinces. However, the majority (52) are concentrated in the İstanbul province (Ref. 8.22).

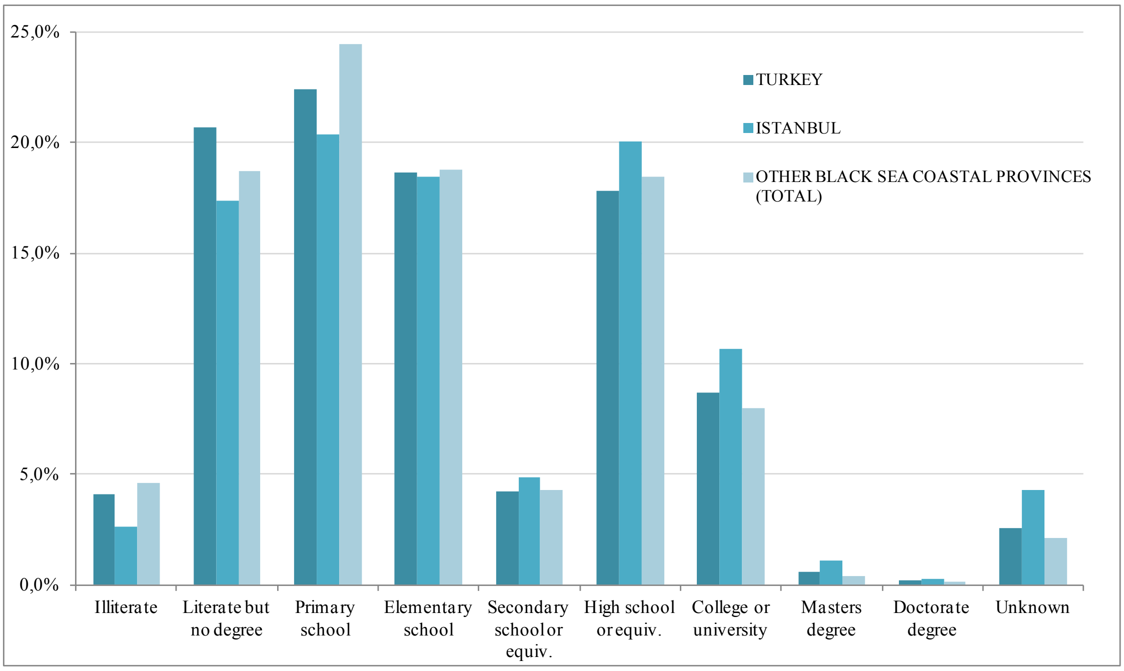


Figure 8.4: Comparison of Educational Levels of Turkey, Istanbul and Other Black Sea Provinces (2012)
(Note: Data from Ref. 8.21)

The Project will have no impacts on levels of education, or education infrastructure and services, in Turkey.

8.9 Health

In recent years, the provision of public and private sector healthcare has been increasing significantly. As of 2011, the number of hospitals and total number of beds were 1,410 and 188,047, respectively. The number of hospital beds per 1,000 population was 2.52 as of 2011 (Ref. 8.23).

Across the Black Sea coastal provinces, there are 401 hospitals including 187 government (i.e. Ministry of Health) hospitals, 15 university hospitals, 198 private hospitals and 1 other public hospital. These hospitals together provide 52,474 hospital beds. Table 8.19 below summarises the number of hospitals by hospital type, as well as number of hospital beds available in the Black Sea coastal provinces. The number of hospital beds per 1,000 population across all of the Black Sea coastal provinces (2.42) appears to be marginally lower than the national average.

Table 8.19: Number of Hospitals (Based on Hospital Type) and Hospital Beds in the Black Sea Coastal Provinces and Turkey, 2011 (Ref. 8.23)

Provinces	Number of Hospitals/Beds						
	Ministry of Health	University	Private	Other Public	Total Number of Hospitals	Total Number of Hospital Beds	Number of Hospital Beds per 1000 Population
Marmara Region coastal provinces							
İstanbul	52	9	152	1	214	30,219	2.23
Kırklareli	5	0	3	0	8	783	2.30
Kocaeli	10	1	12	0	23	3,510	2.20
Sakarya	13	0	6	0	19	1,509	1.70
Black Sea Region coastal provinces							
Düzce	2	1	1	0	4	663	1.94
Zonguldak	8	1	2	0	11	2,038	3.32
Bartın	2	0	0	0	2	417	2.23
Kastamonu	14	0	3	0	17	1,104	3.06
Sinop	6	0	0	0	6	500	2.46
Samsun	19	1	8	0	28	4,066	3.25
Ordu	13	0	5	0	18	1,934	2.71
Giresun	12	1	2	0	15	1,258	2.99
Trabzon	17	1	3	0	21	3,012	3.97
Rize	6	0	1	0	7	1,012	3.14
Artvin	8	0	0	0	8	449	2.70
Black Sea coastal provinces Total	**187**	**15**	**198**	**1**	**401**	**52474**	**2,42**
TURKEY	**840**	**65**	**503**	**2**	**1,410**	**188,047**	**2.52**

Note: Military hospitals are not included.

The number of patients per healthcare practitioner (doctors, dentists and nurses) in each Black Sea coastal province is shown in Table 8.20 below. The table shows that provision rates for health care are notably lower in most Black Sea coastal provinces, including Kırklareli, Sakarya, Bartın, Kastamonu, Sinop, Ordu, Giresun and Artvin, compared to the national average.

Table 8.20: Number of Patients per Healthcare Personnel, 2011 (Ref. 8.24)

Provinces	Number of Patients per Healthcare Personnel		
	Number of patients per doctor	Number of patients per dentist	Number of patients per nurse
Marmara Region coastal provinces			
İstanbul	530	2,538	681
Kırklareli	793	4,011	787
Kocaeli	661	3,352	613
Sakarya	795	3,490	809
Black Sea Region coastal provinces			

Provinces	Number of Patients per Healthcare Personnel		
	Number of patients per doctor	Number of patients per dentist	Number of patients per nurse
Düzce	557	4,504	587
Zonguldak	570	4,240	514
Bartın	847	5,347	564
Kastamonu	738	4,684	471
Sinop	820	4,419	523
Samsun	518	2,849	494
Ordu	805	5,893	570
Giresun	763	5,839	473
Trabzon	449	3,770	316
Rize	640	3,748	478
Artvin	732	4,888	498
Black Sea coastal provinces - Average	**681**	**4,238**	**558**
TURKEY Average	**587**	**3,505**	**592**

No Project impacts are expected on health infrastructure or services in Turkey.

8.10 Industry

An overview of the status of industrial development in the Black Sea coastal provinces is provided in Table 8.21 below (for information related to fishing, refer to Sections 8.2 and 8.3). The western part of the Black Sea coast, especially the neighbouring provinces of İstanbul and Kocaeli, are important centres in Turkey in terms of manufacturing industry. Towards the western part of the Black Sea coast, especially the Zonguldak area, is a centre of coal mining and heavy industry. In the eastern part of the Black Sea coast, the Samsun area is a major tobacco-growing region and manufacturer of tobacco products. Further east, Trabzon and Rize provinces are world-renowned for production of hazelnuts and have numerous tea plantations, and therefore, the hazelnut and tea processing industries prevail in this area.

Table 8.21: Industry in the Black Sea coastal provinces (Ref. 8.25)

Province	Labour Force Employed in Industry Sector, 2011 (%)	Industrial Development
Marmara Region coastal provinces		
Istanbul	36.7	İstanbul is the leading city in Turkey, economically. It provides employment opportunities for 32% of Turkey's total working population, hosts 55% of total trade activities in Turkey, has 38% of the manufacturing plants in Turkey and accounts for 43% of Turkey's total international trade volume. Non-agricultural employment's share in total employment in İstanbul is 92%. Manufacturing industry has a 32% share; business industry has a 19% share and services industry has a 35% share. Industrial plants in İstanbul generally concentrate in small-scale industrial zones and organised industrial zones. There are three large organised industrial zones within the borders of the province: Tuzla Organized Leather Industry, İkitelli Organized Industrial Zone and Dudullu Organized Industrial Zone. Additionally, a total of 101 small-scale industrial zones are scattered throughout İstanbul. Industrial zones contain plants operating in various industries including especially ready-to-wear clothing, metals and textile. İstanbul is rich natural resources. Some of these resources are directly used to meet the needs of the province, whereas other industrial raw materials including glass sand,

Province	Labour Force Employed in Industry Sector, 2011 (%)	Industrial Development
		moulding sand, ceramic sand, ceramic clay and bentonite are utilised by industrial companies throughout the country and also exported to other countries from time to time. On the other hand, lignite coal extracted along the coastal corridor extending from Şile to Karaburun is still used to meet the energy needs of the region to a certain extent.
Kirklareli	44.0	There are a total of 269 manufacturing plants in Kırklareli. 87.5% of these plants are located in the city center and Babaeski and Lüleburgaz districts, and 12.5 % is located in other districts. Some of the important plants which operate in glass, textile, pharmaceuticals and food industries are found in Kırklareli. The province has four small-scale industrial zones and one organised industrial zone. There are lignite mines with an average depth of 150 to 350 meters. There are 23 companies that are licensed in the province to perform exploratory drilling for lignite mining.
Kocaeli	51.5	Eighty-four of the top 500 companies in Turkey are located in Kocaeli. 2.82% of the consumer goods, 22.3% of the intermediary goods and 10.23% of investment goods in Turkey are manufactured in Kocaeli. Kocaeli was the second province with an export rate above 1 billion dollars in 2011. The province has 13 Organized Industrial Zones and seven small-scale industrial zones.
Sakarya	43.2	Automotive, textile and food industries are especially developed in the province. Giant companies in the automotive industry such as Toyota, Otoyol, Otokar and Tırsan have made important investments in Düzce. There are distinct Organized Industrial Zones in three districts. The province also has 13 Small-Scale Organized Industrial Zones.
Black Sea Region coastal provinces		
Düzce	34.6	Düzce Organized Industrial Zone No. 1 includes plants belonging to many industries and especially textile, rubber, machinery, furniture, automotive supplies industries. The industrial branches prevalent in Düzce Organized Industrial Zone No. 2 are aluminium profile, furniture, electrical materials and especially glass. There are also small-scale industrial zones in the province.
Zonguldak	43.5	Coal mining in Zonguldak has been continuing for more than 170 years and thus the economy of the city relies largely on coal and coal-based industries. The most important coal mines in Turkey are in Zonguldak and there are four active coal mining enterprises (Armutçuk, Kozlu, Üzülmez, Karadon) in the province. Additionally, there are 81 licensed stone quarries and 44 licensed sand-gravel quarries in Zonguldak. There are four organised industrial zones in the province – one in the planning phase. A recent rising industry in Zonguldak is shipbuilding.
Bartın	37.2	Bartın's economy is mostly dependent on coal and the only enterprise that operates in this industry is Amasra Coal Enterprise (Amasra TaşkömürüİŞletmesi). Other important industries in the province are; textile, ready-to-wear clothing, chemical products, coal and plastic industry, stone- and earth-based industries, forestry products and furniture, and food industry. There is one organised industrial zone and 39 licensed sand-gravel and stone-earth quarries.
Kastamonu	34.5	Kastamonu does not have a very well developed manufacturing industry, but the major plants in the province are: a sugar refinery, two particleboard factories, a copper concentrate plant and a cigarette rolling paper plant.
Sinop	38.8	Sinop does not have a very well developed manufacturing industry. The industry that is present is based on manufacturing, agriculture, animal husbandry and mining. The province is relatively more developed in industries based on forestry, fishery, stone-earth and animal products. Approximately 90 % of the industrial businesses are small and medium sized industrial enterprises. There are five industrial zones in the province.
Samsun	40.3	Samsun is an industrial province and owing toits geographical characteristics, its economy has a strong reliance on agricultural production. Apart from a copper, fertilizer and tobacco factories, the other manufacturing industries that are prevalent in Samsun are the food and beverage industry, base metal industry, machine and equipment industry, timber and furniture industry and herbal production industries. There are a total of 16 small-scale industrial zones in the province: 5 in the provincial city of Samsun and 11 in towns.
Ordu	31.1	There are five small-scaled industrial zones and three organised industrial zones in the province.

Province	Labour Force Employed in Industry Sector, 2011 (%)	Industrial Development
Giresun	37.0	The most important branch of manufacturing industry in Giresun is agriculture industry. Hazelnut and tea enterprises are scattered along the coastal towns. Currently 61 enterprises are in operation in the food industry branch, which is composed mostly of small sized tea and hazelnut processing factories.
Trabzon	43.8	There are scarcely any large-scale manufacturing plants in the province. The most important manufacturing plant is a cement plant privatised in 1992. The manufacturing industry in the province is largely related to agriculture (e.g. tea and hazelnuts) and is largely made up of small and medium sized enterprises. Other items manufactured in the plants throughout the province include flour & bran, dairy products, fish oil & fish meal, ready-to-wear clothing, furnishing products, shoes, timber, rock dust, aggregate, concrete pillar, rubber and plastic products, PVC pipes, copper, zinc, lead, aluminium, lead products, pipes, galvanized sheet, brick, metal, automotive supply products and surgical suture materials.
Rize	39.9	The Province's climate characteristics are suitable for growing tea plants and the province's manufacturing industry is mostly based on tea processing. Apart from the tea processing and packaging plants in the province, there are also fish quick-freezing plants, sawmills, parquet production plants, concrete and ready-mixed concrete plants.
Artvin	45.2	In Artvin province, the economy mostly relies on agriculture and services industries, and partially on business industry. Manufacturing industry's input to the economy of Artvin is extremely low. Companies operating in the manufacturing industry focus mostly on animal products and then food, mining and forestry products, in an attempt to utilise the natural resources potential of the city. The key feature of the companies operating in the manufacturing industry is their being small and medium sized enterprises.

The Project is expected to have no impacts on industries in Turkey.

8.11 Economic Life of the Project

The expected service lifetime of the South Stream Offshore Natural Gas Pipeline is 50 years.

8.12 Project's Benefit-Cost Analysis

As it is unlikely that the Project will generate employment in Turkey, or those other Turkish economic sectors such as fisheries or tourism will be negatively affected by the Project, no direct or indirect economic benefits or costs are expected in Turkey during the entire lifetime of the Project. The results from numerous detailed surveys and research studies in the fields of geology, geophysics, seismic, bathymetry, hydrography, oceanography, marine biology and marine chemistry (carried out within the construction corridor) were shared with the Ministry of Foreign Affairs and used in this report. This means that the Ministry possesses comprehensive data and knowledge about the Turkish EEZ in the Black Sea.

On this basis, no quantitative Benefit-Cost Analysis could be performed for the purpose of this EIA Report.

8.13 Other Issues

There are no issues to be discussed under this heading.

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8.1	Turkish Statistical Institute (TUIK or TurkStat) (2013) Main Statistics: National Accounts data sets: Gross Domestic Prices in Constant Prices by Kind of Economic Activity. Accessed at: http://www.turkstat.gov.tr/UstMenu.do?metod=temelist.Accessed on 17 September 2013.
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9. ASSESMENT OF PROJECT ACTIVITIES

This chapter identifies and where possible quantifies aspects of the project activities with relevance to applicable national or international standards.

The Design and Basic Engineering phase was limited to feasibility studies, conceptual designs and geotechnical/environmental survey activities. The survey activities will have given rise to releases to the environment. However, these will be very small compared to those associated with the Construction and Operation phases.

The decommissioning scenarios considered in this EIA Report are that either the pipelines would be left in situ, or that they would be removed. If the pipelines were to be left in situ, no activities would be required. However, if the pipeline were to be removed, the required activities would be essentially the same as those associated with the construction phase, and are only briefly discussed as a result.

The scope of this chapter therefore focusses on activities associated with construction, including pre-commissioning, and operation.

In accordance with the Special Format, this chapter addresses the following;

- Water Usage and Disposal;
- Supply of Energy and Fuel;
- Potential Uses of Resources;
- Assessment of Air Quality;
- Emission Calculations and Emission Management;
- Noise and Vibration;
- Sea Traffic;
- Waste Generation and Waste Disposal;
- Risk Analysis;
- Contingencies (Compensation for Damages in case of Accidents);
- Visual Effects;
- Impacts of Lighting; and
- Odour.

A typical construction spread has been developed as a basis for this EIA Report, and is set out in Table 9.1 below. It should be noted that the spread is indicative at this stage. It should also be noted that the spread has been assumed to be the same, irrespective of which pipe lay method is adopted as defined in Section 1.5 in **Chapter 1 General Features of the Project.**

Table 9.1: Project Phases and Associated Activities.

Construction Activity	Type of Vessel	Task	Number of Vessels	Duration (days) per vessel	Persons on Board	Utilisation (%)
Offshore Pipe-laying >600 m water depth	Deep water pipe-lay vessel	Deep water pipe-laying	1	170 (based on length and vessel speed)	725	40
	Tugs	General support	1	As above	40	60
	Pipe-lay Supply Vessel (PSV)	Supplying pipe to pipe-lay vessel	5	As above	16	60
	Survey Vessel	Surveying the sea floor in front and behind the pipe-lay vessel	2	As above	62	60
	MSV (Multi Service Vessel)	ROV Support, Diving Support, Consumables supply, Bunker supply, Provisions supply Water supply	2	As above	70	60
	Crew boats, fast cats	Crew changes	1	5 (i.e. 10 half day trips)	70	60
	Maintenance vessel	Delivery of spare parts / equipment	1	9	16	60
	Fuel / waste water collection vessel	Waste water collection	1	9	5	60
	Rescue vessel	Safety and Rescue Operations	1	Only required in case of emergency	23	60

It should be noted that the Project will be developed and operated in accordance with the Adopted Project Standards which are set out in Table 3.3 of Chapter 3, and which include international and national legal requirements. Furthermore, the Project has committed to the adoption of Good International Industry Practice.

9.1 Water Usage and Disposal

9.1.1 Water Usage during Construction Phase

There are no international standards or Turkish regulations which specify water consumption requirements on board vessels operating in the Turkish EEZ.

No significant water use is likely to be associated with the Design and Basic Engineering phases.

During the Construction phases, water would be required by vessel personnel for domestic purposes, including drinking water, washing, cooking, laundry and general cleaning, and possibly during pipeline fabrication process. Although some of the vessel types listed in Section 1.6.9 of this EIA Report may have desalinisation plant to produce freshwater, it is assumed for the purposes of the EIA Report that freshwater will be provided by supply vessels. Bottled water will be provided for drinking purposes. Other than drinking and utility water, no other water requirement is anticipated for the personnel working on the construction and operation (survey) vessels.

Tables 9.2 set out the assumed level of water consumption associated with the Project during construction phase, based on the nature, personnel and deployment of vessels associated with each phase.

It is estimated that 200 litres/day of water will be required per person per pipeline and the average number of persons on board (POB) will be 1,000 on the vessels during construction.

Table 9.2: Estimated Water Consumption during Construction for all four pipelines

Construction Activities	Type of Vessel	Number	Duration	POB	Water Consumption Per Person / Day (l)	Total Water Consumption for Construction (l)
Offshore pipe-lay >600mbsl	Deep water Pipe-lay Vessel	1	170	725	200	24.650.000
	Tugs	1	170	40	200	1.360.000
	Survey Vessel	2	170	62	200	4.216.000
	PSV	5	170	16	200	2.720.000
	MSV	2	170	70	200	4.760.000
	Fast Supply Vessels	1	5	70	200	70.000
	Maintenance vessel	1	9	16	200	28.800
	Fuel / waste water collection vessel	1	9	5	200	9.000
	Rescue Vessel	1	NA	23	NA	NA

TOTALS (Construction Activity) (L)	Total Water Consumption per Day (l)	Total Water Consumption for Construction for one pipe line (l)	Total Water Consumption for Construction for four pipeline (l)
Offshore pipe-lay (>600 mbsl)	200.800	37.813.800	151.255.200

9.1.2 Water Usage During Operational Phase

Activities during operation are limited to a total deployment of 29 days of surveys mentioned in Section 1.8 of this EIA Report. Water will be supplied in the same manner as during construction. It is assumed that the survey vessel has an average of 62 persons on board.

From Table 9.3 the total volume of water consumption associated with the Project is approximately 1,438 m^3 during operation, based on all four pipelines.

Table 9.3: Estimated Water Consumption during the Operation Phase

Type of Vessel	Task	Number	Duration	POB	Water Consumption Per Person / Day (l)	Water Consumption per Day (l)	Total Water Consumption for Operation (l) for one pipeline	Total Water Consumption for Operation (l) for four pipeline
Survey Vessel	Surveying the sea floor	1	29	62	200	12.400	359.600	1.438.400

9.1.3 Water Usage During Decommissioning

No water use is associated with the Decommissioning option of leaving the pipelines in Situ. However it is worth noting that the pipelines would be flushed with water. Water would come from either Russia or Bulgaria, and would be removed via the hydro-test valves in either country. No water will be required from Turkish sources. Water usage for the Decommissioning option of removing the pipelines would be similar to that outlined for the Construction phase.

9.1.4 Quantities of Domestic Wastewater to be Generated during the Construction Phase and Disposal Methods

Disposal of domestic wastewater in the Turkish EEZ is regulated in accordance with the Regulation on Water Pollution Control (Official Gazette with Date: 31 December 2004 and No: 25687), which incorporates the provisions of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) Annex IV.

Domestic waste water arising from the Project will comprise sewage (as defined in MARPOL Annex IV as drainage from toilets and urinals, and from medical facilities) and drainage from dishwater, showers, laundry, bath and washbasin drains, which is not defined and not regulated by Annex IV (defined in this Chapter as “grey water”). Sewage will be managed and, if necessary, treated in accordance with applicable regulations. These regulations incorporate the provisions of MARPOL Annex IV, namely;

- Using a treatment system approved by the Administration; and
- Discharging at a distance of more than 3 nautical miles (NM) from the nearest land, or, if a vessel has no approved treatment system, at a distance of more than 12 nautical miles from the nearest land; and
- Discharged at a moderate rate according to the speed of the vessel which shall be at no less than 4 knots.

The conditions placed on the discharge of sewage shall not apply in the following circumstances:

- Where it is necessary for the safety of a vessel or those on board or for saving life at sea; and

- Discharges resulting from damage to a ship or its equipment provided that all reasonable precautions have been taken before and after the occurrence of the damage, for the purpose of preventing or minimising discharge.

There are no regulations and no provisions of MARPOL Annex IV which apply to the discharge of drainage from dishwater, showers, laundry, bath and washbasin drains.

Table 9.4 set out the assumed level of domestic waste water generation associated with the Project during construction phase, based on the nature, personnel and deployment of vessels.

Table 9.4: Estimated Domestic Waste Water Generation during Construction for all four pipelines

Deep water Pipe-lay Vessel	Number	Duration	POB	Domestic Waste Water Generation per Per Person / Day (l)	Total Domestic Waste Water Generated During Construction for one pipeline (l)	Total Grey Water Generated During Construction for one pipeline (1)	Total Sewage Generated During Construction for four pipeline (l)
Deep water Pipe-lay Vessel	1	170	725	192	23.664.000	22,185,000	1,479,000
Tug	1	170	40	192	1.305.600	1,224,000	81,600
Survey Vessel	2	170	62	192	4.047.360	3,794,400	252,960
PSV	5	170	16	192	2.611.200	2,448,000	163,200
MSV	2	170	70	192	4.569.600	4,284,000	285,600
Fast Supply Vessel	1	9	10	NA	NA	63,000	4,200
Maintenance Vessel	1	9	16	192	27.648	25,920	1,728
Fuel/waste water collection	1	9	5	192	8.640	8,100	5,40
Rescue Vessel	1	NA	23	NA	NA	NA	NA

TOTALS (Construction Activity) (L)	Total Domestic Waste Water Generation by the Project (4 pipelines) During Construction (m3)	Total Grey Water Generation by the Project (4 pipelines) During Construction (m3)	Total Sewage Generation by the Project (4 pipelines) During Construction (m3)
Offshore pipe-lay (>600 mbsl)	145,203	136,128	9,075

Also the volume of cooling water discharges is expected to be 1,100 m^3/hr from the pipe-laying vessel. Cooling water will be managed and discharged as domestic waste water as it will not contain any chemicals / hazardous substances. The discharges will be complied with the requirements of MARPOL and Water Pollution Control Regulation.

9.1.5 Quantities of Domestic Wastewater to be Generated during the Operation Phase and Maintenance and Disposal Methods

The type of domestic wastewaters generated during operation will be similar in nature to the construction phase. Table 9.5 sets out the assumed level of domestic waste water generation associated with the Project during the operation phase, based on the nature, personnel and deployment of vessels.

Table 9.5: Estimated Domestic Waste Water Generation during Operation Phase

Operation Activities	Deep water Pipe-lay Vessel	Duration	POB	Grey Water Generation for the Project (m3)	Sewage Generation for the Project (m3)	Total Domestic Waste Water for the Project (m3)
Survey	Survey Vessel	29	235	647	43	690.5

9.1.6 Quantities of Domestic Wastewater to be Generated during the Decommissioning Phase and Maintenance and Disposal Methods

It is expected that quantities of domestic waste water generated by the decommissioning phase, based on the removal of the pipelines, will be essentially the same as those expected during the construction phase. The disposal methods will be in accordance with practice and requirements prevailing at that time. No wastewater would be generated if the pipelines were left in situ.

9.1.7 Quantities of Other Liquid Wastes from Vessel Operations to be Generated during the Construction and Operation Phases, and Disposal Methods

Disposal of waste water in the Turkish EEZ is regulated in accordance with the Regulation on Water Pollution Control (Official Gazette with Date: 31 December 2004 and No: 25687), Regulation on Waste Collection from the Ships and Control of Wastes (Official Gazette Date: 26 December 2004 and No: 25682); and MARPOL 73/78 and also other relevant regulations. It has been assumed that the Regulation on Water Pollution Control's Article 23 is consistent with the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), and that compliance with Annex I in respect of oil wastes and Annex V in respect of will mean compliance with the Regulation referenced above.

During Construction and Operation phases, liquid wastes will comprise the following;

- Bilge water (Ref 9.1);
- Ballast water;
- Other liquid wastes, for example, sewage sludge, tank sludges, waste oil including oily bilge water. Note that these wastes will be disposed of on shore.

There are no proposals as part of the Project to use onshore facilities in Turkey for waste disposal. The detailed information of wastes are given in section 9.7.

Estimated bilge water generation during the Construction Phase is given in Table 9.6 and also for Operation Phase is given in Table 9.7.

Table 9.6: Estimated Bilge Water Generation during the Construction Phase for all four pipelines

Vessel name	Number of vessels of this type	Vessel capacity, tonnage	Bilge water generation standard, m^3/day	Vessel operating time, days	Total, m^3
Crew boats, fast cats	1	123	0,4	5	

Fuel / waste water collection vessel	1	855	2,2	9	19,8
Rescue vessel	1	1.768	8	n/a	
Pipe-lay Supply Vessel (PSV)	5	3.663	18	170	15.300
Multi Service Vessel (MSV)	2	5.528	25	170	8.500
Survey Vessel	2	4.398	22	170	7.480
Tug	1	3.664	20	170	3.400
Maintenance Vessel	1	3.663	18	9	162
Deep water pipe-lay vessel	1	69.000	58	170	9.860
Total per 1 pipeline					**44.721,80**
Total per 4 pipelines					**178.887,20**

Table 9.7: Estimated Bilge Water Generation during Operation Phase

Vessel name	Number of vessels of this type	Vessel capacity, tonnage	Bilge water generation standard, m^3/day	Vessel operating time, days	Total, m^3
Survey Vessel	1	4398	22	29	638

From Table 9.6 and 9.7, the assumed level of bilge water generated by the project is 178,888m^3 during the construction phase and 638m^3 during the operational phase. Bilge water will be managed in accordance with national regulations such as the Regulation on Waste Collection from the Ships and Control of Wastes (Official Gazette Date: 26 December 2004 and No: 25682), and international conventions.

Vessels will generally take on ballast water as they unload cargo and release ballast as they take cargo on board. The supply vessels will therefore generally take on ballast while in the Turkish EEZ. The pipe laying vessel may take on/release ballast depending on sea conditions. Consequently, it is not feasible to estimate the volumes of ballast which may be released during the construction and operation phases. No contaminated ballast will be disposed of in the Turkish EEZ. The Project requires all vessels deployed in the Project to implement a voluntary ballast water and sediment management plan in compliance with the International Maritime Organisation (IMO) International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM). Plans will contain a detailed description of the actions to be taken to implement the Ballast Water Management requirements and supplemental Ballast Water Management practices of the Convention.

Cooling of engines is achieved by circulating a cooling liquid around internal passages within the engine. Fresh water is used in a closed circuit to cool down the engine room machinery. The fresh water returning from the heat exchanger after cooling the machines is further cooled by sea water in a sea water cooler. Without adequate cooling certain parts of the engine, which are exposed to very high temperatures, would fail. The cooling water will either be discharged to sea or is re-used over and over. For any kind of discharges MARPOL requirements shall be complied with.

The EIA Report has assumed a worst case scenario in which the cooling water would be discharged. However, as the impact will be localised to the immediate vicinity of the vessel, similar to other routine shipping / vessel discharges in the Black Sea and will adhere to the requirements of MARPOL, the discharge of cooling water could cause negligible level injury to marine organisms.

9.2 Supply of Energy and Fuel

Estimates of the average daily fuel consumption during the Construction Phase for the construction spread are provided in Table 9.8.

Average hourly fuel consumption for all Project vessels in Turkey, including helicopter: 8,831 kg/hr or 10.4 m^3/hr.

Average hourly fuel consumption for all vessels in Turkey, excluding helicopter: 8,826 kg/hr or 10.4 m3/hr.

All materials and equipment will be transported by support vessels from ports in Russia or Bulgaria to the pipe-laying vessel. The following measures will be taken as part of the vessel activities:

- Refuelling of vessels o be undertaken at established port facilities or at sea by means of certified hoses, fitted with anti-drip valves, etc.;
- Refuelling to be undertaken by designated persons with appropriate training; and
- Develop Spill Response Plans & provide spill response equipment on-board including appropriate supplies of absorbent pads, granules etc.

9.3 Potential Uses of Resources

There are no proposals as part of the Project to use facilities in Turkey. Steel will be provided from international suppliers which may be located in Russia, Europe, or Japan. Fuel will be provided from bunkering facilities in Russia and Bulgaria. Water and consumables used in the construction process as well as food and water for vessel crews will also be provided from facilities in Russia and Bulgaria.

9.4 Assessment of Air Quality

This section summarises the scope, approach and conclusions of an assessment of the effects of the Project on air quality. The full modelling report and assessment is presented in **Appendix 6.A** of this EIA Report.

The assessment has modelled predicted ground level concentrations within a study area which includes the Project Area and the section of the Turkish coastline closet to the Project Area. The assessment has focused on the construction phase only, as air emissions will be greatest during this phase and negligible during other phases. It should be noted that that air quality objectives do not exist for the Turkish EEZ within the central Black Sea where the Project is to be located. In the absence of applicable limits, limits which apply on land have been used as a context.

By modelling the likely dispersion and dilution of the key air emissions arising from the Project, the assessment has demonstrated that emission concentrations are very low, and generally one to two orders of magnitude below the annual air quality limit values selected as benchmarks. On this basis, it has been concluded that the Project will have no impact on air quality. MARPOL Annex VI defines specific emission limits from ship engines. Its provisions in controlling emissions from ships engines has been adopted as a Project Standard, as set out in Table 3.3 in **Chapter 3**, and so will apply to all vessels contracted as part of the construction and operation of the Project.

Whilst not directly applicable to the Project, Regulation on Assessment and Management of Air Quality (RAMAQ) in the Official Gazette dated 06.06.2008 and no: 26898 which proposes air quality limits for relevant emissions on land and have been used as a context within which the predicted emissions associated with the Project can be interpreted.

In accordance with the opinion letter (date/no: January 31 2014/866, Appendix 5.A) of the Ministry of Transportation, Maritime Affairs and Communication, General Directorate of Marine and Inland Waters, sulphur rate will be applied as 3.5% as per MARPOL 73/78, Annex VI. As indicated by the same opinion letter, in case of an exigency for the vessels to use Turkish ports, the vessels cannot use marine diesel with sulphur content exceeding 0.1% by mass as per the Regulation on Reduction of Sulphur Rate in Some Types of Fuel Oils.

9.4.1 Emission Calculations and Emission Management

The assessment has addressed the following, being the principal emissions arising from fuel combustion by vessel engines: oxides of nitrogen (NO_x), sulphur dioxide (SO_2), carbon monoxide (CO), particulate matter (PM_{10}), and volatile organic compounds (VOCs).

The method adopted by the modelling study (Appendix 6.A) has followed the requirements of the aforementioned RAMAQ. Emissions calculations have been based on the construction spread and estimated duration of deployment set out in Table 9.1. Characteristics of the flue gases and emission rates have been calculated in accordance with European Environmental Agency guidance[1]. The maximum short term emissions have been modelled for the construction spread, assuming the spread to be a single point source at a height of 30m above sea level, and at its closest point to the coast. The annual average ground/sea level concentrations have been modelled assuming that the construction spread and sequence described in section 1.6.3 Project Implementation Timeline, in **Chapter 1 General Features of the Project**.

Note that vessel activity during operation and decommissioning has not been modelled. Fewer vessels will be deployed annually in these phases and resulting emissions will be materially lower than those for construction phase.

Emissions management mechanisms are built into the emission factors provided in the EEA guidance. These include both legislative controls, e.g. through MARPOL Annex VI, which specifies controls on inter alia NOx limits, sulphur in fuel, VOCs, and through technology, such as improved engine design, catalytic emission reduction. Atmospheric Emissions from Construction Vessels are given in Table 9.8 as tonnes per year.

Table 9.8 Atmospheric Emissions from Construction Vessels (tonnes/year) based on Vessel Spread and Implementation Timeline

	Fuel	CO_2	NO_X	CO	PM	SO_2	NMVOC
Offshore vessels (including helicopter)	77,356	244,444	6,072	572	116	2,321	217

Note: CO_2 – carbon dioxide, NO_X – nitrogen oxides, CO – carbon

[1] EMEP/EEA. Air Pollutant Emission Inventory Guidebook 2009. Table 3-2. Chapter 1.A.3.d.i Tier 1 Emission Factors for ships using marine diesel/marine gas oil

9.4.2 Modelling

Emission concentrations have been predicted using the Aermod[2] Dispersion software, a state of the art computer model which estimates hourly, daily and annual emission concentrations for given emissions data (height, velocity, temperature) and meteorological conditions. Aermod and similar models are routinely used in air dispersion modelling to predict concentrations of pollutants emitted from specific sources. The model has used meteorological data for both the Black Sea and for representative parts of the coast with the study area. The study area has been defined in accordance with the Regulation on the Control of Industrial Air Pollution, and includes part of the Turkish Black Sea coastline. Note however that specific receptors have not been identified.

The results of the modelling are presented in **Appendix 6.A** as a series of plots showing predicted ground level concentrations for each of the five pollutants listed above on an hourly and/or daily and annual basis. These show how the emissions from the construction spread are predicted to disperse away from the Project Area.

9.4.3 Assessment

Table 9.9 below presents the maximum hourly and/or daily and annual ground/sea level concentrations predicted by the model, and compares them against the limits referred to in 9.4.2 above. From the Table, it is evident that the predicted concentrations will be substantially below relevant limits (current and future), over the period of the construction phase. Moreover, as emissions disperse away from the Project Area, concentrations decrease, and along the Turkish coast, concentrations are negligible compared to the limits referenced above.

Table 9.9: Maximum Modelled GLC Calculated through Modelling Studies

Parameter		Max Modelled GLC (µg/m^3)/ Coordinates	Limit Value (µg/m^3)					
			2013	2014	2015	2016	2017	2018
NO_2	Hourly (P99.79th)	23.6 (416250, 4753046)	-	300	290	280	270	260
	Annual	1.4 (533671, 4769804)	-	60	58	56	54	52
SO_2	Hourly (P99.72th)	14.5 (416250, 4753046)	-	500	470	440	410	380
	Daily (P99.17th)	3.2 (416250, 4753046)	-	250	225	200	175	150
	Annual	0.9 (533671, 4769804)	-	20	20	20	20	20
CO	Daily8-Hours	2.2 (345797, 4741874)	-	16,000	14,000	12,000	10,000	10,000
PM_{10}	Hourly (P99.41th)	0.1 (416250, 4753046)	-	100	90	80	70	60
	Annual	0.04 (533671, 4769804)	-	60	56	52	48	44
VOC*	Hourly	1,7 (426250, 4753046)	280	-	-	-	-	-

[2] The American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC) was formed to introduce state-of-the-art modeling concepts into the EPA's air quality models. Through AERMIC, a modeling system, AERMOD, was introduced that incorporated air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain

Parameter	Max Modelled GLC (µg/m^3)/ Coordinates	Limit Value (µg/m^3)					
		2013	2014	2015	2016	2017	2018
Daily	0,4 (533671, 4764218)	70	-	-	-	-	-

*Since emission limits not included in RAMAQ, VOC emissions are assessed according to RCAPOI Annex 2

In conclusion, the Project is predicted to have no impact on air quality in the Project Area, wider Black Sea or Turkish coastline.

9.5 Noise and Vibration

The following Project activities are likely to generate noise; pre-construction surveys; pipe-laying, and pipeline survey as part of the operations phase and decommissioning phases. The main sources of noise are likely to be on-board generators, lifting gear and engine/propeller noise. Of these, propeller noise, specifically the dynamic thrusters used to position the pipe laying vessel, is considered to be the principal source. No activities are considered likely to give vibration.

All noise sources associated with the Project will arise in the Project Area. The Project will give rise to no noise and vibration that would be experienced by people or property on land in Turkey. The Turkish Environmental Noise Control Regulations will not be applicable therefore.

Underwater noise will be generated during the pipe-laying and associated activities planned for the Turkish Sector of the Project. The noise thus produced has the potential to impact on biological receptors in the marine environment. An assessment of the propagation of underwater noise by the Project and its possible impact on marine mammals and fish has been undertaken and is presented in **Chapter 7 Assessment of the Biological Environment** of this EIA Report and is summarised below:.

A number of marine species have been identified as being of specific concern to the pipe-laying activities. These are the bottlenose dolphin, common dolphin and species of fish specifically anchovy. The published literature has been assessed to determine threshold values relating to acoustic impacts on marine life. The impacts considered were fatality; physical injury, temporary deafness and behavioural reactions.

Underwater acoustic propagation modelling was undertaken using site- and time-specific environmental data relating to the Black Sea and the results were applied to noise source data for each of the Project activities (see **Appendix 7.B**). The Project activities were found to be pipe-laying and maintenance. All of the activities are vessel based. From a review of the available literature each task has been discussed in terms of their acoustic characteristics and it was found that only pipe-laying was likely to generate noise levels sufficiently high to give rise to an acoustic impact.

The impact analysis showed that sound levels generated by pipe-laying in the Black Sea are insufficient to cause mortality in the marine species local to the area. Similarly, the no-injury threshold for fish is not exceeded.

This assessment indicates that migratory species, such as anchovy, could be impacted by either the physical presence of vessels or noise generation from vessels impacting migratory routes and/or patterns. Anchovy are the only species in the Black Sea known to migrate across the Project Area (see Section 6.4.1 of this EIA Report for more information on anchovy migration). Anchovy undertake two migrations annually; one southward in the autumn to the Turkish and Georgian coasts (Ref. 7.30) where they form dense wintering concentrations (Ref. 7.27) and one in the spring, to spawning areas in the northern Black Sea. The exact months in which these migrations will take place are not known. Impacts will be direct displacement from the immediate vicinity of the construction spread and could cause minor changes in the migration route of the anchovy.

However, as the construction spread will only be moving at around 2.5 to 2.75 km/ day it can be considered a stationary object and anchovy will be able to avoid this area. Only one construction spread will be present in Turkish waters at any one time (see Section 1.6.3 of this EIA Report for the construction schedule). Migrating schools of fish are fast moving and their presence at a particular point is temporary. The Turkish pipeline sector is 470 km long which suggests a total transit time of a maximum 170 days or around 6 months for construction vessels for each pipeline. The main anchovy migration corridor could extend around 125 km in width through the Turkish EEZ. The pipe-laying vessel would cross over this corridor in 45 to 50 days. Consequently, even if the transit of the vessel and the migration periods do coincide, the migration period is over two months (60 days) in both spring and autumn and therefore there would a clear period when the vessel would not be in the path of the main migration (Ref. 7.8).

Although the presence of the spread and the noise emitted during construction will be continuous, the impact of noise on migrating species is localised. Mild avoidance reactions will only cause limited behavioural changes in the anchovy. They are unlikely to adversely impact the migration patterns of fish which will exhibit mild startle reactions to the noise source and could potentially alter the migration course but will not cause major disruptions to the anchovy's migration. It should be noted that these mild avoidance reactions are a worst case and based on all vessels in the construction spread, including supply and support vessels, operating in the area at the same time.

The construction of pipelines 2 and 4 could potential overlap with the spring migration period for the month of May whereas pipeline 3 construction could overlap with the autumn migration in the months of September and October. Pipeline 1 construction could impact the spring migration period but in all cases the area of impact as discussed above, is only a maximum of 15 km around the construction spread compared to the 125 km migration corridor for anchovy.

Noise emissions from vessels within the construction spread are also lower than noise emitted from super tankers and other cargo vessels which transverse the Black Sea along numerous shipping routes. In addition, fish can become habituated to noise emissions, are highly mobile and will be migrating over a wide area through the middle of the Black Sea. As such, it is likely that any impacts to fish migrations will be localised to around the construction spread, intermittent based on the number of vessels operating in the area and temporary, as impacts will only occur for the duration of the construction for each pipeline which will not completely overlap with migration periods.

9.6 Sea Traffic

The shipping routes and work hours of the vessels to be appointed during the construction and operation of the project as well as the project coordinates will be provided to the relevant Port Authorities, Coastal Security Institutions and Coast Guard as appropriate. These notifications will be included in the Monitoring Control Plans.

During the Construction Phase, Navigation Plans would be submitted to the Turkish Armed Forces- Coast Guard Black Sea Regional Command (Command) if so requested by the Command.

The vessels that will be operating in the Black Sea Turkey EEZ will obtain all necessary permissions at least six months in advance.

Data has been requested from the General Directorate of Coastal Security which has not been made available at the time of submitting the EIA Report. If necessary, the information presented in this Report can be updated when the requested data is provided.

Main vessel movements are indicated in Figure 9.1 and 9.2.

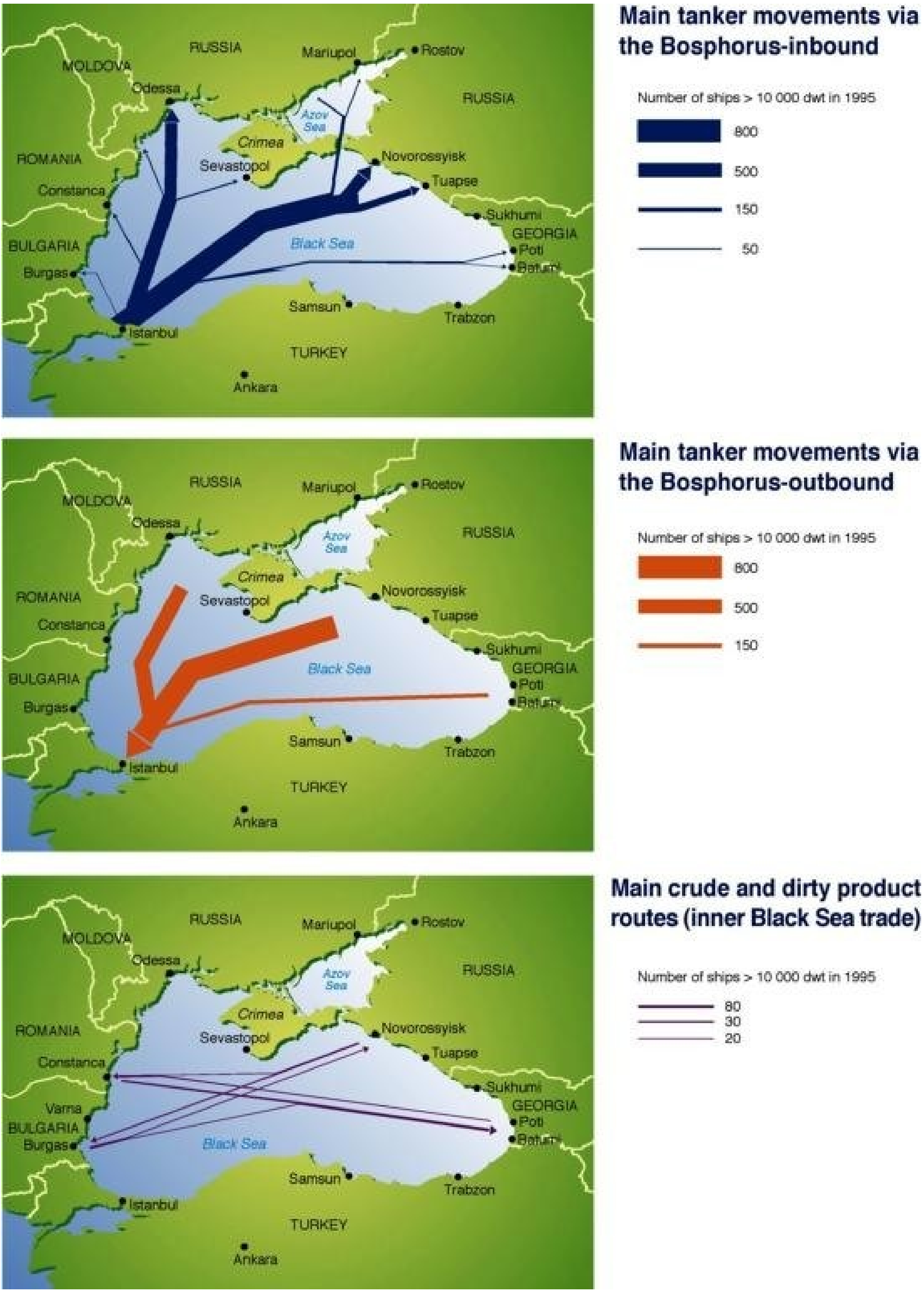


Figure 9.1: Main Tanker Routes in the Black Sea

(Ref: http://www.grida.no/graphicslib/detail/oil-transport-in-the-black-sea_d73e#)

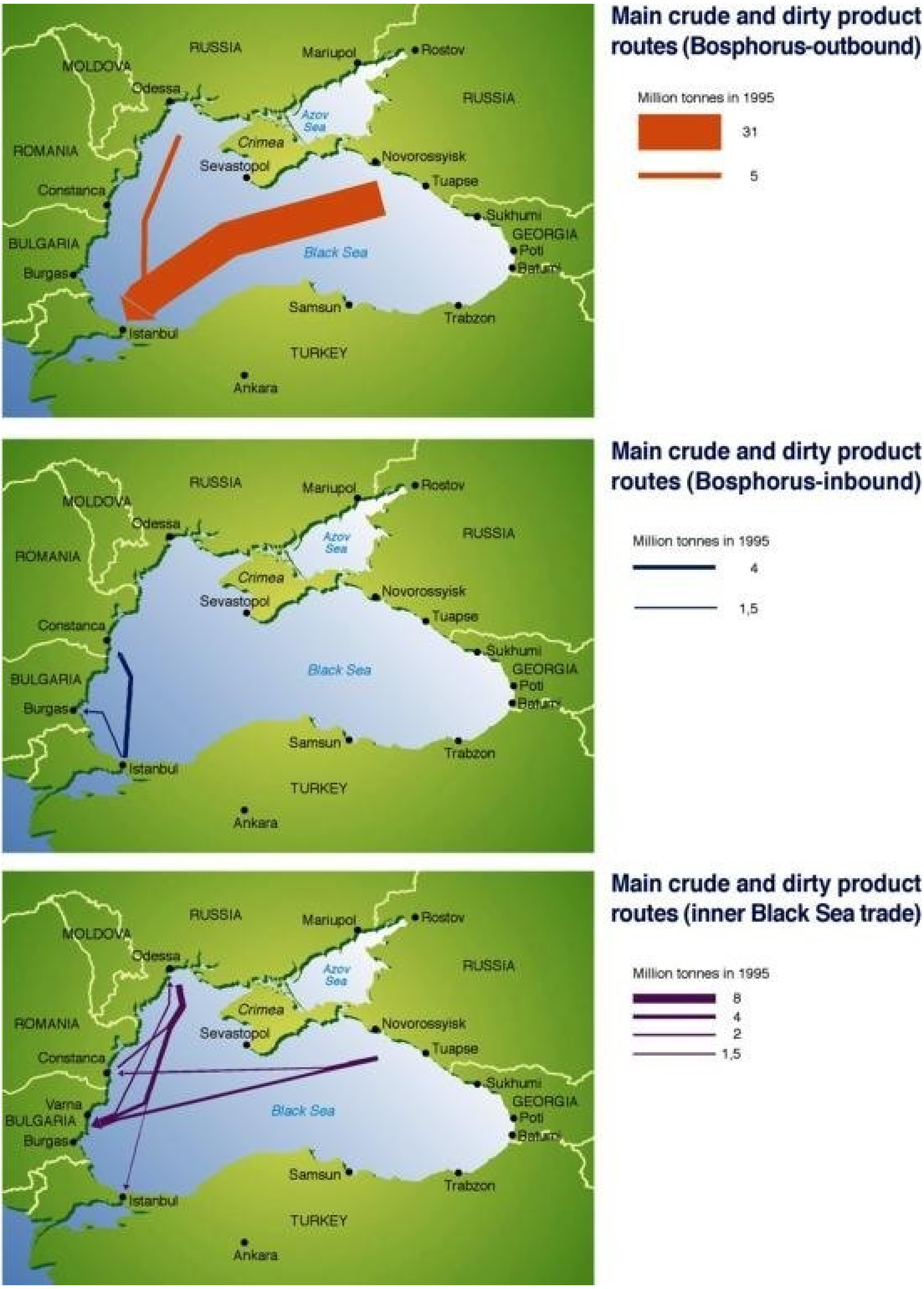


Figure 9.2: Marine Crude and Dirty Product Routes in the Black Sea

(Ref: http://www.grida.no/graphicslib/detail/main-crude-and-dirty-product-routes-in-the-black-sea_48ad#)

9.7 Waste Generation and Waste Disposal

The waste generation will be from vessel and crew activities and will therefore all be confined to the vessels. There are no proposals as part of the Project to use onshore facilities in Turkey. Typical vessel type and characteristics were given in Table 9.1. The following sections discuss the types and characteristics of the wastes that are expected to be generated. South Stream Transport commits that no liquid or solid wastes will be discharged into the Black Sea during the project activities other than is in compliance with especially Regulation on Water Pollution Control (Official Gazette with Date: 31 December 2004 and No: 25687), Regulation on Waste Collection from the Ships and Control of Wastes (Official Gazette Date: 26 December 2004 and No: 25682) and all relevant Turkish Regulations or MARPOL 73/78 requirements. No wastes are planned to be disposed of at Turkish facilities.

9.7.1 Types and Quantities of Wastes and Disposal Methods (during construction, operation and decommissioning)

Table 9.10 presents the total amount of wastes that will generated during the Construction and Operational Phases of the four pipelines. The decommissioning scenario will be determined at the appropriate time in accordance with Good International Industry Practice which prevails at that time.

The waste characterization has been conducted based on the Regulation on General Principles of Waste Management (Official Gazette Date: 05 July 2008 and No: 26927) with is identical to the EU Waste Directive Characterisation. Wastes will be managed in accordance with the requirements of MARPOL 73/78 Annexes V which requires that vessels greater than 400 Gross Ton and more than 15 crew members operating in a Special Area like the Black Sea to have a Waste Management Plan and Waste Management Ledger, and require one crew member to be responsible for the waste management plan. Wastes will be segregated in appropriate containers.

Table 9.10: Waste Characterisation and Estimated Arisings

EWC Code	EWC Description	Source	MARPOL Category	Estimated Arising (tonnes)
12 01 01	ferrous metal filings and turnings	Scrap from preparing pipes for welding	MARPOL Annex V Waste	100 - 1000
12 01 05	plastics shavings and turnings	Scrap from preparing pipes for welding by abrasion of polypropylene coating	MARPOL Annex V Waste	10 – 100
12 01 13	welding wastes	Waste from pipe welding	MARPOL Annex V Waste	10 – 100
13 01 10*	mineral based non-chlorinated hydraulic oils	MARPOL Annex I waste from vessels	MARPOL Annex I Oily Waste	1 – 10
13 02 05*	mineral-based non-chlorinated engine, gear and lubricating oils	Maintenance of mobile plant and MARPOL Annex I waste from vessels	MARPOL Annex I Oily Waste	1 – 10
13 04 03*	bilge oils from other navigation	MARPOL Annex I waste from vessels	MARPOL Annex I Oily Waste	10 – 100
13 07 01*	fuel oil and diesel	MARPOL Annex I waste from vessels	MARPOL Annex I Oily Waste	1,000-2,000
15 01 01	paper and cardboard packaging	Waste paper/card packaging from construction materials and office/mess facilities	MARPOL Annex V Waste	1 - 10
15 01 02	plastic packaging	Waste plastic packaging from construction materials	MARPOL Annex V Waste	1 - 10

EWC Code	EWC Description	Source	MARPOL Category	Estimated Arising (tonnes)
		and office/mess facilities		
15 01 03	wooden packaging	Waste wooden packaging from construction materials	MARPOL Annex V Waste	10 - 100
15 01 04	metallic packaging	Waste metal drums (clean) and drinks cans	MARPOL Annex V Waste	1 - 10
15 01 07	glass packaging	Waste glass from construction materials and office/mess facilities	MARPOL Annex V Waste	1 - 10
15 01 10*	packaging containing residues of or contaminated by dangerous substances	Waste metal drums containing solvent/oil residues	MARPOL Annex V Waste	< 1
15 02 02*	absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances	Oily rags	MARPOL Annex V Waste	< 1
16 01 14*	antifreeze fluids containing dangerous substances	Antifreeze (MEG) from drying of pipeline		0
16 05 05	gases in pressure containers other than those mentioned in 16 05 04	Empty gas bottles/canisters	MARPOL Annex V Waste	< 1
17 02 03	plastic	Waste plastic from joint protection sleeves	MARPOL Annex V Waste	< 1
17 09 04	mixed construction wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	General mixed construction waste	MARPOL Annex V Waste	100 – 1,000
18 01 03*	wastes whose collection and disposal is subject to special requirements in order to prevent infection	Medical wastes generated by the infirmary on the vessel.	-Segregated and treated in the same manner as MARPOL Annex V Waste	< 1
20 01 08	biodegradable kitchen and canteen waste	Source-separated waste canteen waste (from welfare facilities/mess/offices) and MARPOL Annex V waste	MARPOL Annex V Waste	100-1,000
20 01 21*	fluorescent tubes and other mercury-containing waste	Source-separated waste fluorescent tubes (from welfare facilities/mess/offices)	MARPOL Annex V Waste	< 1
20 03 01	mixed municipal waste	Mixed waste (from welfare facilities/mess/offices) and MARPOL Annex V waste	MARPOL Annex V Waste	100-1,000

* contains hazardous wastes

The wastes listed in Table 9.10 include solid wastes, hazardous wastes, waste oils, packaging waste, medical wastes. Specific waste management information is described in the following sections.

9.7.1.1 Solid Wastes

Solid waste will be generated from vessels during construction and operational phases. These will include mixed waste as well as scrap from preparing pipes for welding and waste from pipe welding. The solid waste generation and the estimated quantities are given in Table 9.11.

Table 9.11: Solid Waste Generated (waste codes, types, amount)

EWC Code	EWC Description	Source	MARPOL Category	Estimated Arising (tonnes)
12 01 01	ferrous metal filings and turnings	Scrap from preparing pipes for welding	MARPOL Annex V Waste	100 - 1000
12 01 05	plastics shavings and turnings	Scrap from preparing pipes for welding by abrasion of polypropylene coating	MARPOL Annex V Waste	10 – 100
12 01 13	welding wastes	Waste from pipe welding	MARPOL Annex V Waste	10 – 100
17 02 03	plastic	Waste plastic from joint protection sleeves	MARPOL Annex V Waste	< 1
17 09 04	mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03	General mixed construction waste	MARPOL Annex V Waste	100 – 1000
20 01 08	biodegradable kitchen and canteen waste	Source-separated waste canteen waste (from welfare facilities/mess/offices) and MARPOL Annex V waste	MARPOL Annex V Waste	100-1,000
20 03 01	mixed municipal waste	Mixed waste (from welfare facilities/mess/offices) and MARPOL Annex V waste	MARPOL Annex V Waste	100-1,000

9.7.1.2 Hazardous Wastes

Hazardous waste will be generated in vessels during the construction and operation phase. The waste description, the source and the estimated quantities are given in Table 9.12.

Table 9.12: Hazardous Waste Generated (types, amount and waste codes)

EWC Code	EWC Description	Source	MARPOL Category	Estimated Arising (tonnes)
15 01 10*	packaging containing residues of or contaminated by dangerous substances	Waste metal drums containing solvent/oil residues	MARPOL Annex V Waste	< 1
15 02 02*	absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances	Oily rags	MARPOL Annex V Waste	< 1
16 01 14*	antifreeze fluids containing dangerous substances	Antifreeze (MEG) from drying of pipeline		0

EWC Code	EWC Description	Source	MARPOL Category	Estimated Arising (tonnes)
20 01 21*	fluorescent tubes and other mercury-containing waste	Source-separated waste fluorescent tubes (from welfare facilities/mess/offices)	MARPOL Annex V Waste	< 1

9.7.1.3 Waste Oils

Waste oils will be generated in vessels during the construction and operation phase. The waste description, the source and the estimated quantities are given in Table 9.13. Waste oils will be managed in accordance with the provisions of MARPOL Annex I.

Table 9.13: Waste Oils Generated (types, amount and waste codes)

EWC Code	EWC Description	Source	MARPOL Category	Estimated Arising (tonnes)
13 01 10*	mineral based non-chlorinated hydraulic oils	MARPOL Annex I waste from vessels	MARPOL Annex I Oily Waste	1 – 10
13 02 05*	mineral-based non-chlorinated engine, gear and lubricating oils	Maintenance of mobile plant and MARPOL Annex I waste from vessels	MARPOL Annex I Oily Waste	1 – 10
13 04 03*	bilge oils from other navigation	MARPOL Annex I waste from vessels	MARPOL Annex I Oily Waste	10 – 100
13 07 01*	fuel oil and diesel	MARPOL Annex I waste from vessels	MARPOL Annex I Oily Waste	1,000-2,000

9.7.1.4 Packaging Wastes

Packaging waste will be generated in vessels during the construction and operation phase. The waste description, the source and the estimated quantities are given in Table 9.14. Packaging wastes fall under the definition of garbage in MARPOL Annex V and will be managed accordingly.

Table 9.14: Packaging Waste Generated (types, amount and waste codes)

EWC Code	EWC Description	Source	MARPOL Category	Estimated Arising (tonnes)
15 01 01	paper and cardboard packaging	Waste paper/card packaging from construction materials and office/mess facilities	MARPOL Annex V Waste	1 - 10
15 01 02	plastic packaging	Waste plastic packaging from construction materials and office/mess facilities	MARPOL Annex V Waste	1 - 10
15 01 03	wooden packaging	Waste wooden packaging from construction materials	MARPOL Annex V Waste	10 - 100
15 01 04	metallic packaging	Waste metal drums (clean) and drinks cans	MARPOL Annex V Waste	1 - 10
15 01 07	glass packaging	Waste glass from construction materials and office/mess facilities	MARPOL Annex V Waste	1 - 10

9.7.1.5 Medical Wastes

Medical waste will be generated in vessels during the construction and operation phase. The waste description, the source and the estimated quantities are given in Table 9.15.

Table 9.15: Medical Waste Generated (types, amount and waste codes)

EWC Code	EWC Description	Source	MARPOL Category	Estimated Arising (tonnes)
18 01 03*	Wastes whose collection and disposal is subject to special requirements in order to prevent infection (Medical Wastes)	Medical wastes generated by the infirmary on the vessel.	- Wastes will be segregated and treated in the same manner as MARPOL Annex V wastes	< 1

9.8 Risk Analysis

9.8.1 Introduction

An assessment of the possibility of unplanned events from offshore construction activities, from the use of maritime vessels and as a result of maritime vessel accidents and of the associated risks has been prepared for the Project. The risk assessment given in this chapter targets at providing a general opinion in consideration with the unplanned events that may lead to environmental impacts and related risks. Furthermore, the Risk Assessment and Emergency Response Plan enforced by the Law Pertaining to Principles of Emergency Response and Compensation for Damages in Pollution of Marine Environment by Oil and Other Harmful Substances, No:5312 and its governing regulations, will be prepared by an institution authorized by the Ministry prior to the Construction Phase and the required approvals will be received.

9.8.2 Oil Spill Risks, Consequences and Mitigation Measures

Some maritime vessel accidents and collisions may result in oil spillages which can have resultant impacts upon environmental, as well as socio-economic and human health receptors. In order to assist in defining the risks and potential knock-on environmental impacts associated with maritime accidents and associated oil spills, a maritime risk assessment has been undertaken which has included modelling of marine oil spills that are considered most likely to occur (due to accidental collisions of marine vessels or during vessel bunkering (refuelling)). Given the character of the marine biological environment in the vicinity of the Project Area, as discussed in **Chapter 7 Biological Environment,** an oil spill in the Project Area could have short term effects on sensitive marine ecological species. It is therefore a key objective of the Project to minimise the probability of occurrence of an oil spill and to develop Oil Spill Prevention and Response Plans that would minimise the potential for adverse impacts on potentially impacted marine species and habitats. Mitigation measures to be applied include the following:

- Wherever practicable, all vessels involved with the Project will use MGO or MDO whilst deployed in the Project Area and, therefore, any accidental spill of fuel will have less adverse consequences than a spill that involves heavier fuels;
- Contractors and operators of marine vessels working on behalf of South Stream Transport will be required to develop and implement an Oil Spill Prevention and Response Plans. South Stream Transport will ensure that contractor Oil Spill Prevention and Response Plans

are appropriately aligned with the Black Sea Contingency Plan (Ref. 12.2). The Oil Spill Prevention and Response Plans will specifically target the prevention of potential oil spillage incidents;

- Contractors and operators of vessels working on behalf of South Stream Transport will operate in compliance with MARPOL regulations on oil spill prevention and response and are required to prepare Shipboard Oil Pollution Emergency Plans (SOPEP) and SMPEP as applicable for each vessel (Ref. 12.3; Ref. 12.4). The SOPEPs will specify the control and response measures that have to be available on board every vessel to respond to a spill that does not require external intervention; and
- All marine vessel crews will have the appropriate training, qualification and certification to undertake the tasks required during the construction of the pipelines.

The mitigation measures indicated above will minimise the probability of an oil spill occurring, and thus reduce the potential adverse impacts to marine habitats in the event of a spill

As discussed in **Chapters 6** and **7**, impacts from and oil spill on socio-economic (fisheries, fishing and fish products) and on marine ecological receptors have been assessed as short term and infrequent.

9.8.3 Risks from Vessel Collisions

An assessment has been made of the probability of vessel collision. Two scenarios have been considered; the probability of a third party vessel colliding with the pipelay vessel during construction; and the probability of a vessel colliding with a pipe supply vessels in the Bosphorus Straits whilst en route to a marshalling facility in Russia or Bulgaria.

The first has derived an estimate of the total number of vessel movements across the Black Sea per year based on a proprietary database. Routes identified to cross the pipeline route within the Turkish EEZ are trafficked by an estimated 21,115 ships per year, the vast majority of which are cargo vessels or tankers. The level of shipping on individual routes varies significantly, with the busiest route (between the Bosphorus and Kerch / Sea of Azov) used by over 5,000 vessels per year in each direction.

Measures to prevent accidents are routinely employed. The following additional measures have been assumed;

- that a 2km radius navigation exclusion zone will be established around the PLV during construction and will be communicated to Turkish maritime authorities;
- that a support vessel in the vicinity of the PLV will act as a guard vessel, keeping a Radar, AIS and visual lookout on passing traffic and attempting to contact any vessel on a potential collision course;
- details of the pipe-lay operation communicated to the Turkish maritime authorities, ensuring that details of the operation are distributed via Notices to Mariners; and
- that the pipe-lay vessel will have appropriate marking and lighting. It will also broadcast appropriate navigation status information on AIS, i.e., restricted manoeuvrability.

Taking into account the above, it has been estimated that the probability of a ship-to-PLV collision during the pipe-laying operations is estimated to be 1.3×10^{-3}.

Based on the total length of the PLV transits (approx. 1880km) and the average speed (2.75 km/day), the duration of the operation is estimated at two years. Therefore, the annual risk of collision is very low, being in the order of 6.5 in 10,000 (Appendix 9.A).

The probability of an incident involving pipe supply vessel within the Bosphorus Straits has been considered. It is expected that pipes will be supplied on "Handysize" class dry bulk carriers; these are vessels with a capacity of between 15,000 and 35,000 DWT, or occasionally up to 60,000. These vessels also have shallower draught in comparison to larger bulk supply vessels which allows them to operate in most of ports and terminals across the world.

Approximately, five Handysize deliveries per month are expected, equivalent to 120 return trips a year.

A review of past studies reporting accident statistics in the Strait of Istanbul by Otay and Özkan (2013) indicate accident probabilities ranging from 5x10-5 to 7x10-4 (Appendix 9.A). Note that this data is for all vessel classes; however, Ministry of Transport statistics show that 16% of the transit vessels have lengths between 150m-200m (i.e. equivalent to Handysize class). The same percentage of the overall accidents (16%) was found to be caused by this length class of vessels. It can be concluded that the probability of accident for the PSV is consistent with the overall accident probability in the Strait.

Long term accident records collected by the Ministry of Transport during 2001-2011 showed different probabilities for different accident types; collision, ramming and grounding (Table 9.16).

Table 9.16. Recorded CRG accidents in the Strait during 2001-2011 (data from Turkish Maritime Affairs, 2012)

	Collision (C)	Ramming (R)	Grounding (G)	RG (R+G)	CRG (C+R+G)
Number of accidents 2001-2012	40	14	36	50	90
Number of accidents per year	3.60	1.26	3.24	4.50	8.10
% distribution of accidents	44%	16%	40%	56%	100%
Number of accidents per 100,000 vessels in the Strait	7.02	2.46	6.32	8.78	15.80

From Government data, the overall accident probability for the PSV including collision, ramming and grounding is $1.58x10^{-4}$ per passage through the Strait. On the basis of 120 passages/year, the number of accidents will be (1.58x10-4) x 120 = 0.019. The probability of an accident in one year is given by

P (accident in 1yr) = 1-(1-p) = 0.0188, i.e. the probability of an accident involving a PSV in the Bosphorus Straits is less than 2 in 100.

This is a simplistic, worst case assessment. It assumes no traffic management and no navigation control. In practice, navigational controls are expected to require that the Straits will be closed to other traffic as the Handysize vessel passes through. As a result, the probability of a collision with would be significantly less. The additional 120 PSV passages per year may affect the overall accident probability in the Strait in two ways. The first one may apply if the selected PSV is a more accident-prone vessel than the typical vessels of its size currently transiting the Strait. Assuming that this is not the case, the second aspect may control the impact.

It is known that theoretically, the accident probability in a narrow strait increases with the traffic volume (number of passages per year) in a narrow Strait either linearly or quadratically. The exact power relationship depends on the type of accidents (collision versus ramming and grounding), navigation regulations (one-way vs. 2-way traffic), and the level of traffic saturation (Tan and Otay, 1999). Consequently, the Strait's overall accident probability may increase by an amount of somewhere from zero to 7.59×10^{-7}.

9.9 Contingencies (Compensation for Damages in case of Accidents)

Detailed plans will be prepared setting out the arrangements for managing the following:

- Emergency Response;
- Pollution Prevention;
- Waste Management;
- Cultural Heritage Object Management; and
- Vessel Traffic Management.

The arrangements for each will be set out in the Project Environmental and Social Management System, the content of which is set out in **Chapter 11, Environmental and Social Management System.**

If significant adverse transboundary environmental impacts or environmental impacts occurring in the Turkish EEZ reach the Turkish EEZ under Turkish sovereignty, Turkish terrestrial waters or coasts, these impacts will be indemnified in coordination of South Stream Transport B.V. with relevant organisations and institutions. Furthermore the project owner agrees to comply with all applicable Turkish and applicable international legislation, for the avoidance of doubt this includes any financial liabilities thereunder.

Furthermore, as indicated in the opinion letter of the General Directorate of Environmental Management dated 15.11.2013 and numbered 44679, the Emergency Response Plan enforced by the Law Pertaining to Principles of Emergency Response and Compensation for Damages in Pollution of Marine Environment by Oil and Other Harmful Substances, No:5312 and its governing regulations, will be prepared by an institution authorized by the Ministry prior to the Construction Phase and the required approvals will be received.

9.10 Visual Effects

No visual impacts are anticipated from the project activities.

9.11 Impacts of Lighting

All vessels associated with the construction and operation of the Project will be illuminated in accordance with maritime requirements. The pipe laying vessel will be illuminated to allow for 24 hour operation, again in accordance with maritime regulations.

Use of screening and correctly angled lights; Minimise use of lighting where possible. Appropriate lighting design during night-time works will be implemented.

9.12 Odour

No odour issues are anticipated from the project activities.

9.13 Other Issues

There are no other issues to be assessed under this topic.

10. CUMULATIVE IMPACT ASSESEMENT

This Chapter discusses the potential cumulative and transboundary impacts associated with the Project. Cumulative impacts are impacts which result from the addition of Project impacts combined with existing, planned or future projects or developments which may cause any changes in baseline conditions. The cumulative assessment is conducted in relation to other pipeline projects and the cumulative effects of the Russian and Bulgarian Sectors of the South Stream Offshore Natural Gas Pipeline.

The Chapter also outlines any potential transboundary impacts from the Project. For the purposes of the transboundary impact assessment, the Turkish Black Sea EEZ boundaries define the transboundary impact boundaries. Transboundary impacts are considered as any changes in baseline conditions extending across these boundaries.

The cumulative and transboundary impact assessment draws upon the following information:

- The project based risk analysis given in **Section 9.8** of this EIA Report which relates to the risks associated with unplanned / emergency events (such as pipeline rupture and vessel collisions) (**Appendix 9.A**);
- The air quality modelling report undertaken for the Project (**Appendix 6.A**); and
- The underwater noise modelling report undertaken for the Project (**Appendix 7.B**).

10.1 Interaction with the Other Components of the Project; i.e. The Russian and Bulgarian Sectors

The South Stream Offshore Natural Gas Pipeline will involve activities in three countries: Russia, Turkey and Bulgaria. As such, there is potential for activities and impacts from the Project (in Turkish Sector) to interact with activities and impacts from the Russian and Bulgarian Sectors.

The main cumulative impacts on the Black Sea are likely to occur during construction of the Project in the EEZs of Russia, Turkey and Bulgaria. The activities which could potentially interact and will be considered in the cumulative assessment are listed in Table 10.1.

All four pipelines will be laid sequentially from Russia to Bulgaria in an east to west direction and the construction spread will be travelling at a rate of 2.75 km per day. An overview of the planned construction schedule of the overall South Stream Offshore Natural Gas Pipeline is provided in Table 10.2. According to the indicative schedule, there will be limited periods of time where activities are taking place simultaneously in both the Russian and Turkish EEZs; from 9 April 2016 to 5 June 2016 (pipelines 2 and 3) and from 7 October to 5 December 2016 (pipelines 3 and 4). There are also limited periods where activities in Bulgaria and Turkey will overlap; from 19 June to 6 August 2016 (pipelines 2 and 3) and 17 December 2016 and 5 February 2017 (pipelines 3 and 4).

For Russian and Turkish cumulative effects, when construction of pipeline 3 commences in the Russian EEZ, the construction spread for pipeline 2 in Turkey will have been operating for 110 days, as such, the construction spread will be around 300 km from the border of the Turkish / Russian EEZ. Likewise, when construction of pipeline 4 commences in Russia, the construction spread in Russia will be 195 km from the border of the Turkish / Russian EEZ. As such, the minimum distance of the Russian construction spread from the Turkish EEZ is 195 km.

Table 10.1: Offshore Construction Activities in the Turkish, Russian and Bulgarian Sectors

Sector, infrastructure	Activities
Russia Offshore • Approximately 225 km from 400 m offshore to boundary of Russian and Turkish EEZ. • Pipelines will be laid on the seabed. **Turkey Sector** • Approximately 470 km in length (entirely within Turkish EEZ). • Pipelines will be laid on the seabed. **Bulgaria Offshore** • Approximately 233 km from the border of the Turkish and Bulgarian EEZ to water depth of 35 m (where dredging starts). • Pipelines will be laid on the seabed.	• Mobilisation of vessels to and from site and vessel movements within construction spread. • Perform as-laid, pre-laid and as-built survey ROV surveys etc.). • Delivery of fuel, pipe and other supplies including hazardous substances to pipe-lay vessel by supply vessel.. • Storage of fuel and other hazardous materials. • Refuelling of vessels, plant and machinery. • Helicopter operations for crew changes. • Maintenance of plant and machinery. • Waste generation from vessel operations. • Use of fresh water maker/desalination unit and vessel cooling water system (As is the case for all vessels, cooling water is the outcome of the heat of the vessel's engines, not arising from a thermal procedure and process.) • Night time working.

For Bulgarian and Turkish cumulative effects, when construction of pipeline 3 commences in the Turkish EEZ, the construction spread for pipeline 2 in Bulgaria will have been operating for 50 days, as such, the construction spread will be around 132 km from the border of the Turkish / Bulgarian EEZ. Likewise, when construction of pipeline 4 commences in Turkey, the construction spread in Bulgarian waters for pipeline 3 will have been operating for 11 days, as such, the construction spread in Bulgaria will be around 30 km from the border of the Turkish / Bulgarian EEZ.

It is not planned that there will be two construction spreads in Turkish waters at the same time. Given the construction spreads will be travelling at the same speed, there will also be at least 470 km between the spreads at any given time. As such, the total amount of time that cumulative impacts can occur will be 10 months; 6 months for activities in Russian and Turkish waters and 4 months for activities in Turkish and Bulgarian waters.

During the Construction Phase of the Project there is a potential for cumulative impacts associated with the construction spreads operating at the same time. Impacts may occur .from exhaust emissions, waste discharges and underwater noise generation resulting from planned construction activities and from unplanned / emergency events.

During operation of the Project, impacts will be restricted to the use of vessels undertaking routine inspection and maintenance activities such as surveys. These activities will take place on a regular but infrequent basis. As such, cumulative impacts during the Operational Phase of the Project resulting from planned activities are not expected.

Table 10.2: Indicative Construction Schedule for the Russian, Turkish and Bulgarian Sectors of the South Stream Natural Gas Offshore Pipeline

Schedule	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17
Pipeline 1																																			
Russia	■	■	■	◩																															
Turkey				◩	■	■	■	■	◩																										
Bulgaria									◩	■	■																								
Pipeline 2																																			
Russia													■	■	■																				
Turkey																■	■	■	■	■	◩														
Bulgaria																					◩	■	■												
Pipeline 3																																			
Russia																			■	■	◩														
Turkey																					◩	■	■	■	■	■	◩								
Bulgaria																											◩	■	■						
Pipeline 4																																			
Russia																									■	■	◩								
Turkey																											◩	■	■	■	■	■	◩		
Bulgaria																																	◩	■	■

Note: cells marked with a diagonal line indicate construction activities only occurring for half of the month.

10.1.1 Underwater Noise

Underwater noise has the potential to cause disturbance behaviour or cause fatalities to fish and marine mammal species. Underwater acoustic propagation modelling was undertaken for the Project (**Appendix 7.B**). The analysis showed that sound levels generated by pipe-laying are insufficient to cause mortality in the marine species in the area. Strong avoidance is seen out to a distance of 810 m from the vessels whereas mild avoidance can occur out to 5 km[1].

For hearing generalist fish[2], strong avoidance reactions may be seen out to a maximum distance of 55 m while mild avoidance may be evident out to a maximum distance of 330 m. Hearing specialist fish are generally more sensitive to underwater noise: the corresponding ranges are 436 m and 2.1 km. Therefore, any impacts to fish on their migration will be localised to 2.1 km (worst case) around the construction spread. Impacts (i.e., strong avoidance behaviour) are more likely to occur in the 436 m around the construction spread. Therefore covering a diameter of 872 m within the 125 km migration corridor could impact fish migration.

Construction activities in two countries will occur at the same time. As such, there is potential for noise reactions from mammal species in Turkish and Russian or Turkish and Bulgarian waters at the same time. The total impact area for harassment in marine mammals is 220 km in diameter around the pipe-lay vessel. However, this is only harassment in mammals and is unlikely to cause major changes in the mammals' normal behaviour. Strong avoidance reactions which could potentially cause minor disruptions to marine mammals' behaviour will only extend a maximum of 810 m in radius (1.62 km in diameter) around the pipe-lay vessel.

Given that marine mammal ranges cover the whole of the Black Sea and the extent of the Black Sea itself and the fact that marine mammals are highly mobile and likely to avoid any areas of noise disturbance; this impact is localised, temporary and infrequent in terms of the construction period as a whole.

As planned activities associated with operation of the pipelines will be limited to periodic routine inspection and maintenance activities utilising few vessels and generating very limited, temporary and localised impacts, cumulative impacts from noise are not expected during operation.

10.1.2 Air Quality

As shown in the air quality modelling study undertaken for the Project (**Appendix 6.A**), emissions from vessels relating to one construction spread, show that levels of PM_{10} and CO are less than 1% of the national limit values at the location of maximum impact. The modelled impact of NO_2 and SO_2 are slightly higher, but still less than 10% of the limit values and therefore also considered to be negligible. Even if these figures were to double based on two construction spreads operating at the same time, impacts to air quality are localised and less than the RAMAQ limit and unlikely to affect ambient air quality. In addition, the anticipated distances between the construction spreads of the Project and the Russian/Bulgarian Sectors is greater than 400 km at any one time. Furthermore, the

[1] Mild and strong avoidance reactions generally relate to either a brief, minor behavioural change impacting a few individuals or a longer, larger behavioural change relating to the majority of individuals respectively. However, mild and strong avoidance is difficult to define and is discussed in more detail in **Appendix 7-B**.

[2] Fish may be either hearing specialists or hearing generalists; the former are usually species with large swim bladders and are more sensitive to noise.

provisions of the Convention of Long Range Transboundary Air Pollution (CLRTAP) will be complied with.

As planned activities associated with operation of the pipelines will be limited to periodic routine inspection and maintenance activities utilising few vessels and generating very limited, temporary and localised exhaust emissions, cumulative impacts on air quality are not expected during operation.

10.1.3 Waste Generation

Management of all wastes generated by the vessels within the scope of MARPOL will be performed in compliance with the relevant Turkish legislation and MARPOL.

Detailed information of the waste management is provided in Chapter 9. Waste discharges will be limited to treated sewage and garbage, and grey water. The extent of impacts from waste disposal will be infrequent and localised to the immediate vicinity of the construction spreads. In addition, the anticipated distances between the construction spreads of the Project and the Russian/Bulgarian Sectors is greater than 400km at any one time. As such, no cumulative impacts from waste discharged to sea over the entire construction schedule are likely to occur within the Black Sea.

As planned activities associated with operation of the pipelines will be limited to periodic routine inspection and maintenance activities utilising few vessels and generating very limited amount of waste, cumulative impacts from waste generation are not expected during operation.

10.1.4 Unplanned / Emergency Events

There is potential for unplanned / emergency events to occur during construction and operation of the Project. These will either be oil or chemical spills or a rupture of the pipeline resulting in a release of gas.

In terms of oil or chemical spills during construction; the severity of the consequences of an oil spill depends on several factors including (a) type of oil spilled, (b) the amount of oil spilled and, importantly, (c) the proximity of the oil spill to oil-sensitive resources. Spills occurring from pipe-laying vessels in the open sea appear to cause no lasting effects; the spilled oil is eventually dispersed and dissipated by the effects of wind, waves and currents.

Most damage is done by oil spills when the oil drifts ashore or is naturally dispersed into shallow water by wave action in the surf zone. All vessels involved with the Project will use Marine Gas Oils or Marine Diesel Oils (light, easily dispersed fuels) and, therefore, any accidental spill of fuel will have less adverse consequences than a spill that involved heavier fuels.

Oil spills are a rare consequence of most unplanned events at sea. Given the very low likelihood of such events, it is highly unlikely that more than one spill event could occur at the same time during the Project.

All contractors involved with the Project will be contractually bound to developing and implementing an Emergency Response Plan, a Pollution Prevention Plan and an Oil Spill Prevention and Response Plan. In addition, every vessel that will be working on the Project will be compliant with MARPOL regulations on oil spill prevention and response and will hold a valid Ship Oil Pollution Emergency Plan (SOPEP) (Ref. 10.1 and 10.2).

The SOPEPs will specify the control and response measures that have to be available on board every vessel to respond to a spill that does not require external intervention. As such, given the measures in place to mitigate any potential spills, the limited extent of any impact and the rarity of such an event occurring cumulative impacts from spills from vessels during construction are unlikely.

As activities associated with operation of the pipelines will be limited to periodic routine inspection and maintenance activities utilising few vessels, it is unlikely that cumulative impacts from potential oils spills during operation will occur. During operation, there is the potential for a rupture of the pipeline leading to a loss of containment. Any gas released from a damaged sub-sea pipeline would rise through the water column as a plume of gas bubbles. On reaching the sea surface, the gas would disperse into the air. As detailed in **Section 6.4.3.4** of this EIA Report, gas releases into the atmosphere would not result in acute environmental damage. In the event of a gas release from the pipeline, the gas flow will be shut off as soon as practicable. All ignition sources and personnel will be kept clear of the area until the gas has dissipated. The actions to be taken in the event of a gas release will be defined in the Emergency Response Plan in **Section 11.2.1** of this EIA Report. As such, given the measures in place to mitigate any potential impacts from gas releases, the limited extent of any impact and the rarity of such an event occurring cumulative impacts from gas releases from the pipeline during operation are unlikely.

Furthermore, as indicated in the opinion letter of the General Directorate of Environmental Management dated 15.11.2013 and numbered 44679, the Emergency Response Plan enforced by the Law Pertaining to Principles of Emergency Response and Compensation for Damages in Pollution of Marine Environment by Oil and Other Harmful Substances, No:5312 and its governing regulations, will be prepared by an institution authorized by the Ministry prior to the Construction Phase and the required approvals will be received.

10.2 Interaction with Other Existing or Planned Pipelines

There is the potential for other pipelines to be built in the vicinity of the Project which would result in cumulative impacts during the Construction Phase. The Project team consulted with the TPAO who have provided provisional information on a potential pipeline which may be located within the vicinity of the Project.

This pipeline may need to intersect with the South Stream Offshore Natural Gas Pipeline if a hydrocarbon discovery is made in TPAO license no. AR/TPO/3921. A map of this area is given in **Section 6.7** of this EIA Report. TPAO stated that oil and gas exploration planning is on-going within the Turkish EEZ. No activities are currently planned for 2014. However from 2015 a number of site surveys and 2D and 3D seismic surveys are planned to take place (in area 3921 and potentially in area 3920). These areas are shown in **Section 6.7** of this EIA Report. The exact co-ordinates of any survey work are yet to be confirmed and will have to be informed by further geological and geophysical studies.

As a result, South Stream Transport (or their chosen contractors) will undertake regular liaison meetings with TPAO in order confirm when the construction of this potential pipeline will take place. The current information available indicates that the TPAO pipeline will only be constructed after the construction of the Project has been completed.

If the timescale changes, then a joint plan of working will be produced in order to minimise or eliminate any cumulative impacts. South Stream Transport (or their chosen contractors) will also liaise with TPAO to ensure they are provided with additional details relating to the anticipated TPAO site surveys and 2D and 3D surveys as they become available.

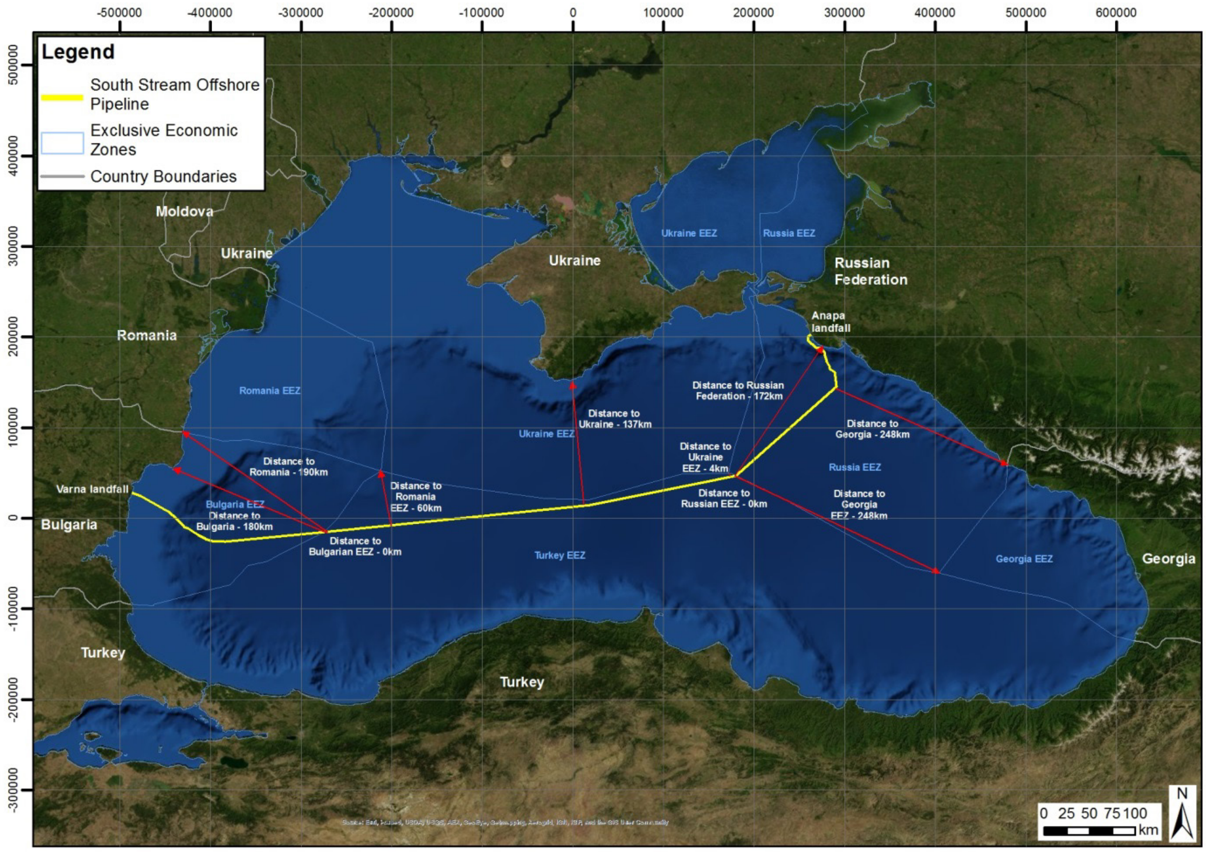
No other pipelines have been identified through consultations with authorities that would have a potential cumulative impact with the Project.

10.3 Assessment of Transboundary Impacts

Transboundary impacts may arise from activities associated with the Russian or Bulgarian Sectors of the South Stream Offshore Natural Gas Pipeline affecting Turkey. The borders of the Turkish EEZ constitute the borders of the transboundary impact assessment.

Potential transboundary impacts include those relating to air emissions, noise and vibration and waste generation. The distances of the Project from Black Sea countries EEZ borders and coastlines is given in Figure 10.1.

Figure 10.1: Distances of Project from EEZ Borders and Coastlines in the Black Sea



10.3.1 Underwater Noise

Noise and vibration from pipe-laying activities have been shown to be perceptible up to a maximum distance of 4 km from the construction spread (see **Section 10.1.1**).

Strong avoidance for fish are only likely to occur in the 436 m around the construction spread. Strong avoidance reactions on mammals can be observed within 810 m (radius) of the construction spread. As such, fish and mammals in Turkish waters could be impacted by construction spreads in Russia or Bulgaria for less than eight days in total for all pipelines (**Appendix 7.B**).

Given the mobile nature of mammal species and the short duration of potentially occurring transboundary impacts, there are unlikely to be any transboundary impacts from noise generation on mammal species in the Turkish EEZ during construction.

As planned activities associated with operation of the pipelines will be limited to periodic routine inspection and maintenance activities utilising few vessels, it is unlikely that transboundary impacts from noise will occur during operation.

10.3.2 Air quality

Due to the nature of air emissions, these are able to travel in the atmosphere and cross national borders. As discussed in **Section 10.1.2**, air quality modelling for construction activities within the Turkish EEZ (**Appendix 6.A**) show that levels of VOCs, PM_{10} and CO are less than 1% of the RAMAQ limit values at the location of maximum impact. The modelled impact of NO_2 and SO_2 are slightly higher, but still less than 10% of the limit values and therefore also considered to be negligible. As the extent of impacts from exhaust emissions will be localised to the immediate vicinity of the construction spreads; vessels would need to be in close proximity to the Turkish EEZ border for transboundary impacts to occur. Given the localised nature of the impacts; there are unlikely to be any transboundary impacts associated with exhaust emissions from vessels. As planned activities associated with operation of the pipelines will be limited to periodic routine inspection and maintenance activities utilising few vessels, it is unlikely that transboundary impacts from exhaust emissions will occur during operation. Fuel usage of all vessels will comply with MARPOL Appendix VI and relevant Turkish Legislation (Regulation on the Reduction of Sulphur Content of Certain Fuels). Furthermore, the provisions of the Convention of Long Range Transboundary Air Pollution (CLRTAP) will be complied with.

10.3.3 Waste Generation

Waste discharged from vessels could lead to a localised deterioration of water quality. As discussed in **Section 10.1.3**, any waste discharges from vessels will be undertaken in accordance with MARPOL and relevant Turkish Legislation. and waste discharges are discussed in Chapter 9 of this EIA Report. As the extent of impacts from waste disposal will be infrequent and localised to the immediate vicinity of the construction spreads; vessels would need to be in close proximity to the Turkish EEZ border for transboundary impacts to occur. Given the temporary, localised and very short-term nature of the impacts from waste, there are unlikely to be any transboundary impacts associated with waste disposal to sea. As planned activities associated with operation of the pipelines will be limited to periodic routine inspection and maintenance activities utilising few vessels, it is unlikely that transboundary impacts from waste generation will occur during operation.

10.3.4 Unplanned / Emergency Events

Impacts associated with unplanned / emergency events could generate some potential transboundary impacts. This is largely related to the location of where any incidents would happen. The closer the activity and incident is to the edge of an EEZ border then the greater the potential there is to have a transboundary impact. These impacts primarily relate to potential oil spills from vessels. Information relating to the potential impacts, causes and likelihood of such events is given in **Section 10.1.4**. The Project has identified a series of design controls which would limit or minimise any impacts from any accidental event.

As activities associated with operation of the pipelines will be limited to periodic routine inspection and maintenance activities utilising few vessels, it is unlikely that major transboundary impacts from a spill event will occur during operation.

As discussed in **Section 10.1.4**, there is potential for a rupture of the pipeline during operation leading to a loss of containment. Any gas released from a damaged sub-sea pipeline would rise through the water column as a plume of gas bubbles. On reaching the sea surface, the gas would disperse into the air. Gas releases into the atmosphere would not result in acute environmental damage. For transboundary impacts to occur, the rupture would have to be in close vicinity to the Turkish EEZ border.

Given the design controls in place, as noted in **Section 10.1.4**, the limited extent of any impact and the rarity of such an event occurring transboundary impacts from gas releases from the pipeline during operation are unlikely.

10.4 Results of the Cumulative Impact Assessment

Cumulative impacts could arise from two or more construction spreads operating in the Black Sea at the same time (e.g. one in the Project Area and one in the Bulgarian or Russian Sectors). Construction activities in two countries will occur at the same time. Based on current Project planning, there will never be two construction spreads in the Turkish Sector at the same time. The total amount of time that cumulative impacts can occur will be 9 months; 6 months for activities in Russian and Turkish waters and 3 months for activities in Turkish and Bulgarian waters. Vessel movements can generate underwater noise which may be able to cause strong avoidance behaviour in marine mammals out to a distance of 810 m radius from the construction spread; with a total impact area of (π * 0.810^2) = 2,061 km^2. Mammals are highly mobile and will be able to avoid this area of impact. In addition, given the extent of marine mammal ranges in the Black Sea and the extent of the Black Sea itself; this impact is localised, temporary and infrequent. Exhaust emissions and waste discharges are unlikely to have a cumulative impact as they are limited in extent (localised to the immediate vicinity of the construction spread) and infrequent; these are unlikely to have any cumulative impact.

The likelihood of a spill occurring in the open sea is low. The likelihood of there being cumulative impacts from more than one spill event at the same time is low. As such, cumulative impacts from spills in other sectors of the Project (Russia and Bulgaria) and spills associated with the Project are unlikely. As activities associated with operation of the pipelines will be limited to periodic routine inspection and maintenance activities utilising few vessels, it is unlikely that cumulative impacts will occur during operation.

During the Construction and Operational Phases of the South Stream Offshore Natural Gas Pipeline, transboundary impacts or environmental adverse impacts that may originate from the Turkish EEZ shall be compensate in coordination with related organisations and institutions in the event of these impacts reaching the Turkish EEZ, Turkish territorial waters or the coastline under Turkish sovereignty.

References:

Ref. No	Reference
10.1	"Guidelines for the development of the Shipboard Oil Pollution Emergency Plans", [IMO Resolution MEPC.54(32); adopted on March 6, 1992; and Resolution MEPC.86(44), adopted on 13 March 2000]
10.2	IMO IB586E – Shipboard Oil Pollution Emergency Plans (SOPEP), 2010 Edition.

11. ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM

11.1 Components of the Environmental and Social Management System

Protection of the environment is the primary objective of the EIA process, therefore the Environmental and Social Management System (ESMS) which forms part of the Health, Safety, Security and Environmental Integrated Management System (HSSE-IMS) is considered as an integral part of the Project. The ESMS has been developed to provide a robust framework to assess and manage environmental and social issues throughout the lifetime of the Project. The ESMS is designed to manage the Project's environmental and social (E&S) performance and to achieve continual improvement in performance.

The creation of a strong organisation structure is important for the successful implementation of an ESMS. Before the Construction Phase of the Project starts, an organisational structure (with job definitions) will be defined and made fully functional, as part of the implementation of the ESMS.

Key elements of the ESMS include:

- Identification and assessment of significant E&S issues;
- Identification of relevant legislation and other standards and systems to ensure ongoing compliance with these standards;
- Establishment of objectives and targets;
- Establishing resources, roles and responsibilities to implement the system;
- Ensuring that Project personnel have adequate competency to avoid significant E&S risks;
- Establishing procedures and processes to manage significant E&S risks;
- Measurement of E&S performance through monitoring and auditing; and
- Systems for addressing any deficiencies that are identified

The ESMS will be supported by management plans, as detailed in Section 11.2 below. These plans will be dynamic documents that will evolve in parallel with the EIA and ESIA process and be updated to incorporate commitments made in these assessments and commitments originating in permits. South Stream Transport B.V. will ensure that these plans will be reviewed regularly (and updated if necessary) and that they will comply with their objectives throughout all phases of the Project.

11.2 Environmental and Social Management Plans (Construction, Operation and Decommissioning)

The core environmental and social elements of the South Stream Transport B.V. Health, Safety, Security and Environmental Integrated Management System (HSSE-IMS) are the Environmental and Social Management Plans (ESMPs) for Construction Phase and Operational Phase.

Management plans are prepared to define the implementation of the HSSE-IMS. The key plans include:

- **Environmental and Social Management Plans** and subsidiary Construction and Operation plans;
- **Emergency Response Plan;**
- **Occupational Health Plan;**
- **Security Plan;** and
- **Crisis Management Plan;**

An overview of the anticipated management plans is summarised in Figure 11.1.

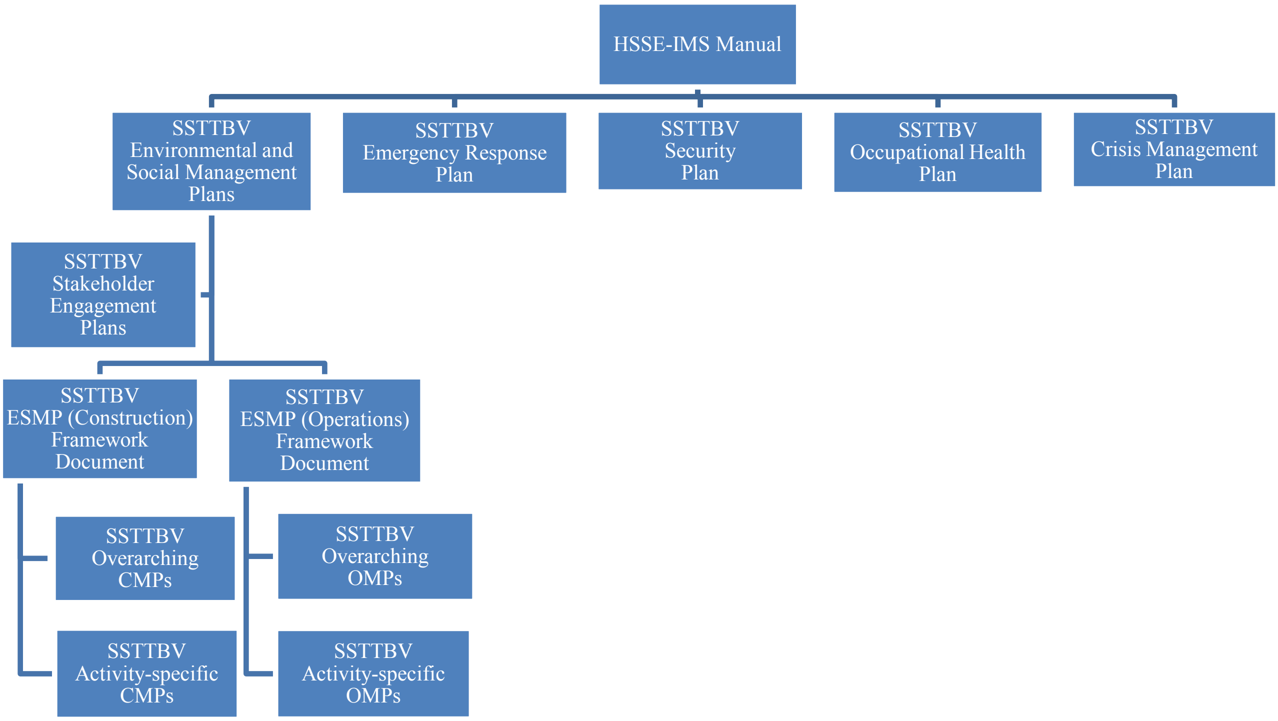


Figure 11.1: SSTTBV Management Plans

ESMPs are the principal mechanisms by which South Stream Transport B.V. will manage the significant environmental and social impacts of the Project construction and operations (as defined in the HSSE-IMS Manual) and ensure compliance with environmental and social, legal and other requirements applicable to the Project (Project commitments and applicable Project Standards).

The aim of this section is to provide information on the scope of each ESMP, including the detailed scope of the individual Construction Management Plans (CMPs) and related Framework Document and the indicative scope of Operations Management Plans (OMPs).

ESMPs and Environmental Monitoring Plans are an important part of the ESMS. The ESMS covers not only the South Stream Offshore Natural Gas Pipeline – Turkish Sector but also the Russia and Bulgaria Sectors of the overall South Stream Offshore Natural Gas Pipeline.

Construction Management Plans (CMPs) and Operations Management Plans (OMPs) are produced in two stages:

- **Pre-Permit CMP**– these CMPs are generated as part of the finalisation of the national EIA and international ESIA documents but before all permits are secured; and
- **Post-Permit CMP / OMP** (updated Pre-Permit CMPs/OMPs) – these are generated after the receipt of EIA/ESIA approvals and related environmental and construction/operations permits.

The final set of CMPs and OMPs are completed prior to the start of the Construction and Operational Phases, respectively.

The core environmental and social elements of the HSSE-IMS will therefore be related to the production and implementation of the ESMPs for the Construction and Operational Phases of the Project. ESMPs consolidate the management actions and commitments which are contained within:

- Environmental Aspects and Impacts Register;
- Project Commitments Register;
- HSSE Legal Register;
- National EIAs and Appropriate Assessments;
- International ESIAs;
- Permits; and
- Stakeholder consultations.

The inputs to ESMPs are illustrated in Figure 11.2

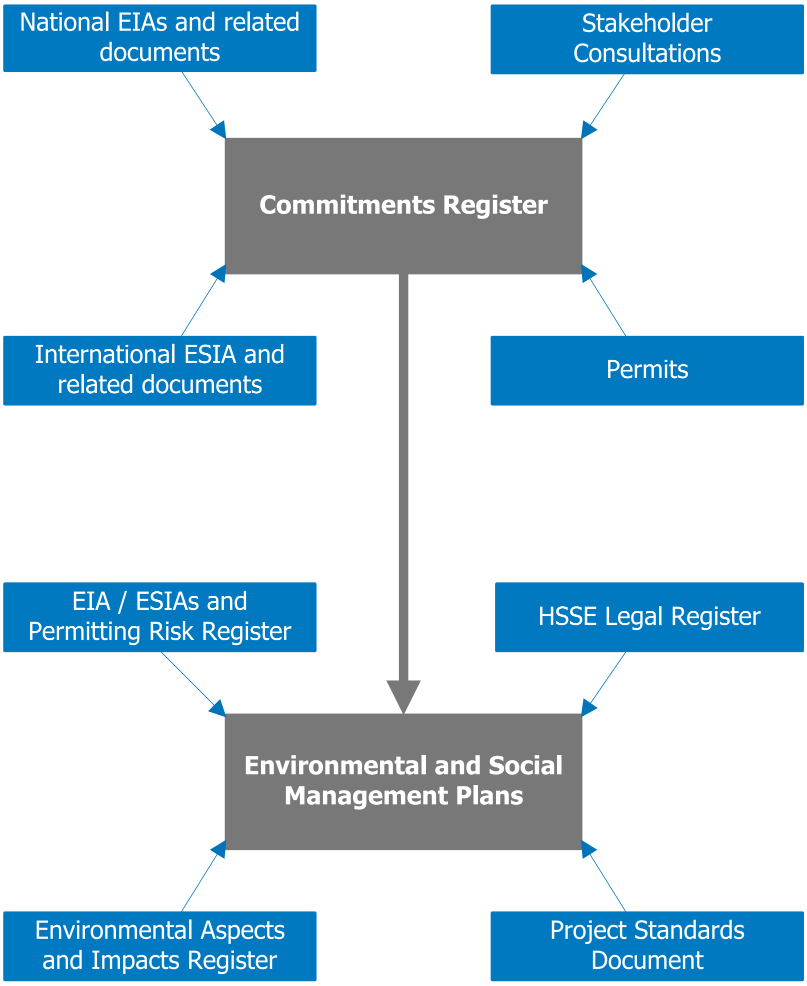


Figure 11.2: Inputs to Environmental and Social Management Plans

Separate ESMPs shall be developed for the Construction and Operational Phases of the Project. The overarching ESMP for each phase will consist of:

- An ESMP Framework Document to define the context of the specific ESMP and consolidate generic requirements with references to the subsidiary management plans; and

- Suite of management plans that describe mitigation measures, monitoring requirements and other actions related to control of environmental and social issues and to ensure compliance with the HSSE-IMS.

  Some of the plans are directly relevant to the requirements of this EIA Report:

- Emergency Response Plan which will be produced as an individual plan and not directly linked to the ESMPs, but the plan will be prepared by a company authorised by the Ministry and will be approved by relevant authorities. see Figure 11.1);
- Pollution Prevention Plan;
- Waste Management Plan;
- Cultural Heritage Objects Management Plan; and
- Vessel and Marine Transport Management Plan.

Construction Management Plans

The individual CMPs that form the Construction ESMP are:

- Activity-specific CMPs:
  - Vessels and Marine Transport CMP*;
  - Offshore Pipe-lay CMP*;
  - Landfall CMP (Russia);
  - Landfall CMP (Bulgaria);
  - Marshalling Yard CMP (Russia);
  - Marshalling Yard CMP (Bulgaria); and
  - Pre-commissioning CMP*;

  *Plans which are particularly relevant for the Turkish Sector.

- Overarching CMPs:
  - Labour & Working Conditions Management Plan;
  - Biodiversity Management Plan;
  - Cultural Heritage Management Plan*;
  - Stakeholder Engagement Plan*.

  * Plans which are particularly relevant for the Turkish Sector.

Overarching CMPs (which apply to all three Sectors of the South Stream Offshore Natural Gas Pipeline) are referenced as necessary within the activity-specific CMPs. The activity-specific CMPs capture any specific commitments related to overall topics to be implemented by South Stream Transport B.V. and its contractors and are specifically related to the activity.

Appropriate CMPs are issued to construction Contractors who are required to demonstrate how they will ensure compliance with these CMPs through the development of their own contract-specific plans and procedures.

It is anticipated that the following plans will be relevant for the Turkish Sector:

Activity-Specific CMPs

Vessels and Marine Transport CMP

This CMP covers Project commitments (mitigation, management and monitoring) relating to the day-to-day routine vessel and marine transport activities of all vessels associated with the Construction Phase, including pipe-laying vessels (pipe-lay specific activities are included in the Offshore Pipe-laying CMP), supply vessels, anchor handling tugs, support vessels and barges.

It covers all vessel operations including those within the Project area, vessels in port and vessels transiting between ports and the Project Area.

The provisional list of activities to be covered by the Vessels and Marine Transport CMP includes:

- Mobilisation and routing of vessels to and from site and vessel movements within the construction spread;
- Helicopter operations for crew changes;
- Delivery of pipe and other supplies (including crew change) by supply vessel;
- Delivery of hazardous substances by supply vessel;
- Marine survey and clearance activities;*
- Pipe-lay installation;*
- Refuelling of machinery;
- Maintenance of machinery;
- Use of vessel engines and power generation sets;
- Night time working and lighting;
- Hazardous materials storage and handling;
- Management of wastes generated by routine vessel operations (i.e. food waste, plastics, scrap metal, oily wastes, medical waste, paints/chemicals, incinerator ash, etc.) including transfer to shore for disposal;
- Use of on-board incinerators;
- Management of wastewater (including deck washings, bilge water and other oil contaminated water);
- Management of ballast water;
- Operation of vessel cooling water system and air conditioning;
- Extraction of seawater for fresh water maker/desalination unit;
- Emergency preparedness and response planning (including oil spill response);
- Notification and reporting to authorities;
- Managing interactions with other vessels (safety exclusion zones and communications); and
- Offshore surveys.

* This CMP will only cover the vessel operations associated with these construction activities. The construction activities themselves are covered by the Offshore Pipe-laying CMP.

Offshore Pipe-laying CMP

The scope of this CMP is restricted to the Project commitments (mitigation, management and monitoring) relating to the work activities of the pipe-laying vessels and only deals with activities in the immediate vicinity of the pipeline route. Therefore, it should be noted that it does not include activities of other vessels and general activities on the pipe-laying vessels that are not specific to the pipe-laying activity (which will be addressed in the Vessels and Marine Transport CMP).

The provisional list of activities to be covered by the Offshore Pipe-laying CMP relevant to the Turkish Sector includes:

- Line up of pipe, welding of pipe sections, weld testing and coating of welding joints;
- Laying pipe to seabed by S-Lay and J-Lay methods;
- Abandonment and Recovery Operations (e.g. in event of severe weather events);
- Specialist supervision (watching brief) in ecological/heritage sensitive zones (if required);
- Management of pipe-laying specific waste (i.e. bevelling scrap, welding flux, heat-shrink-sleeve cut-offs, polyurethane infill from field joint coating and concrete debris/dust etc.);
- Management of pipe-laying specific hazardous materials (i.e. component materials for field joint coating);
- Night time working (i.e. in terms of minimising light levels);
- Management of chance finds (cultural heritage and munitions);
- Notification and reporting to authorities (specifically relating to pipe-laying works); and
- Pipe-laying specific surveys.

Pre-Commissioning CMP

This CMP covers Project commitments (mitigation, management and monitoring) relating to pre-commissioning activities. The geographic scope of this CMP covers the whole South Stream Offshore Pipeline Project. It includes nearshore and offshore activities.

The provisional activities relevant to the Turkish Sector to be covered by the Pre-Commissioning CMP include:

- Flooding, cleaning & gauging of the pipelines; and
- Drying of the pipelines.

Overarching CMPs

Labour and Working Conditions Management Plan

The Labour and Working Conditions Management Plan will capture Project commitments (mitigation, management and monitoring) relating to:

- recruitment;
- safe, fair and healthy working conditions;
- terms of employment;
- discrimination;
- grievance procedure; and
- generic (i.e. not activity-specific) environmental and social training.

These issues are of relevance in relation to direct workers, contracted workers and supply chain workers. In particular it includes the requirements of IFC PS2 (Labour and Working Conditions) which includes International Labour Organisation standards as well as the need to meet national level requirements. It is anticipated that the commitments included will be relevant to SSTTBV and its contractors.

In the Turkish Sector this CMP will cover all personnel working on behalf of the Project within the Turkish EEZ.

Biodiversity Management Plan

The Biodiversity Management Plan will ensure that the Project recognises that in order to achieve sustainable development there is a need to:

- protect and conserve biodiversity;
- maintain ecosystem services; and
- sustainably manage living natural resources.

The Biodiversity Management Plan will focus on the wider, high level requirements relating to biodiversity and in particular in relation to protected areas or sensitive habitats that are likely to be the responsibility of SSTTBV rather than individual contractors. Topics likely to be included within the Biodiversity Management Plan relate to disturbance, scheduling, off-set compensation and restoration. Mitigation, management and monitoring requirements that are specific to an activity will be included within the activity-specific CMPs. It is expected that there will some overlap between the Biodiversity Management Plan and the activity-specific CMPs. Requirements relating to fisheries will also be included in the activity-specific CMPs.

Operations Management Plans

An Operations ESMP Framework Document will describe the ESMP including its constituent parts and key linkages to other elements of the HSSE-IMS. In particular, it will set out the context, purpose and content of the activity-specific and overarching OMPs and will describe the rationale behind their development and how it is intended that they are implemented.

The ESMP (Operations) Framework Document is also expected to provide a summary of the relevant policies, legal and regulatory requirements and other applicable standards relevant to the Project. Furthermore it is intended that the framework document will discuss issues such as roles and responsibilities, training, Key Performance Indicators, verification (i.e. inspection and audit) and reporting, which are likely to be common to all OMPs.

The provisional list of proposed Activity (Location) Specific OMPs is as follows:

- Offshore Pipelines OMP*;
- Russian Landfall OMP (not relevant to the Turkish Sector); and
- Bulgarian Landfall OMP (not relevant to the Turkish Sector).

The provisional list of proposed Overarching OMPs is as follows:

- Monitoring OMP*; and
- Social and Employment OMP*.

* Plans which are relevant for the Turkish Sector.

Each OMP describes environmental and social mitigation, management and monitoring requirements and actions in relation to normal operating conditions and planned maintenance, minor repairs and minor incidents. Unscheduled major repair work relating to the offshore pipelines will be subject to impact assessment activities and the development of bespoke management plans and procedures. It is anticipated that emergency situations would be covered by a separate emergency response procedure (section 11.2.2).

It is anticipated that decommissioning activities will be covered by specific management plans to be developed during the operations phase. The remainder of this section provides indicative details of each of the OMPs.

Activity–Specific OMPs

Offshore Pipelines OMP

It is proposed that this OMP defines the Environmental and Social mitigation and management measures that apply to planned routine and day-to-day activities undertaken along the offshore pipeline system during pipeline operations.

These activities primarily relate to scheduled maintenance activities, including survey and inspection of the pipeline condition via:

- Visual inspection of the pipelines by ROV to identify any pipeline movement or damage, scouring of pipeline protection, or formation of free-spans, or other risks to the pipeline;
- Operation of a pipeline leak detection system; and
- Periodic use of intelligent PIGs.

The provisional list of supporting activities relevant to the Project to be covered by this OMP includes:

- Mobilisation and routing of vessels to and from site and vessel movements along pipeline;
- Specialist supervision in ecological/heritage sensitive zones (if required);
- Night time working and lighting;
- Refuelling of machinery;
- Maintenance of machinery (including deck/equipment wash down);
- Use of power generation sets (for example diesel generator);
- Hazardous materials storage and handling;
- Management of wastes;
- Use of onboard incinerators;
- Management of wastewater (including deck washings, bilge water and other oil contaminated water);
- Management of ballast water;
- Operation of vessel cooling water system and air conditioning;
- Extraction of seawater for fresh water maker/desalination unit;
- Emergency preparedness and response planning (including gas loss of containment and oil spill response);
- Notification and reporting to authorities; and
- Managing interactions with other vessels (safety exclusion zones and communications).

However, the following activities are not covered by this OMP:

- Other types of unscheduled maintenance and repair works. These will be subject to permitting and impact assessment activities and development of bespoke management plans and procedures; and
- Environmental monitoring (to be covered by the Monitoring OMP).

Overarching OMPs

Monitoring OMP

The Monitoring OMP will outline the Environmental and Social monitoring to be undertaken during pipeline operations. The objectives of the Environmental and Social monitoring activities covered by this OMP are intended to be to:

- assess recovery of the environment following the construction of the Project;
- assess physical condition of the pipelines and identify any potential impacts or risks to the environment;
- assess potential environmental/social effects of the long-term presence of the pipelines and facilities included as part of the South Stream Offshore Pipeline; and
- assess and control potential environmental and social impacts associated with routine/day-to-day operation and maintenance activities (operation/maintenance activities are further described in the relevant OMPs).

Decommissioning Management Plans

At the time of writing this EIA Report, the strategy for decommissioning is unknown and no decommissioning management plan has been prepared. It is likely that the technological options and preferred methods for decommissioning of pipelines will be different in 50 years' time. The Decommissioning activities will be carried out according to the international and national legislation and regulations and GIIP prevailing at the time.

11.2.1 Emergency Response Plan

The Emergency Response Plan (ERP) being prepared by South Stream Transport B.V. is a general plan that has been prepared to detail the procedure and measures which contractors are expected to follow during an emergency. This covers both the Construction and Operational Phase of the Project. The contractors, who will be selected during the Construction and subsequent phases, will prepare their own detailed plans and procedures and will submit them for approval of South Stream Transport B.V. prior to the commencement of any works.

Furthermore, the Emergency Response Plan enforced by the Law Pertaining to Principles of Emergency Response and Compensation for Damages in Pollution of Marine Environment by Oil and Other Harmful Substances, No:5312 and its governing regulations, will be prepared by an institution authorized by the Ministry prior to the Construction Phase and the required approvals will be received.

The ERP includes:

- Emergency Response / Crisis Management Strategy;
- Emergency Response Planning;
- Emergency Risk Analysis;
- Emergency Response Plans;
- Crisis Management Plan;
- Information on Bridging the South Stream Transport B.V. ERP to that of the chosen Contractor(s);
- Roles & Responsibilities;
- Site-level Emergency Response Team;
- South Stream Transport B.V. Emergency Response Team;

- Call-out procedure of Emergency Response Team;
- Role of Duty Emergency Contact Person;
- Role of Emergency Team Leader;
- Role of Emergency Team Coordinator;
- Role of Other Persons/Specialist Support;
- Competency and Training;
- Communication and Emergency Notification and Reporting;
- Emergency Contacts List;
- Emergency Drills;
- Examinations, Inspections and Tests; and
- Review of Emergency Response Plans.

11.2.2 Pollution Prevention Plan

South Stream Transport will not develop a specific Pollution Prevention Plan. Instead, this subject will form an important part of the Construction Management Plans and Operations Management Plans that are being developed for the overall South Stream Offshore Pipeline. In the Turkish Sector, construction phase pollution prevention issues will primarily be managed by the Vessels and Marine Transport and Offshore Pipe-lay CMPs. During the operations phase, pollution prevention will primarily be managed via the Offshore Pipelines OMP. All vessels will have a Pollution Prevention Plan, meeting IMO’s requirements (including compliance with MARPOL).

11.2.3 Waste Management Plan

South Stream Transport will not develop a specific Waste Management Plan. Instead, this subject will form an important part of the Construction Management Plans and Operations Management Plans that are being developed for the overall South Stream Offshore Pipeline. In the Turkish Sector construction phase waste management issues will primarily be managed by the Vessels and Marine Transport and Offshore Pipe-lay CMPs. During the operations phase, waste management will primarily be managed via the Offshore Pipelines OMP. All vessels will have a Waste Management Plan, meeting IMO’s requirements (including compliance with MARPOL).

11.2.4 Cultural Heritage Management Plan

The Cultural Heritage Management Plan is currently being developed. This plan will include all relevant details to ensure the effective management and protection of any identified Cultural Heritage objects during the Project’s life-cycle. Chance Finds Procedures will also be developed in accordance with applicable regulations and in consultation with the MoCT.

11.2.5 Vessel Traffic Management Plan

South Stream Transport will develop a Vessel Traffic Management Plan as part of the Construction Management Plans and Operations Management Plans that are being developed for the overall South Stream Offshore Pipeline. In the Turkish Sector, during the construction phase vessel traffic issues will primarily be managed by the Vessels and Marine Transport CMP. During the Operational Phase, vessel traffic will primarily be managed via the Offshore Pipelines OMP.

11.3 Monitoring Plan for Construction and Operation Phases

Requirements and commitments for environmental and social monitoring across the three countires of the overall South Stream Offshore Natural Gas Pipeline are derived from national EIA reports, international ESIA reports, legal requirements, and specific environmental permits. The environmental and social monitoring obligations are consolidated in the Commitments Register[1].

The Environmental and Social Management Plans (ESMPs) for construction and operations define how the Project will comply with the requirements contained in the Commitments Register, including any requirements relating to environmental and social monitoring.

The monitoring programme is then implemented according to national requirements, in conformance with national reference standards and protocols. In the absence of national reference standards and protocols, environmental and social monitoring is carried out in accordance with recognised international standards, e.g. International Standards Organisation (ISO) or European Union (CEN).

The framework for environmental and social monitoring for the overall South Stream Offshore Natural Gas Pipeline is illustrated below in Figure 11.3:

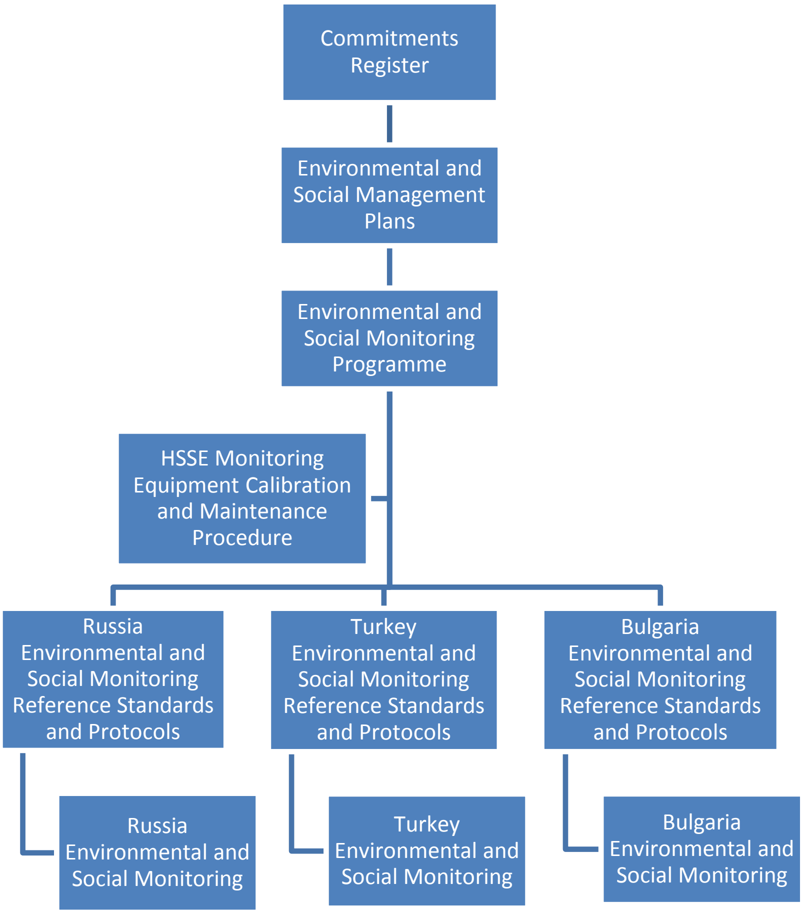


Figure 11.3: Structure of Environmental and Social Monitoring Programme

The environmental and social monitoring programme covers all topics and requirements for monitoring to demonstrate compliance or verify conclusions related to the EIA, ESIA, permit

[1] Commitment register is prepared for contractors by South Stream B.V.

approvals, including emissions from construction activities, pre-commissioning, commissioning and operations, and immissions related to the ambient environment.

The scope of the environmental and social monitoring programme includes:

- *Physical and chemical environment*, including air, water, soil, groundwater, noise;
- *Biological environment*, including terrestrial and marine ecosystems and related flora and fauna; and
- *Socio-economic conditions,* including cultural heritage.

The programme defines the type and frequency of monitoring, roles and responsibilities and the requirements for the maintenance and calibration of the monitoring equipment.

The Turkish Sector environmental and social monitoring programme will be country-specific and the scope depends upon specific national requirements and any over-arching international requirements derived from the ESIA. The Turkish Sector plan will be developed after completion of the EIA and ESIA and receipt of the main environmental permits.

If the Project receives an EIA Positive Decision, the Project Owners are required to engage institutions that have been certified within the scope of the EIA acceptance Notification to monitor whether the EIA commitments are fulfilled in the beginning of Construction Phase. The institution/organisation authorised by the Project Owner will be responsible for preparing the Construction Phase Monitoring-Control Form (Annex-4 of the Notification) and submit to the Ministry within twenty days of the end of the monitoring-control period that has been specified in the Final EIA Report.

Reports summarising data collected in the Turkish Sector Monitoring Programme will be regularly submitted to the MoEU and to other institutions upon their request.

12 CONCLUSIONS

12.1 Non-Technical Summary of the Project

The South Stream Offshore Natural Gas Pipeline is the offshore component of the South Stream Pipeline System that will deliver natural gas from Russia to the countries of Central and South-Eastern Europe. When complete, the pipeline system will extend over more than 2,300 kilometres (km).

The South Stream Offshore Natural Gas Pipeline will comprise four parallel 32 inch (813 millimetres (mm)) diameter pipelines extending approximately 931 km across the Black Sea from the Russian coast near Anapa, through the Turkish Exclusive Economic Zone (EEZ), to the Bulgarian coast near Varna (Figure 12.1). In addition to the offshore pipelines, the South Stream Offshore Natural Gas Pipeline will also consist of short onshore parts, known as landfall sections, in Russia and Bulgaria, with landfall facilities.

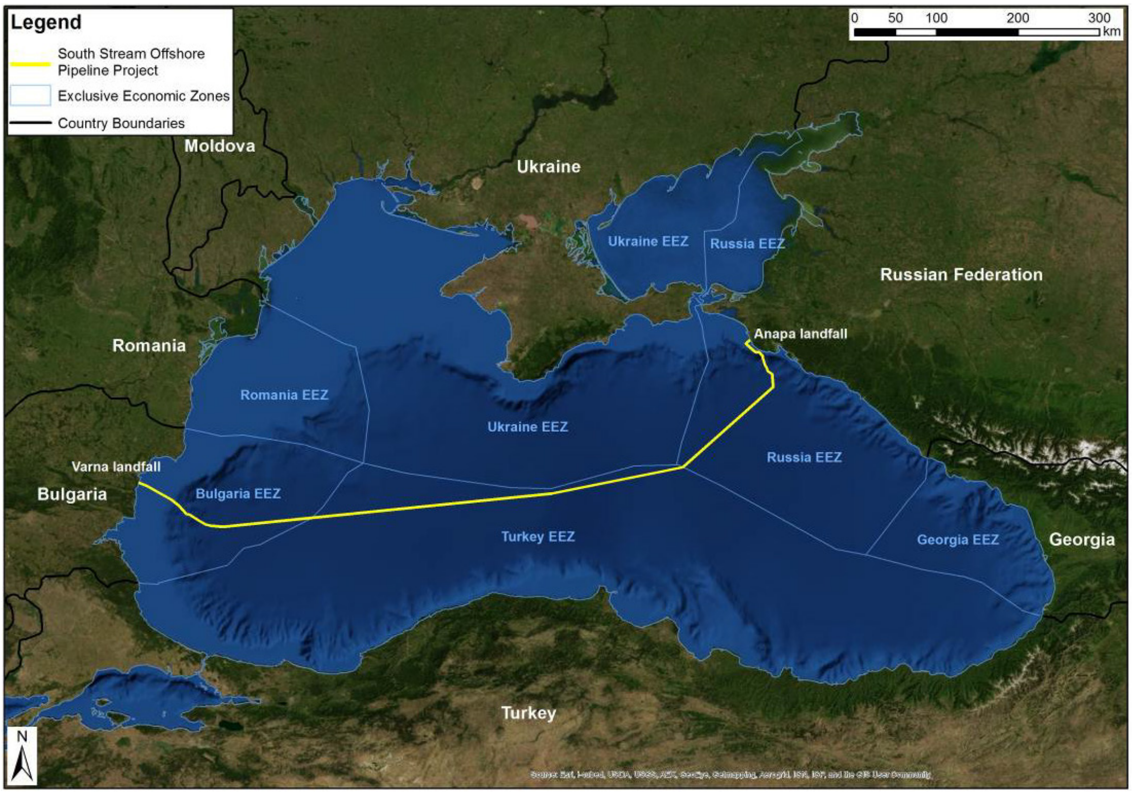


Figure 12.1: South Stream Offshore Pipeline

As introduced in **Chapter 1 Introduction**, the Turkish part of the South Stream Offshore Natural Gas Pipeline is known as the 'South Stream Offshore Natural Gas Pipeline – Turkish Sector' and is referred to throughout this EIA Report as 'the Project'.

The Project is approximately 470 km in length and runs through the Black Sea from the border between the Russian and Turkish EEZs in the east to the border between the Turkish and Bulgarian EEZs in the west (Figure 12.2). Within the Turkish EEZ the pipelines will be laid directly on the seabed within a 2 km wide corridor at a depth ranging between approximately 2,000 m and

2,200 m. At its closest location to the Turkish mainland the Project is located over 110 km from Sinop.

South Stream Transport B.V. is a joint venture company, and is responsible for developing the Project. The Russian company OAO Gazprom holds a 50% stake. The Italian company Eni S.p.A has a 20% stake, whilst the French energy company Électricité de France (EDF Group) and German company Wintershall Holding GmbH (BASF Group) each hold 15%.

Engineering and design studies for the Project began in 2008. This included the evaluation of options for the transport of gas from Russia before selecting the current pipeline route. The choice of route for the Project was based on technical and environmental factors described in **Chapter 4 Grounds for the Route Selection and Assessment of the Alternatives** of this EIA report. These factors led to the selection of the current route (Figure 12.2) through the Turkish EEZ.

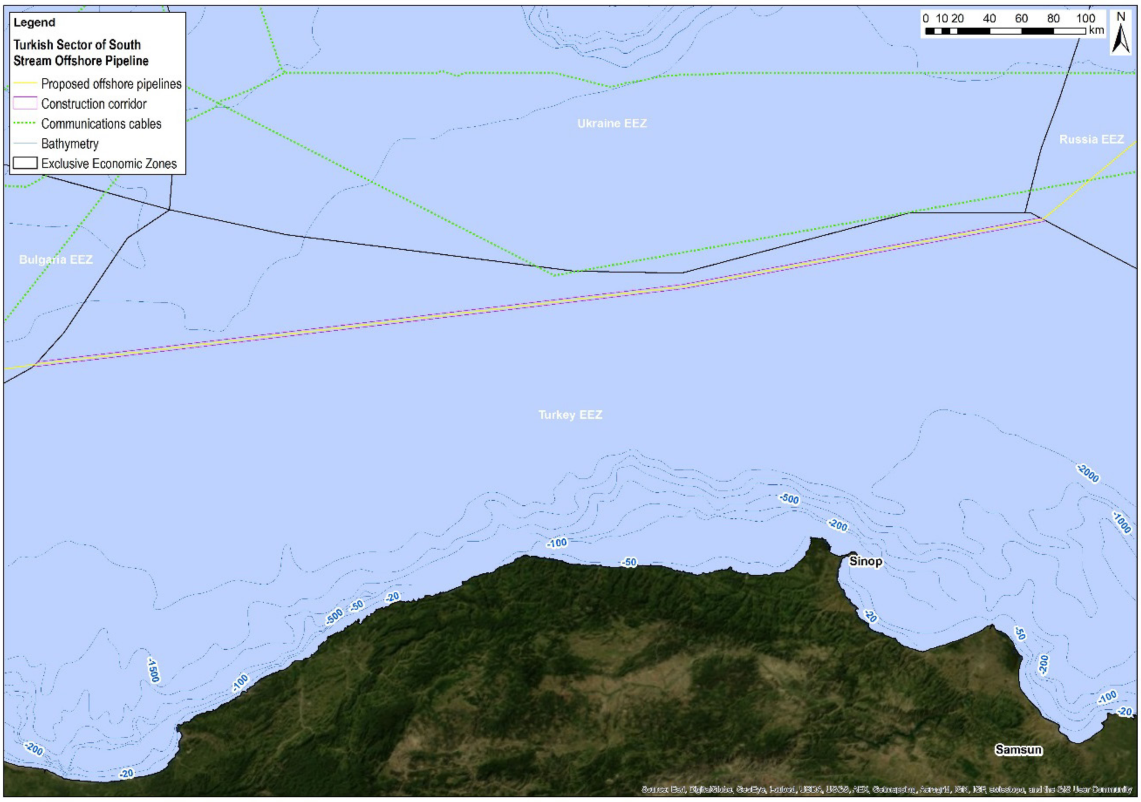


Figure 12.2: South Stream Offshore Pipeline – Turkish Sector

Construction of the overall South Stream Offshore Natural Gas Pipeline is scheduled to start in 2014 and run until 2017. Construction within the Turkish EEZ is currently scheduled to commence in late 2014. The construction of the first pipeline will be completed prior to the other three pipelines and gas flow through the first pipeline is planned for as early as 2015. In order to reach the total capacity by 2017, construction of the second and third pipelines will be performed in parallel.

Accordingly, the second and third pipelines are planned to be in operation in late 2016 and mid 2017 respectively and the fourth pipeline by late 2017. The pipelines will be designed to transport gas for at least 50 years. The maximum capacity of all four pipelines together will be 63 billion cubic metres (bcm)/year, or approximately 15 bcm/year per line. The pipelines will each have a design pressure of 300 bar.

The pipelines will be constructed from 12 m sections of steel pipe that will be welded together and coated inside, to improve internal cleanliness and gas flow, and outside to protect the pipelines from corrosion. The pipelines will be further protected against corrosion by a cathodic protection system. The pipes will have a wall thickness of 39 mm.

The four pipelines will be installed using a pipe-laying vessel (a specialised ship or barge for underwater pipeline construction, an example of which is shown in Figure 12.3). The pipelines will be laid directly on the seabed. No excavation of or filling over the seabed is anticipated. Pipes are lined up and welded together on board the vessel, and welded sections are lowered into the sea as new segments are added. The Project is proposing a 2 km radius temporary safety exclusion zone around the pipe-laying vessel to prevent the potential for vessel collisions.

Bunkering (i.e. the process of supplying a ship with fuel or water) and waste disposal facilities and temporary storage facilities, such as marshalling yards and shore bases, will be needed for the construction process. Under current Project planning, these will be located in Russia or Bulgaria; there are no plans to use facilities in Turkey.

Once each pipeline has been built, it will be tested to ensure that it is safe, intact and fit to operate. This process is called pre-commissioning and will include hydrotesting (testing the pipeline with water) of the shallow water sections of the pipeline in Russia and Bulgaria. Hydrotesting of the deep water sections of the pipelines, including the pipelines within the Turkish EEZ, will not be needed. Turkish waters will therefore not be impacted by any pre-commissioning activities as these activities will be undertaken within Russian and Bulgarian waters only. Pipelines in the Turkish EEZ will be cleaned, gauged and dried to check pipeline integrity.

The pipelines will operate in compliance with national regulatory requirements of the Republic of Turkey and in line with internationally recognised standards. An operational safety zone will be determined in consultation with the relevant Turkish authorities in compliance with Turkish requirements and relevant industry and international standards prior to construction, to protect the pipelines from other activities. A maintenance programme will be implemented. In addition, the pipelines will be regularly monitored from a central control room by means of continuously measuring the pressure and the flow rates. The control room will not be located in Turkey. In the unlikely event of damage to any of the pipelines, or if a leak is detected, emergency procedures will be implemented. These procedures include emergency shutdown followed by an inspection of the pipeline.

At the end of its operational life, i.e. after an expected 50 years, the offshore pipeline will be decommissioned (shut down). Decommissioning of the pipeline will be undertaken in accordance with national legislation applicable at that time and good international industry practice (GIIP), in liaison with the regulatory authorities.

Image supplied courtesy of Saipem

Figure 12.3: Example of Pipe-laying Vessel

12.2 Summary of the Assessment of Main Environmental Impacts

The potential environmental impacts of the Project have been assessed based on the anticipated activities related to its Construction, Operational and Decommissioning Phases described in **Chapter 1 Introduction**. The assessment has been performed in line with the Turkish EIA Regulation described in **Chapter 2 Environmental Impact Assessment Approach** and is presented in **Chapter 6 Assessment of the Physical Environment, Chapter 7 Assessment of the Biological Environment and Chapter 10 Cumulative Impact Assessment** of this EIA Report. A comparison of impacts to relevant Turkish standards is given in **Chapter 9 Assessment of Project Activities** of this EIA Report.

The following describes the potential impacts arising from the Project. As the discussion in **Chapter 6 Assessment of the Physical Environment, Chapter 7 Assessment of the Biological Environment and Chapter 10 Cumulative Impact Assessment** indicates, all identified impacts will be temporary in duration and localised in extent. This is explained by the nature of the Project, its location more than 110 km from the Turkish mainland, the limited occurrence of sensitive receptors in the Project Area as well as the design controls and mitigation measures proposed by the Project (see Section 12.3).

12.2.1 Seabed Geology

Limited and localised mobilisation of sediments as a result of the placement of the pipeline on the seabed during construction will occur. However, sediment plumes are unlikely to deteriorate water quality, given the depth at which the pipeline is being laid.

Whereas geological features will not be impacted by pipe-laying activities the presence of such features can adversely affect the long term viability of the pipelines. Example geological features, which are often referred to as geohazards, include mud volcanoes and active gas seeps that are known to exist on the abyssal plain of the Black Sea. The routing of the pipeline has been selected to avoid such geological features. Furthermore, the placement of the pipelines on the seabed will be monitored in real time using ROVs which will assist in the avoidance of any such seabed structures as pipe-laying takes place.

Routine operational activities will not interact with seabed sediments or other geological features.

12.2.2 Water Quality

Water quality has the potential to be impacted by the waste and wastewater that will be generated as a result of construction activities. Wastes generated from the Construction Phase will include domestic waste water, such as black (sewage) and grey waters (non-sanitary wastewater), domestic solid waste, waste oils (petroleum and petroleum derived products), and bilge water.

All waste and wastewater within the scope of MARPOL generated will be managed in accordance with the requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL) and relevant Turkish Legislation and are not expected to generate any significant impacts to the marine environment. Black water will be treated on board the vessels and when treated may be discharged at sea, along with grey water. All liquid wastes and waste waters will be managed according to MARPOL 73/78, the Turkish Regulation on Waste Collection from the Ships and Control of Wastes and the Turkish Water Pollution Control Regulation. Other specific waste types (canteen waste, wood, paper, oily waste etc.) may be incinerated on-board the vessels or transferred to shore based licenced facilities for disposal.

All waste that cannot be treated on board the vessels will be stored on board, transferred to a supply vessel and finally disposed of at a legally certified disposal site. There is not planned to use Turkish disposal sites.

The unlikely occurrence of accidental oil spills associated with the Project's activities or a loss of gas from the pipelines could also potentially impact water quality. In such an event, the Project's Emergency Response Plan (described in **Chapter 11 Environmental and Social Management System** of this Report and enclosed in Appendix 11.A) would be deployed which would limit the extent of any loss and any resulting impact. Pollutants would rapidly become diluted in the open waters of the central Black Sea so that any impacts are likely to be local and short-term. Natural gas would rapidly disperse through the water column.

Water quality impacts during the Operational Phase are likely to be minimal, limited to discharges of treated black and grey water from vessels associated with routine maintenance operations.

12.2.3 Air Quality

Construction activities will result in the release of exhaust emissions to the air from the pipe-laying, supply and support vessels and helicopters. Such emissions will be minimal in the context of other marine traffic in the Black Sea. Air dispersion modelling carried out for the Project, which is reported in **Chapter 9 Assessment of Project Activities** and **Appendix 6.A**, has established that, given the location of the Project Area within the Turkish EEZ, exhaust emissions from construction activities are unlikely to impact sensitive human or biological receptors.

Air emissions during the Operational Phase are likely to be minimal and associated with routine maintenance operations.

12.2.4 Vessel Traffic

The Project is proposing a 2 km radius safety exclusion zone around the pipe-laying vessel to minimise the potential for vessel collision. The construction spread (pipe-laying and supporting vessels) will move at very low speeds, less than two nautical miles a day. The spread can be considered as a stationary object rather than as ordinary vessels and other vessels will be notified of its daily position to minimise the risk of vessel collisions. A collision risk analysis carried out for the Project and reported in **Chapter 9 Assessment of Project Activities** and **Appendix 9.A** has concluded that the probability of a collision during Construction is extremely low.

During the Operational Phase of the Project, traffic will be limited to routine and occasional maintenance vessels and it is therefore anticipated that there will be no marine traffic impacts during this Phase.

12.2.5 Cultural Heritage

As a result of the anoxic conditions in the Black Sea, which inhibit corrosion and microbial degradation, the preservation potential for any cultural heritage object is greatly enhanced below a water depth of 120-200 m. As such, it is likely that any remains from wooden vessels have been well preserved.

As presented in **Chapter 6 Assessment of the Physical Environment,** interpretation of geophysical data followed by visual inspection of selected targets identified only two cultural heritage objects greater than 5 m within 150 m of any of the four pipelines. They are shipwrecks from the post-Medieval to Modern period (18th to 19th century).

In order to minimise the potential for impacts the pipeline routes have been amended so that they will avoid the identified cultural heritage objects (CHOs) by a distance no less than 150 m. Appropriate measures to minimise the potential for impacts during construction on these known CHOs will be developed as part of the Cultural Heritage Management Plan. In addition, pre-lay surveys will be undertaken and a Chance Find Procedure set up for the Project to ensure no impacts occur to any previously unidentified CHO's (should they exist). The opinion letter of the Ministry of Culture and Tourism is shown in Appendix 5.A.

It is anticipated that there will be no impact on cultural heritage during the Operational Phase of the Project.

12.2.6 Marine Ecology

There are no nationally or internationally protected areas within the Turkish EEZ and hence within the Project Area. A number of internationally and regionally protected species may however, be present in the Project Area; these are mobile species that do not rely on habitats within the Project Area for their survival but may migrate across or feed within it.

There is the potential for underwater noise, waste and wastewater discharges and vessel lighting, to affect some marine species during the Construction Phase.

Underwater noise will be generated by the vessels involved in construction activities. An assessment of underwater noise was undertaken for the Project and is reported in **Chapter 7**

Assessment of the Biological Environment and **Appendix 7.B**. This assessment looked at the effects of underwater noise on both fish and marine mammals and concluded that only mild behavioural changes are expected and will be limited to the vicinity of the Project Area. Any impacts on fish (including migratory patterns of the European anchovy) are expected to be minimal.

As described above, waste and wastewater discharges will be limited and will be managed in accordance with MARPOL and relevant Turkish Legislation impacts on marine ecological resources are therefore not expected.

Impacts to birds as a result of lighting from vessels is expected to be limited.

The seabed of the deeper parts of the Black Sea is unlikely to support significant biological communities due to the anoxic conditions below approximately 150 m and therefore benthic communities will not be impacted by Project construction activities.

The unlikely occurrence of accidental oil spills associated with the Project's activities or of a loss of gas from the pipelines could also potentially impact marine species. Pollutants would however rapidly become diluted in the open waters of the central Black Sea and most species encountered in the Project Area are highly mobile so that any impacts are likely to be local and short-term.

Introduction of alien species of algae or other marine organisms that could pose a threat to the marine ecosystem of the Black Sea by the Project's vessels have been considered. The possibility of this event is, however, unlikely given commitments to adopt a voluntary ballast water management plan in compliance with the International Maritime Organisation (IMO) recommendations as described in **Chapter 7 Assessment of the Biological Environment.**

It is not anticipated that there will be any significant impacts on marine ecology during the Operational Phase.

12.2.7 Socio-Economic

Turkish fishing vessels are not expected to intersect the Project Area during either the Construction or Operational Phases. Impacts of the Project on the migration patterns of the European anchovy have been assessed in relation to the potential to adversely impact the Turkish commercial fishing industry. The European anchovy is the most commercially important species to the Turkish fishing industry, both in terms of quantity caught and economic value, and its migration intersects the Project Area twice per year. Even though the timing of the migration will coincide with some construction activities, the lateral extent of the construction spread and the extent of any likely avoidance by the fish, are both small compared to the likely width of the migration corridor. As such, it is unlikely that the migration would be significantly disturbed, therefore no impact is anticipated on the catch levels achieved by the Turkish fishing industry.

The Directorate General of Agricultural Production and Development has been asked for their opinion on reviewing and re-examining the present conditions in the Project Area. According to the opinion received from the Directorate General; relevant measures have been determined to control and to mitigate potential impacts to the marine ecosystem during the construction and operational phases of the project, and the Project Area is deemed to comply with the Aquaculture legislation as it is located in an offshore area where conditions are such that life diminishes significantly at depths lower than 150 m. The aforementioned opinion is provided in **Appendix-5.A**.

Due to the location and nature of the Project, the Turkish fishing industry is very unlikely to be impacted by the Project. It is possible that future resource exploration or development activities in the Turkish EEZ could be impacted by the Project due to the permanent operational exclusion zone on the seabed which will be in place for the Project. The operational exclusion zone is limited to a narrow corridor, encompassing the width of the four pipelines and the safety zone on either side of the outer pipelines, covering the 470 km length of the Project across the Turkish EEZ. In the event that resource exploration or extraction activities take place within the vicinity of the Project Area, this would necessitate the use of horizontal directional drilling techniques on the seabed to avoid direct impacts to the Project and proximity agreements would be negotiated with the relevant authorities and third parties.

12.2.8 Cumulative Impacts

Cumulative impacts are impacts which result from the addition of Project impacts combined with existing, planned or future projects or developments. The cumulative assessment has been conducted in relation to other pipeline projects and the cumulative effects of the Russian and Bulgarian Sectors of the South Stream Offshore Natural Gas Pipeline. A particular focus was given to underwater noise, air quality, waste generation and unplanned events.

Based on current Project planning, there will only be one construction spread in the Turkish Sector at any one time. The minimum distances between the construction spreads of the Project and the Russian and/or Bulgarian Sectors is greater than 400 km. Therefore no significant cumulative impacts are expected.

Oil and gas exploration surveys are planned for 2015 in the vicinity of the Project Area. The timing of these surveys is yet to be confirmed, however, due to the nature of the surveys, the distances involved between the Project's construction spread and the likely location of the surveys, no significant cumulative impacts are expected.

No cumulative impacts are expected during the Operational phase.

12.2.9 Transboundary Impacts

Transboundary impacts from activities associated with the Russian or Bulgarian Sector of the South Stream Offshore Natural Gas Pipeline affecting Turkey have been assessed. A particular focus was given to underwater noise, air quality, waste generation and unplanned events.

Only the unlikely occurrence of accidental oil spills associated with the Project's activities may have the potential to cause transboundary impacts. However, the Project has identified a series of design controls which would limit or minimise such impacts. Spills which in near shore Russia and Bulgaria will not impact the Turkish EEZ or coastline. Some open water spills close to the borders of the Turkish EEZ could potentially cause a spill slick to travel into waters of the Turkish EEZ. However, as discussed in **Chapter 10 Cumulative Impact Assessment** spills occurring in the open sea appear to cause no lasting effects; the spilled oil is eventually dispersed and dissipated by the effects of wind, waves and currents and no impacts are expected near the coastline.

12.3 Summary of the Evaluation of Mitigation Measures

As presented in **Chapter 2 Environmental Impacts Assessment Approach, t**he EIA has been performed taking into account any control measures that have been incorporated into the design of the Project to limit potential impacts. These are referred to as "design controls" and have been listed in the introductions of each impact assessment section in **Chapter 6 Assessment of the Physical Environment, Chapter 7 Assessment of the Biological Environment.**

Additional measures aimed at further reducing or controlling identified impacts were proposed when necessary. These are referred to as "mitigation measures". Table 12.1 provides an overview of all of the design control and mitigation measures which will be incorporated into the Project.

Table 12.1: Design Control Measures

Design Control	Receptor
Construction spread minimised as far as practical around vessels.	Ecology
Use of screening and correctly angled lights	
Minimise use of lighting where possible. Appropriate lighting design during night-time works will be implemented.	
Consultation with anticipated marine users.	
Use of protective filters to prevent intake of fish and plankton.	
Use of modern vessels and plant and undertaking of regular maintenance checks.	
All vessels will implement a voluntary ballast water and sediment management plan in compliance with the International Maritime Organisation (IMO) International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM). Plans will contain a detailed description of the actions to be taken to implement the Ballast Water Management requirements and supplemental Ballast Water Management practices of the Convention. Vessels that originate outside the Black Sea should continuously ballast en route to the Project Area to avoid translocation of invasive / non-native species.	
Develop Emergency Response Plan and Spill Response Plans	
Code of conduct for support and supply vessels to avoid or minimise disturbance to marine mammals.	
All bunkering activities will be undertaken in line with the contractor's Environmental Management Plan / Pollution Prevention and Control Plan and Oil Spill Prevention and Response Plan.	
Use of modern, fuel efficient vessels and equipment, where possible.	Air Quality
Compliance with relevant provisions of MARPOL 73/78 relating to ODSs, emissions to air from engines and waste incineration, fuel oil specification, and discharges of waste waters and wastes. The provisions of the Convention of Long Range Transboundary Air Pollution (CLRTAP) will be complied with.	
Regular maintenance checks of engines and equipment.	
Pipeline routing has been optimised based on geophysical and geotechnical constraints in order to avoid physical features and ensure that no seabed intervention is required in the Turkish sector. The pipeline will be laid directly on the seabed to minimise seabed disturbance.	Geology

Following selection of the continental slope crossings in Bulgaria and Russia a straight line route through the Turkish EEZ was selected as far as possible to join up with the required EEZ boundary crossing locations for Bulgaria in the west and Russia in the east. This minimised the pipeline length and therefore its footprint on the seabed.	
The pipe-lay vessels will be Dynamically Positioned. No anchors will impact the seabed.	

Design Control	**Receptor**
All activities will be undertaken in line with the Project's Environmental and Social Management Plans (ESMPs) including an Emergency Response Plan addressing spills.	Hydrology/Oceanography
All activities will be undertaken in line with contractor's Environmental Management Plan / Shipboard Oil Pollution Emergency Plan (SOPEP) compliant with Marpol 73/78 Annex I and International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC).	
A waste management plan will be adopted as part of the Environmental and Social Management system developed for the Project (see section 11.2.3 of this Report).	
Vessel discharges will be compliant with Marpol 73/78 cognisant of the Black Sea's status as an IMO special area with respect to oil and garbage.	Water Quality
All activities will be undertaken in line with the Project's Environmental and Social Management Plans (ESMPs) including an Emergency Response Plan addressing spills.	
All activities will be undertaken in line with contractor's Environmental Management Plan / Shipboard Oil Pollution Emergency Plan (SOPEP) compliant with Marpol 73/78 Annex I and International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC).	
A waste management plan will be adopted as part of the Environmental and Social Management system developed for the Project (see section 11.2.3 of this Report).	
Avoidance was considered during the route selection process. The route was optimised to make sure that a 150 m buffer is included around identified CHO.	Cultural Heritage
Adoption by South Stream Transport of a comprehensive Cultural Heritage Stewardship programme. The objective of such programme is to ensure that all parties involved in the construction, operation and decommissioning of the pipeline are at all times aware of the importance of Cultural Heritage and that compliance with national legislation and international conventions is achieved during any activity associated with the Project.	
Appropriate staff training in cultural heritage awareness will be undertaken by staff and subcontractors during all Phases of the Project to assist in the prevention of interference or accidental damage to cultural heritage. The approach to this training will be included within the Project CHMP.	
Should chance finds of cultural heritage objects occur during Project construction activities, the Chance Finds Procedure will be implemented to allow the monitoring archaeologist to record and assess the find, and carry out an appropriate avoidance or mitigation response. The Project CHMP will be discussed with the relevant Turkish authorities. The relevant authorities will be informed of all chance finds A Chance Find Procedure appropriate to the Operational Phase of the Project will be developed in advance of the commencement of this Phase. The Chance Find Procedure for all Phases of the Project will be developed in consultation with the Turkish Ministry of Culture and Tourism.	
Reducing the risk of looting, vandalism and damage to cultural heritage objects during the Construction and Pre-commissioning and Operational Phases of the Project will be achieved through implementation of the Cultural Heritage Management Plan, including staff cultural heritage awareness training.	

Design Control	Receptor
During Construction specific measures will be taken: o All known marine cultural heritage objects will be delineated on Project maps and in the Project GIS database, which will be available to the design team and construction contractors. Project mapping and GIS will be updated, as necessary, should any chance finds of cultural heritage objects occur. o Real time monitoring of the pipe-laying process to ensure that the pipeline is installed at the stipulated distance from any CHOs. o Potential impacts from the use of ROVs for monitoring and surveying will be minimised by limiting propeller or thruster washing, proper tether management and avoiding ROV strikes by careful piloting; o During surveying and pipe-laying works, archaeological watching briefs will be undertaken to monitor surveying and construction activities. A qualified archaeologist will monitor during the pre-lay surveys and pipe-laying activities to determine the presence or absence of potential cultural heritage objects and to ensure that known cultural heritage sites are not impacted by surveying and pipe-laying activities. Archaeological watching briefs will be undertaken by appropriately qualified and experienced cultural heritage professionals approved and permitted by the competent authorities.