TÜRKİYE PETROLLERİ ANONİM ORTAKLIĞI

OTC OFFSHORE TECHNOLOGY CENTER

SAKARYA GAS FIELD DEVELOPMENT PROJECT

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)

Chapter 6.2. Onshore Physical and Biological Baseline

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Rev. N°	**Modification Description**	**Modified Page No.**
00	6.2.1 Onshore Physical Baseline and 6.2.2 Onshore Biological Baseline chapters were merged and issued for approval	N/A

Information Classification

Code	Description of Information Classification
PUBLIC	Information and data that may be shared without restrictions because it is unlikely to result in any harm if disclosed to outside parties. Permission to actually release information to the public must be obtained separately through External Affairs
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6.0 ENVIRONMENTAL AND SOCIAL BASELINE

6.2 Onshore Physical and Biological Baseline

6.2.1 Physical

6.2.1.1 Meteorology and climatology

Definition	Meteorological characteristics of the AoI is critical in evaluating the air quality and dispersion of pollutants in the air and structural safety of Project components and the Project environment.
Study area	**RSA:** Area covering the Zonguldak, Amasra, Bartın Meteorological Stations **Rationale:** Provincial level meteorological data is used to evaluate the trends and behavior of components such as wind direction, temperature, precipitation, etc. that will directly impact the behavior of air emissions and transport of pollutants.
	AoI: 5,000 m buffer zone **Rationale:** The nearby receptors (i.e., communities), around the Project area, potentially exposed to pollutant emissions.
Data sources	**Primary sources**: ■ Data from Zonguldak, Amasra, Bartın Meteorological Stations
	Secondary sources: ■ Secondary data from scientific papers, grey literature and databases.

This section presents the baseline conditions for local and regional meteorology and climatology providing the basis for later dispersion modelling. Parameters within this section will provide critical information on assessing air quality baselines and to identify dispersion pathways and ranges of pollutants in the air and also provide input for the structural design.

Meteorological data were obtained from Meteorology Stations located around the Project Area. The data were recorded in Amasra Station between 1970-2021, Bartın Station between 1961-2021 and Zonguldak Station between 1939-2021 and obtained from the Turkish State Meteorology General Directorate to establish the basic conditions for meteorology and climatology. The locations of meteorology stations are shown in Figure 6-1.

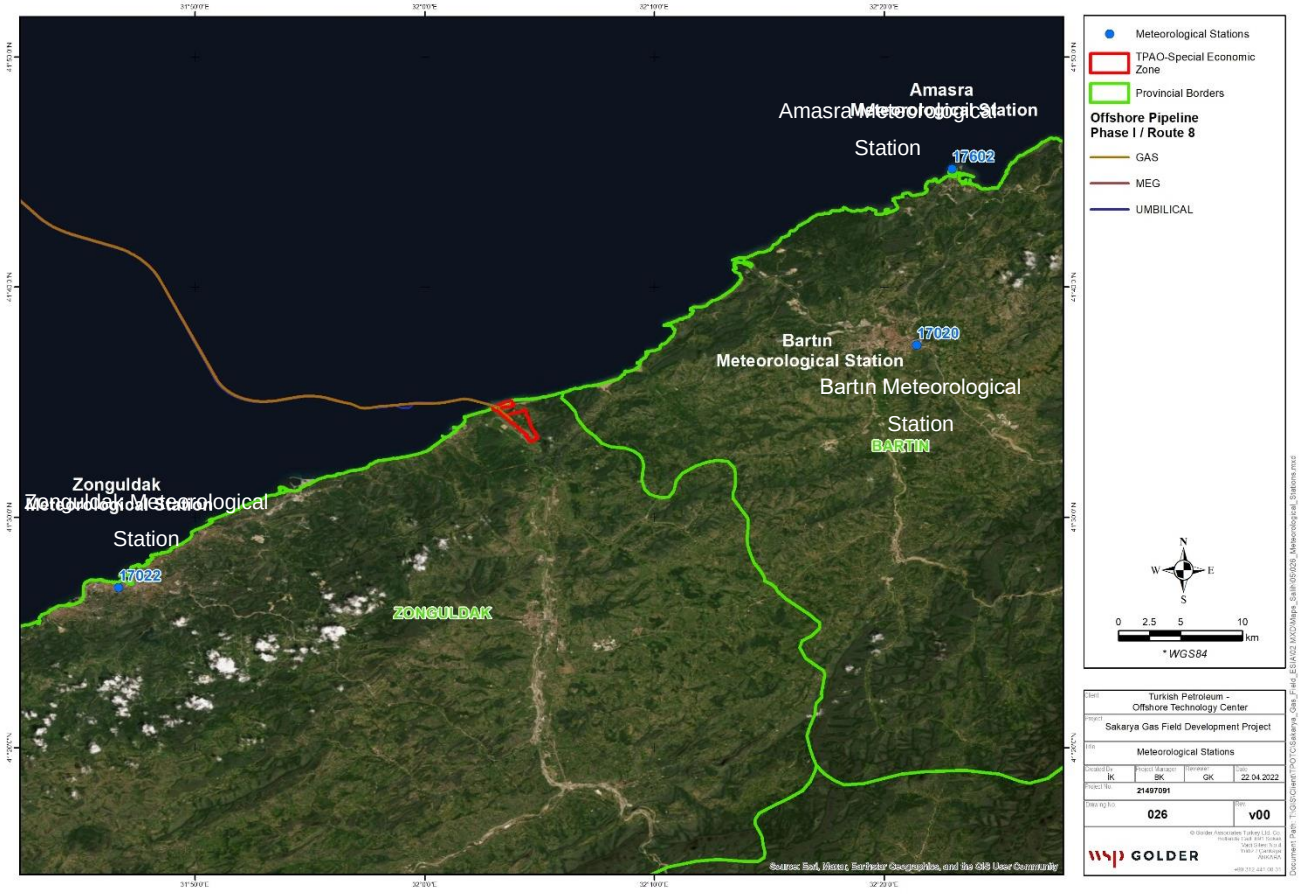


Figure 6-1: Locations of Meteorological Stations around the Project Area

Zonguldak Province is located in the Western Black Sea Region, which has a coast to the Black Sea from the west and north, between 41°-42° latitude North and 31°-32° longitude East. There is no dry season in Zonguldak, which is rainy and warm in all seasons. The most precipitation occurs in autumn and winter seasons. There is no significant temperature difference between seasons and day and night in the province. As you go inland from the sea, the climate gets a little harsher.

The district of Filyos, where the project is located, shows Black Sea climate conditions like Zonguldak Province. It is rainy in all seasons.

Specific weather parameters and meteorological data, obtained from above-mentioned Meteorology Stations, are used in this report to explain the meteorology and climatology of both the regional area (RSA) and the Project Area, including the AoI. These parameters include temperature, precipitation, evaporation, wind, pressure, relative humidity, and others.

A summary of the values for each parameter is reported below and arranged by Meteorological Station, further details are available in Appendix E.

Temperature

Amasra Meteorological Station

Monthly average, absolute minimum and absolute maximum temperatures recorded in Amasra Meteorological Station between the years 1970 and 2021 are presented in Table 1 of Appendix E and the distribution graph is presented in Figure 1 of Appendix E. According to these values, the average temperature varies between 6.4 °C (January) and 22.5 °C (August) and the annual average temperature is 13.9 °C. The minimum temperature was recorded in February of 1985 as -8.4°C, and the maximum temperature were recorded in July of 2000 as 38.4°C. The temperature increases from February to July and decreases from July to January. The coldest months are December, January and February while the hottest are June, July and August.

Bartın Meteorological Station

Monthly average, absolute minimum and absolute maximum temperatures recorded in Bartın Meteorological Station between the years 1961 and 2021 are presented in Table 2 of Appendix E and the distribution graph is presented in Figure 2 of Appendix E. According to these values, the average temperature varies between 4.0 °C (January) and 22.0 °C (July) and the annual average temperature is 12.8 °C. The minimum temperature was recorded in February of 1985 as -18.6°C, and the maximum temperature were recorded in July of 2000 as 42.8°C. The temperature increases from January to July and decreases from July to December. The coldest months are December, January and February while the hottest are June, July and August.

Zonguldak Meteorological Station

Monthly average, absolute minimum and absolute maximum temperatures recorded in Bartın Meteorological Station between the years 1939 and 2021 are presented in Table 3 of Appendix E and the distribution graph is presented in Figure 3 of Appendix E. According to these values, the average temperature varies between 6.2 °C (January) and 22.0 °C (August) and the annual average temperature is 13.7 °C. The minimum temperature was recorded in February of 1950 as -8.0°C, and the maximum temperature were recorded in June of 1942 as 40.5°C. The temperature increases from January to August and decreases from September to December. The coldest months are December, January and February while the hottest are June, July and August.

Figure 6-2 presents the absolute temperatures (maximum, average, and minimum) across the three meteorological stations.

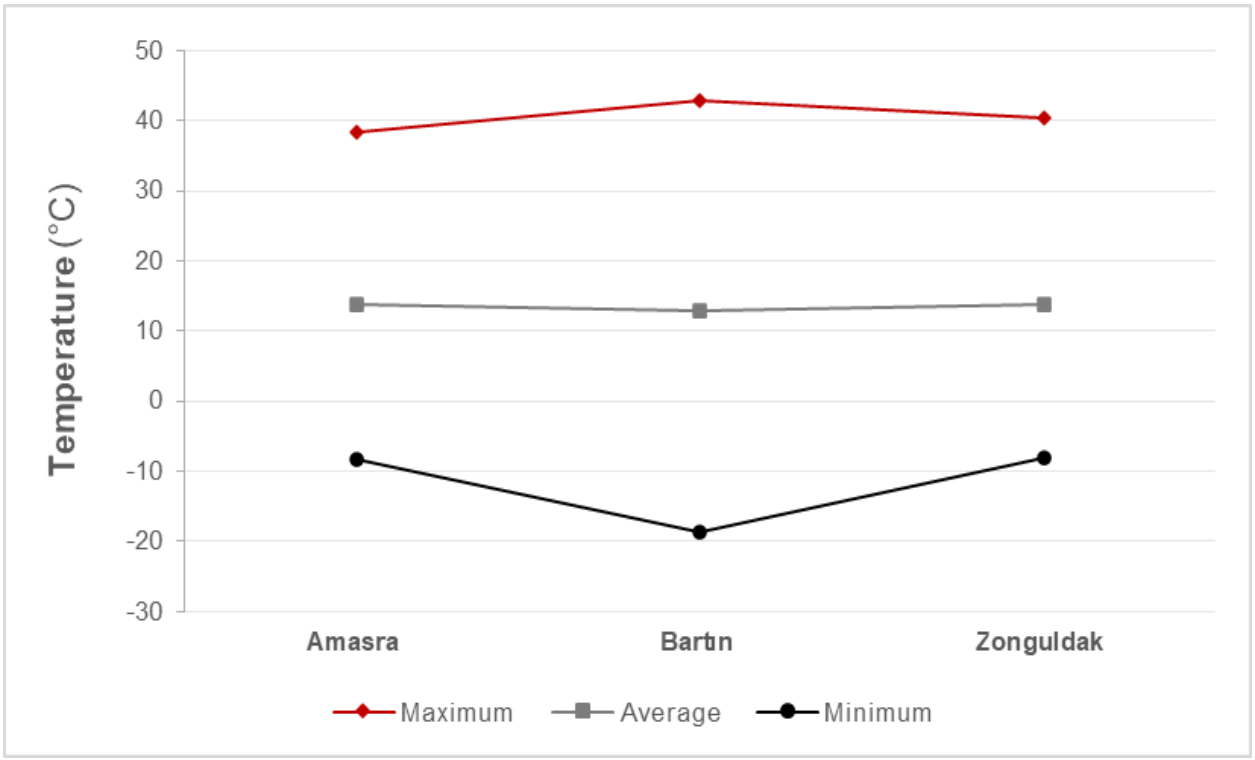


Figure 6-2: Absolute maximum, average and minimum temperatures at the three Meteorological Stations.

Precipitation and Evaporation

Amasra Meteorological Station

Distribution, quantity and type of precipitation are significant factors since they affect wet deposition of air pollutants. Average total and monthly maximum precipitation recorded in Amasra Meteorological Station between the years 1970 and 2021 are presented in the tables and figures of Appendix E. As indicated in Table 4 in Appendix E, the average annual precipitation in the area is recorded as 1009.6 mm. The maximum average monthly precipitation measured is in December (124.7 mm), and the minimum average monthly amount of precipitation measured is in May (46.7 mm). The maximum amount of precipitation observed is observed in 27 August 1970 (95,6 mm).

No data were found on evaporation values for Amasra Meteorology Station.

Bartın Meteorological Station

Average total and monthly maximum precipitation and evaporation recorded in Bartın Meteorological Station between the years 1961 and 2021 are presented in the tables and figures of Appendix E. As indicated in Table 5, Appendix E, the average annual precipitation in the area is recorded as 1049.1 mm. The maximum average monthly amount of precipitation is observed in December (132.9 mm) while the minimum average monthly amount of precipitation measured in May (54.9 mm). The maximum amount of precipitation observed is observed is in 27 August 1970 (161.1 mm).

When the evaporation values for Bartın Meteorology Station are examined, the average annual evaporation is recorded as 787.9 mm (Table 6 of Appendix E). The maximum amount of evaporation is observed in May (9.6 mm).

Zonguldak Meteorological Station

Average total and daily maximum precipitation and evaporation recorded in Bartın Meteorological Station between the years 1939 and 2021 are presented in the tables and figures in Appendix E. As indicated in Table 7 of Appendix E, the average annual precipitation in the area is recorded as 1222.7 mm. The maximum average monthly precipitation is observed in December (154.6 mm) while the minimum average in May (54.9 mm). The maximum amount of precipitation is observed in 1 August 1955 (431.5 mm).

When the evaporation values for Zonguldak Meteorology Station are examined, the average annual evaporation is recorded as 864.6 mm (Table 8 of Appendix E). The maximum amount of evaporation is observed in July (13.8 mm).

Average and monthly maximum precipitations and evaporation values are reported in Figure 6-3 and Figure 6-4.

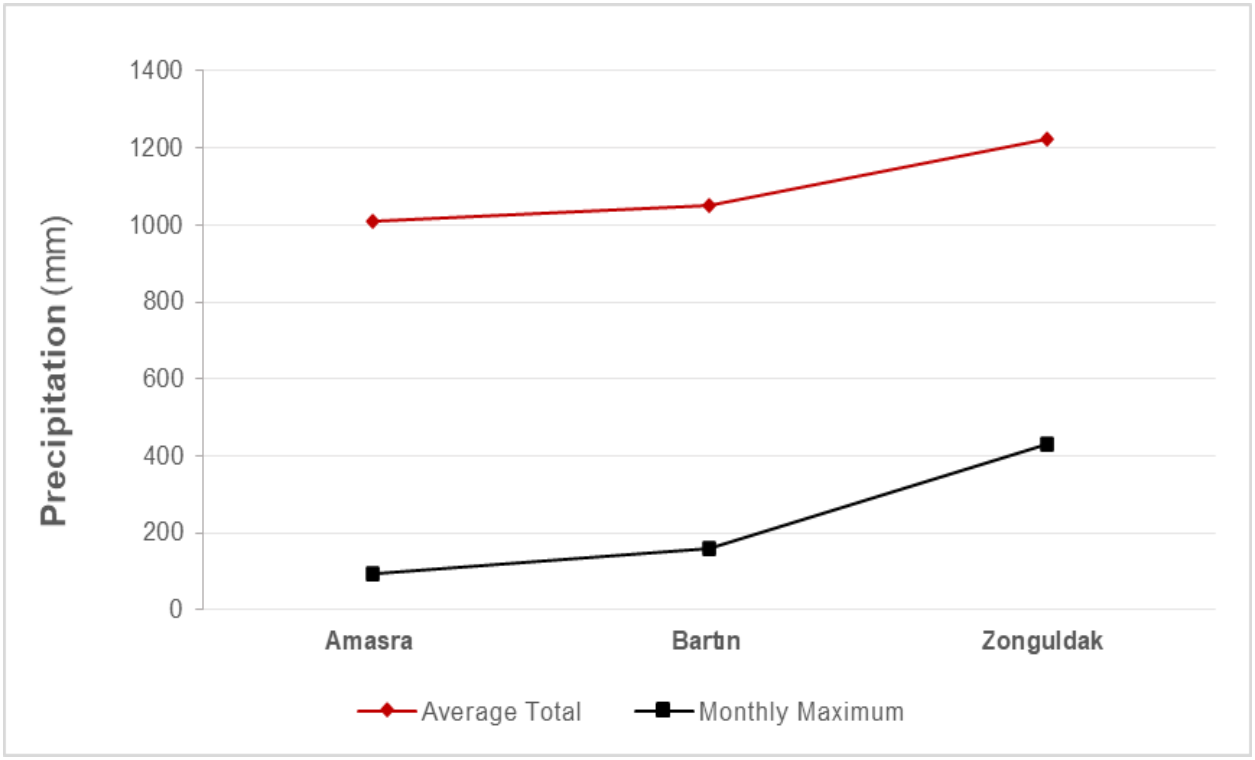


Figure 6-3: Average and Monthly Maximum Precipitation Recorded at all Meteorological Stations

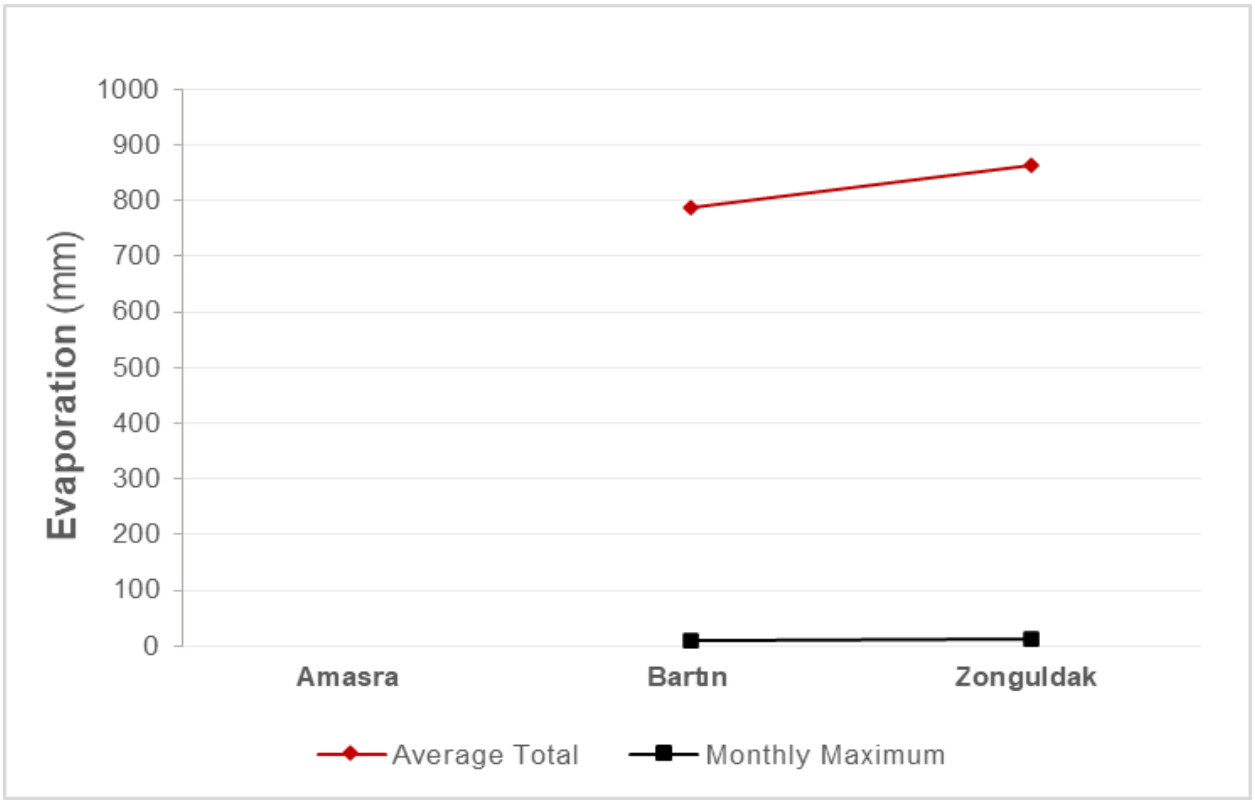


Figure 6-4: Average and Monthly Maximum Evaporation Recorded at Bartin and Zonguldak Meteorological Stations

Wind Distribution

Amasra Meteorological Station

Winds recorded in Amasra Meteorological Station between the years 1970 and 2021 are presented in Table 9 of Appendix E, according to directions. The prevailing wind direction is SSE followed by ENE, and S. Wind rose diagrams for annual and seasonal distributions are presented in Figure 9, Appendix E.

Bartın Meteorological Station

Winds recorded in Bartın Meteorological Station between the years 1961 and 2021 are presented in Table 10 of Appendix E, according to directions. The prevailing wind direction is N followed by NE, and NNE. Wind rose diagrams for annual and seasonal distributions are presented in Figure 10, Appendix E.

Zonguldak Meteorological Station

Winds recorded in Zonguldak Meteorological Station between the years 1939 and 2021 are presented in Table 11 of Appendix E, according to directions. The prevailing wind direction is SE followed by ESE, and NW. Wind rose diagrams for annual and seasonal distributions are presented in Figure 11, Appendix E.

The annual total number of winds and directions are summarized in Table 6-1 and graphically represented in Figure 6-5.

Table 6-1: Total Number of Annual Wind Blowing of all Meteorological Stations According to Directions

	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
Amasra	9823	13122	28594	51191	25234	25923	25511	58901	38184	22014	15084	28231	25340	17600	11978	9937
Bartın	53209	33448	38503	28630	25401	18173	15580	13996	18748	21632	26533	23014	30192	26429	32919	23624
Zonguldak	46448	31553	19247	12906	19342	74675	119943	53973	40823	23524	17182	27532	34578	40418	67558	49970

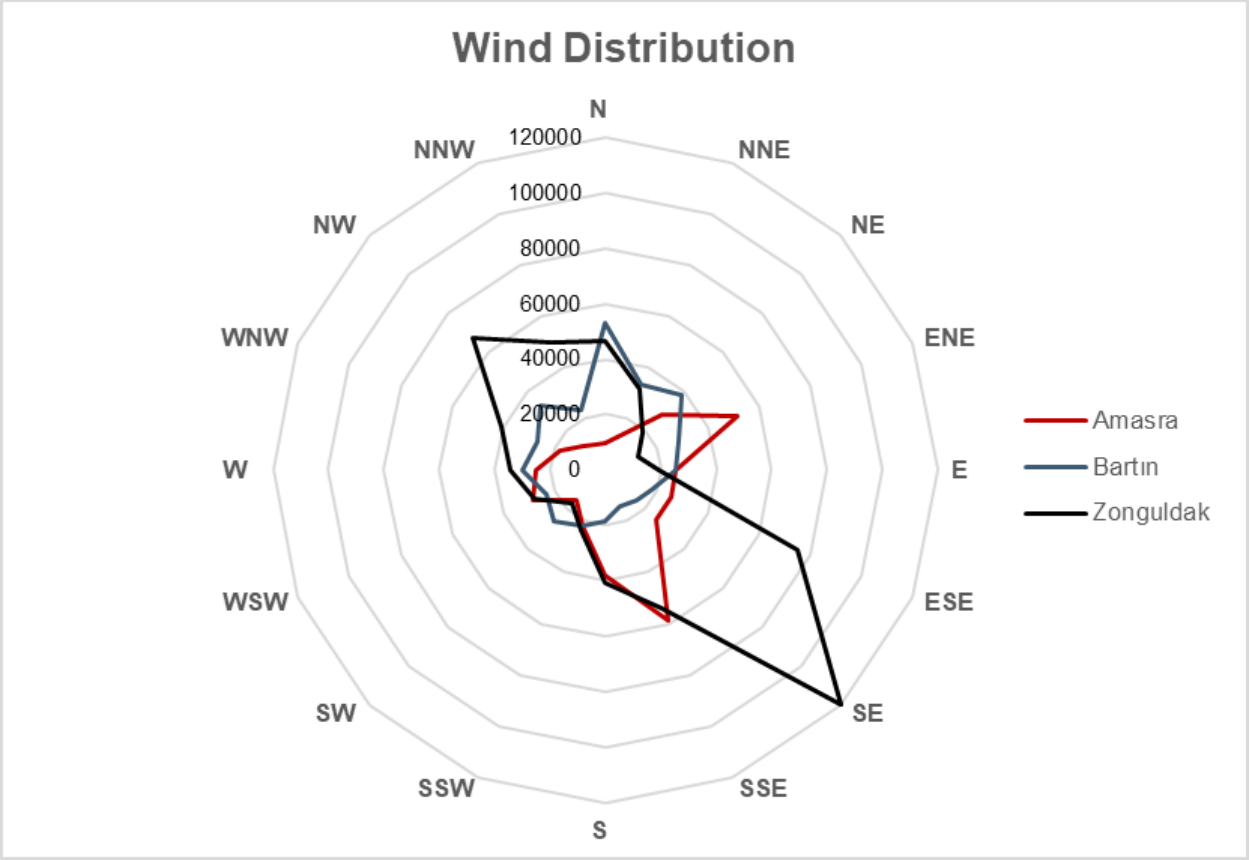


Figure 6-5: Wind Rose Diagrams for all Meteorological Stations (According to Annual Total Number of Wind Blowing

Relative Humidity

Amasra Meteorological Station

Average, average maximum and average minimum relative humidity values recorded at Amasra Meteorological Station between 1970 and 2021 are presented in Table 12 of Appendix E. According to the available information, annual average relative humidity is 72.6%. The annual average minimum relative humidity was observed to be 31.5% and average maximum 96.6%. The monthly distribution of average relative humidity is shown in Figure 12 of Appendix E.

Bartın Meteorological Station

Average, average maximum and average minimum relative humidity values recorded at Bartın Meteorological Station between 1961 and 2021 are presented in Table 13 of Appendix E. According to the available information, annual average relative humidity is 79.2%. The annual average minimum relative humidity was observed to be 28.6% and average maximum 98.2%. The monthly distribution of average relative humidity is shown in Figure 13, Appendix E.

Zonguldak Meteorological Station

Average, average maximum and average minimum relative humidity values recorded at Zonguldak Meteorological Station between 1939 and 2021 are presented in Table 14 of Appendix E. According to the available information, annual average relative humidity is 72.2%. The annual average minimum relative humidity was observed to be 32.2% and average maximum 96.3%. The monthly distribution of average relative humidity is shown in Figure 14, Appendix E.

Annual Average values for Relative Humidity across all meteorological stations are presented in Figure 6-6.

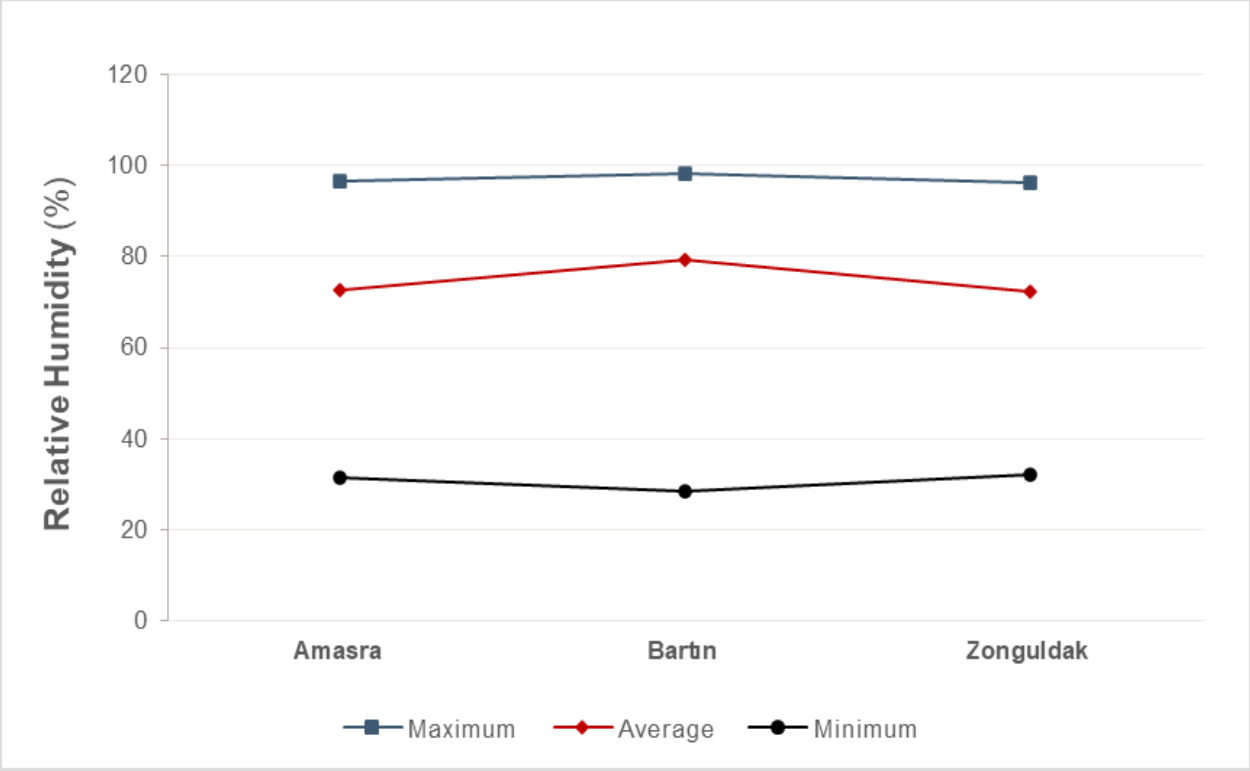


Figure 6-6: All Meteorological Stations, Annual Average Relative Humidity

Local Pressure

Amasra Meteorological Station

Monthly average, absolute maximum and absolute minimum pressure recorded in Amasra Meteorological Station between the years 1970 and 2021 are presented in Table 15 of Appendix E, and the distribution graph is presented in Figure 15 of Appendix E. Annual average pressure recorded at Amasra Meteorological Station

is 1007.5 hPa. The absolute maximum pressure was observed in January (1032.1 hPa), and the absolute minimum pressure was observed in April (978.2 hPa).

Bartın Meteorological Station

Monthly average, absolute maximum and absolute minimum pressure recorded in Bartın Meteorological Station between the years 1961 and 2021 are presented in Table 16 of Appendix E and the distribution graph is presented in Figure 16 of Appendix E. Annual average pressure recorded at Bartın Meteorological Station is 1012.9 hPa. The absolute maximum pressure was observed in February (1047.7 hPa), and the absolute minimum pressure was observed in November (982.4 hPa).

Zonguldak Meteorological Station

Monthly average, absolute maximum and absolute minimum pressure recorded in Zonguldak Meteorological Station between the years 1939 and 2021 are presented in Table 17 of Appendix E and the distribution graph is presented in Figure 17 of Appendix E. Annual average pressure recorded at Zonguldak Meteorological Station is 1000.2 hPa. The absolute maximum pressure was observed in February (1034.1 hPa), and the absolute minimum pressure was observed in March (966.7 hPa).

The annual pressure values across all meteorological stations are graphically represented in Figure *6-7*.

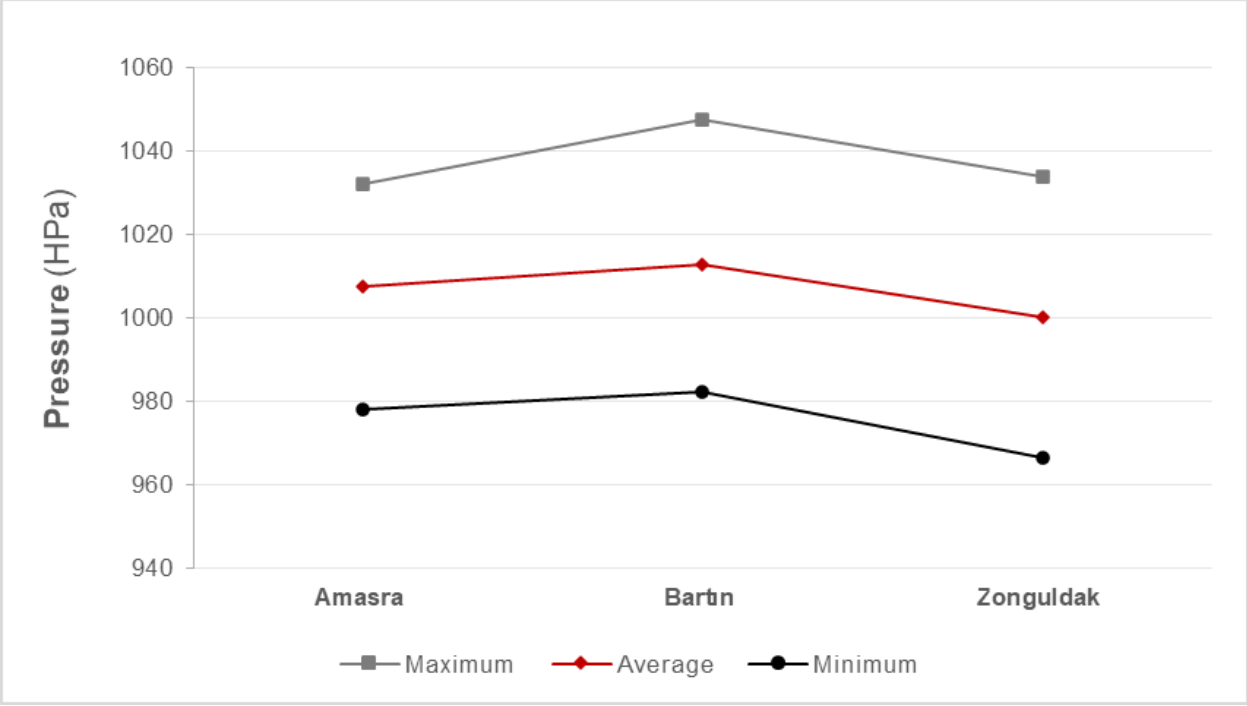


Figure 6-7: All Meteorological Station Annual Pressure Distribution

Other parameters

General annual statistics for weather parameters such as snow, fog, hail, frost, thunderstorms across all meteorological stations are presented in Table 6-2.

Table 6-2: Annual Average Values for Various Meteorological Parameters Across All Meteorological Stations

	Avg. Number of Snow Days	Avg. Number of Snow Cover Days	Avg. Number of Foggy Days	Avg. Number of Hail Days	Avg. Number of Frosty Days	Avg. Number of Thunder Stormy Days	Abs. Max. Snow Depth (cm)
Amasra	13.17	19.65	9.01	1.29	2.85	1.33	7.2
Bartin	12.76	17.75	35.76	1.97	18.39	5.87	9.3
Zonguldak	3.15	12.61	12.81	4.3	3.15	7.16	105

Detailed statistics for weather parameters such as snow, fog, hail, frost, thunderstorms for each meteorological station can be found in the tables from 26 to 29 and the figures 26 to 29 of Appendix E.

6.2.1.2 Air Quality

Definition	Ambient air quality is a broader term used to describe the level of air pollution in outdoor environments. WHO defines ambient air pollution as potentially harmful pollutants emitted by industries, households, vehicles, etc. Construction and decommissioning activities may generate emission of fugitive dust caused by a combination of on-site excavation and movement of earth materials, contact of construction machinery with bare soil, and exposure of bare soil and soil piles to wind. Exhaust gas emissions such as nitrogen oxides, carbon monoxide, hydrocarbon, particulate matter and sulphur dioxide will occur due to the diesel engines that will be used for electricity generation, construction equipment and vessels that will be operated during the onshore land preparation / construction activities and offshore activities. The main sources of air emissions resulting from operations include: combustion emissions from power and heat generation (gas engines and boilers), ground flaring and fugitive emissions (gas/fuel oil leaks). Principal pollutants from these sources include nitrogen oxides, sulphur oxides, carbon monoxide, and particulates. Additional pollutants include: hydrogen sulphide; volatile organic compounds, methane and ethane.
Study area	**RSA:** Zonguldak Province **Rationale:** Provincial level air quality data from the national air quality monitoring stations is available for determination of air quality baseline.
	AoI: 5,000 m buffer zone **Rationale:** The nearby receptors (i.e. communities), around the Project area, potentially exposed to pollutant emissions.
Data sources	**Primary sources**: ■ Field works and baseline air quality measurements conducted in 2022 in the scope of ESIA studies.

	Secondary sources: ■ Data from Filyos Port/Industrial Zone Connections Project ESIA Report ■ Data from Air Quality Monitoring Stations in Zonguldak Province ■ Secondary data from scientific papers, grey literature and databases.

Methodological Approach

Air Quality Monitoring Stations

Information about the air quality in the RSA is provided from the National Air Quality Monitoring Stations in Zonguldak Province. The air quality data at these stations are published in the website[1] of the Continuous Monitoring Center (CMC) of Ministry of Environment, Urbanization and Climate Change (MoEUCC) and 2021 data is summarised for (SO_2), nitrogen oxides (NOx), nitrogen dioxide (NO_2), hydrogen sulphide (H_2S), ozone (O_3), PM_{10} and $PM_{2.5}$ parameters.

According to the CMC website, there are 8 air quality monitoring stations in Zonguldak Province. Locations of the stations are presented in Figure 6-8. Name and locations of the stations are presented in this figure and listed below.

1. Karadeniz Ereğli Station
2. Kozlu Station
3. Zonguldak Station
4. Kilimli Station
5. Çatalağzı Cumayanı Station
6. Çatalağzı Kuzyaka Station
7. Muslu Tepeköy Station
8. Çaycuma Station

[1] https://sim.csb.gov.tr/

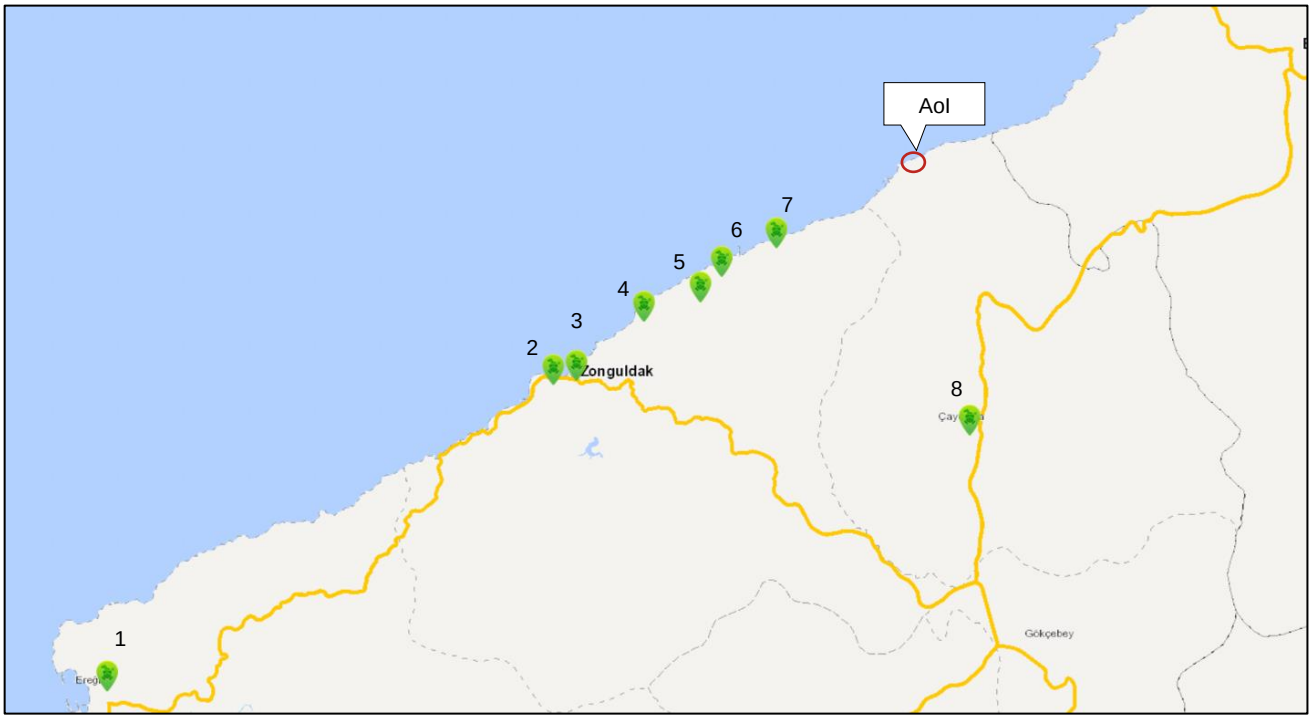


Figure 6-8: Air Quality Monitoring Stations in Zonguldak Province

The nearest air quality monitoring station to the Project area is Muslu Tepeköy Station and the distance between the station and the Project area is approximately 10 km.

Filyos Port/Industrial Zone Connections Project ESIA Studies

Within the scope of the ESIA study of "Filyos Port/Industrial Zone Connections Project" (Çınar, 2020), ambient air quality measurements were conducted in the AoI in 2020 in order to determine the baseline air quality. According to the ESIA Report, the measurement points were chosen adjacent to the emission sources based on nearest settlements and topographic conditions of the Project. The measured parameters include $PM_{2.5}$ and PM_{10}. Particulate matter parameters were measured for 7 days. Locations and coordinates of 5 sampling points (H1 - H5) are given in Table 6-3. Air quality measurement locations are presented in Figure 6-9.

Table 6-3: Locations and Coordinates of the Air Quality Monitoring Points (Filyos Port/Industrial Zone Connections Project ESIA Report)

Monitoring Point	Location	Coordinates (UTM/WGS) (36T)	
		East	North
H-1	Gökçeler Village	421818	4601044
H-2	Sefercik Village	420491	4602090
H-3	Sazköy Village	422449	4603361

Monitoring Point	Location	Coordinates (UTM/WGS) (36T)	
		East	North
H-4	Sazköy Village	422445	4603400
H-5	Derecikören Village	422560	4600522

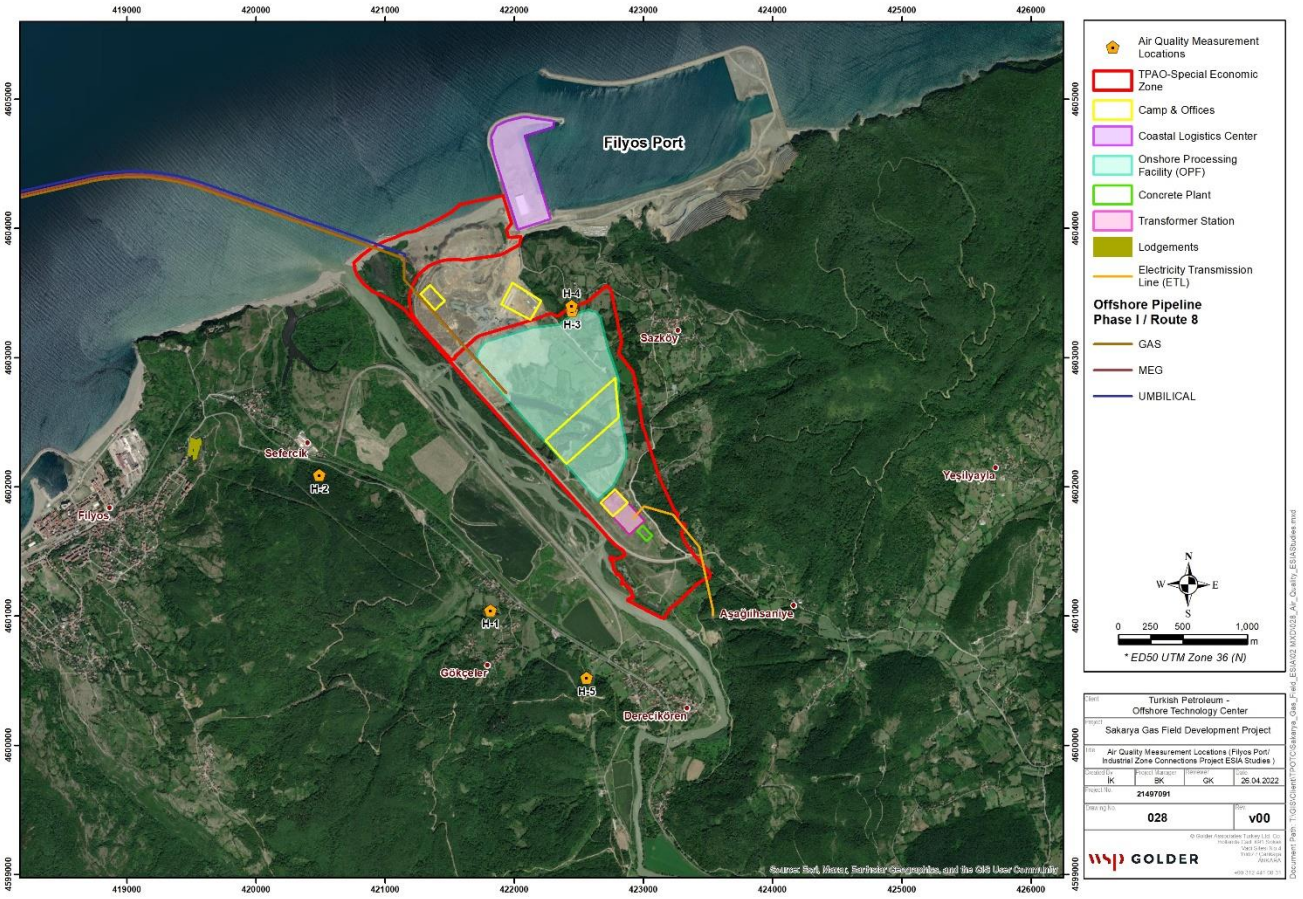


Figure 6-9: Baseline Air Quality Measurement Locations (Filyos Port/Industrial Zone Connections Project ESIA Report, 2020)

Baseline Air Quality Measurements Conducted within the Scope of this ESIA

An air quality monitoring study including 4 separate monitoring campaign was conducted by Çınar between January 17th, 2022 and April 20th, 2022 within the scope of this ESIA Report.

Dates of the above-mentioned monitoring campaigns are listed below.

- #1: January 17th, 2022 - January 19th, 2022
- #2: February 15th, 2022 - February 19th, 2022

- #3: March 16th, 2022 - March 22th, 2022
- #4: April 12th, 2022 - April 20th, 2022

During the air quality monitoring study in the AoI, ambient SO_2, NO_2, H_2S, O_3 and settled dust concentrations including heavy metals were monitored for 3 months and volatile organic compounds (VOC) concentration was monitoring for 2 months by passive sampling method at 12 sensitive receptors (residential areas) around the Project area.

In addition, PM_{10}, $PM_{2.5}$ and CO parameters were monitored for 24 hours during two campaigns by active sampling method at the same 12 locations (HK-1 – HK-12), except HK-2 and HK-12 points for PM and HK-2 and HK-10 points for CO where one monitoring study was not conducted due to the construction works around the station.

The air quality monitoring parameters and the campaigns when the monitoring was conducted are summarized in Table 6-4. Coordinates of monitoring points are provided in Table 6-5 and air quality measurement locations are presented in Figure 6-10.

Table 6-4: Air Quality Monitoring Parameters and Monitoring Campaigns (ESIA, 2022)

Monitoring Point	Monitoring Campaigns								
	SO_2	NO_2,	H_2S	O_3	Settled Dust and Heavy Metals	VOC	PM10	PM2.5	CO
HK-1	1, 2, 3					1 ,2	3, 4		3, 4
HK-2	1, 2, 3					1 ,2	4		4
HK-3	1, 2, 3					1 ,2	2, 4		2, 4
HK-4	1, 2, 3					1 ,2	2, 4		2, 4
HK-5	1, 2, 3					1 ,2	1, 4		1, 4
HK-6	1, 2, 3					1 ,2	1, 4		1, 4
HK-7	1, 2, 3					1 ,2	2, 4		2, 4
HK-8	1, 2, 3					1 ,2	2, 4		2, 4
HK-9	1, 2, 3					1 ,2	2, 4		2, 4
HK-10	1, 2, 3					1 ,2	1, 4		4
HK-11	1, 2, 3					1 ,2	2, 4		2, 4
HK-12	1, 2, 3					1 ,2	4		3, 4

Notes:
1: Exact dates when the monitoring studies are conducted are provided in results tables (Table 6-8, Table 6-9, Table 6-10 and Table 6-11)
2: The monitoring studies in monitoring campaign #3 and #4 were conducted when the onshore construction activities were ongoing

Table 6-5: Locations and Coordinates of the Air Quality Monitoring Points (ESIA, 2022)

Monitoring Point	Location	Coordinates (UTM/WGS) (36T)	
		East	North
HK-1	Aşağıihsaniye Village	424155	4600940
HK-2	Yeşilyayla Village	425744	4601871
HK-3	Gökçeler Village	421717	4601068
HK-4	Sefercik Village	419996	4602522
HK-5	Sazköy Village	423029	4602850
HK-6	Sazköy Village	422449	4603370
HK-7	Derecikören Village	423394	4600118
HK-8	Filyos Municipality	419395	4601886
HK-9	Gökçeler Village	421883	4600727
HK-10	Aşağıihsaniye Village	423367	4601334
HK-11	Filyos Municipality	419615	4599735
HK-12	Derecikören Village	423072	4599243

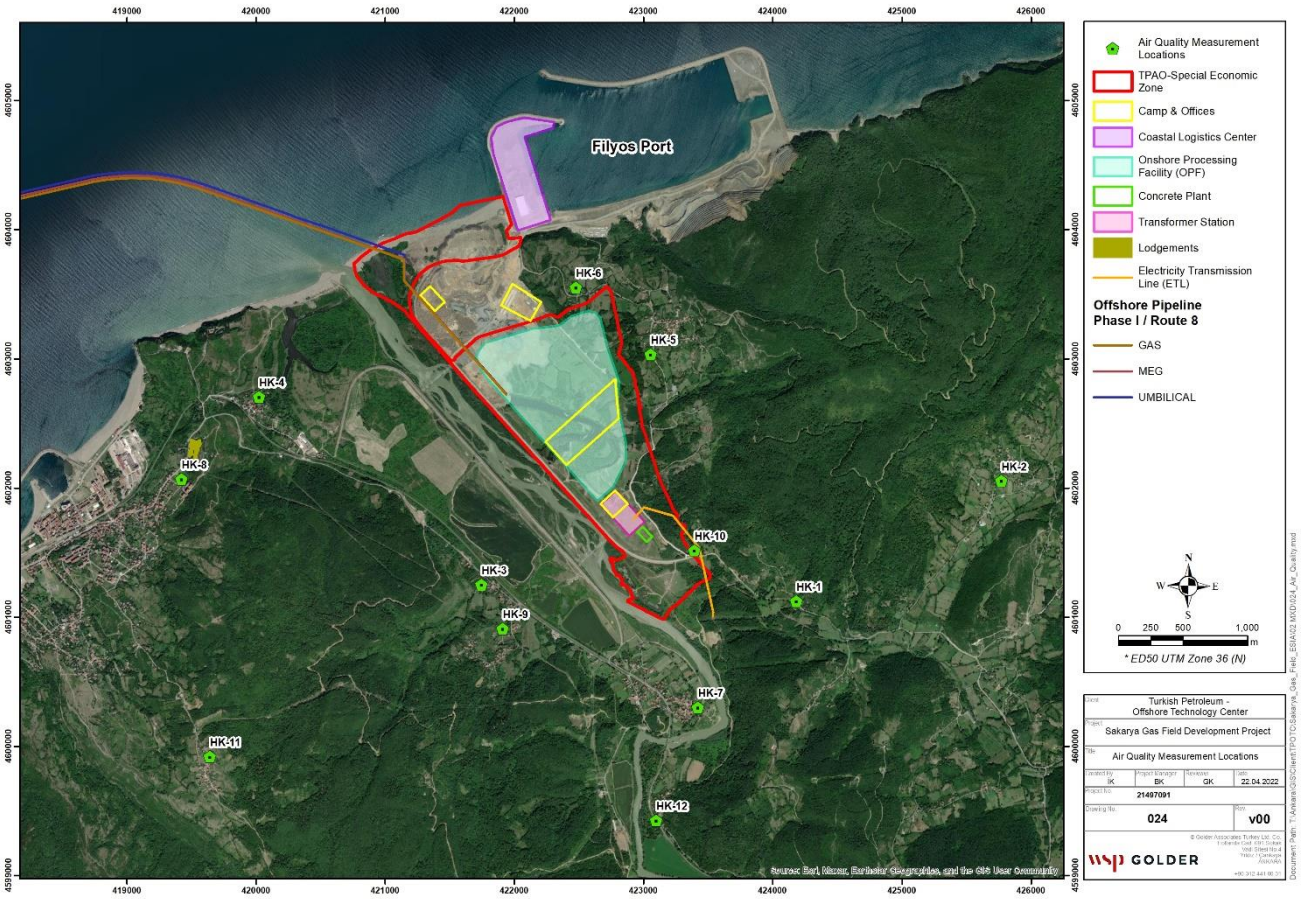


Figure 6-10: Baseline Air Quality Measurement Locations (Çınar, 2022)

Air sampling methodologies are provided from the laboratory (Çınar, 2022) and summarised below.

- Passive diffusion tubes are installed for SO_2, NO_2, H_2S, O_3 monitoring studies at height of approximately 1.5 - 4 meters at the measuring points (Figure 6-11). During the measurement period, the tubes are exposed to the ambient air. After the monitoring period (720 hours), the tubes are collected and sent to the laboratory for analysis. The sample is analysed within 2 weeks by ion chromatography (SO_2), UV spectrophotometry (H_2S, NO_2, O_3) and gas chromatography-tandem mass spectrometry (VOC) methods.

Figure 6-11: Sample Photos from the Passive Diffusion Monitoring Studies

- Settled dust monitoring study is conducted according to TS 2342 standard: “Methods for the measurement of air pollution methods for the installation and the use of the directional dust gauge”. This method is based on collection of particles settled due to the factors such as gravity, precipitation in a directional dust gauge, collection of the gauge after the sampling period (720 hours) and calculation of the dust concentration (Figure 6-12).

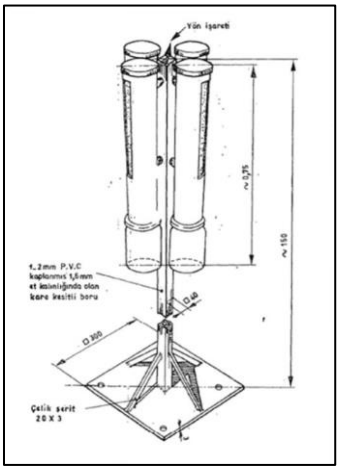


Figure 6-12: Settled Dust Gauge

- PM_{10} and $PM_{2.5}$ monitoring studies are conducted according to the TS 12341 standard: “Standard gravimetric measurement method for the determination of the PM_{10} or $PM_{2.5}$ mass concentration of suspended particulate matter”. In this method, air vacuumed from the ambient air by a pump passes a filter and collected on the filter for 24 hours (Figure 6-13). After the sampling period, the filter is transported to the laboratory and gravimetric analysis is conducted. By calculating the amount of dust on the filter, PM_{10} and $PM_{2.5}$ concentrations in the ambient air are achieved.

Figure 6-13: PM Monitoring Device

- CO monitoring study is conducted according to the TS 14626 standard: "Standard method for the measurement of the concentration of carbon monoxide by nondispersive infrared spectroscopy". In this method, CO concentration in the ambient air is measured by infrared spectroscopy without wavelength separation (NDIR). The air vacuumed by a pump from the ambient air passes through a filter and then through an analyser (Figure 6-14). This method detects the mass concentration of CO in ambient air between 0 mg/m^3 and 100 mg/m^3.

Figure 6-14: CO Monitoring Device

Regional Context (RSA)

2021 air quality monitoring data collected from each monitoring station in Zonguldak Province is provided in Table 6-6. According to the table, annual PM_{10} and $PM_{2.5}$ averages are above the Project Standards at all monitoring stations and average NO_x concentration exceeds the standard at 3 stations.

According to the literature searches, air pollution is an important problem in Zonguldak Province. According to the study of Greenpeace (Ağaçayak, 2021), the most important sources of air pollution in Zonguldak are coal-fired power plants. Air emissions of thermal power plants in Zonguldak generates the pollutants, including particulate matter and NO_x, exceeding the limit values for most of the year. Lokman Hakan Tecer's study (Tecer,

2007) from Balıkesir University states that economy of Zonguldak depends on coal and coal dependent industries, which creates industrial air pollution problem. Air quality of Zonguldak Province is poor due to the city's nearby coal mines and the main source of air pollution is the hard coal mines. In 2020, according to the report of Right to Clean Air Platform (Karababa et. al., 2021), air quality of the cities including Zonguldak improved because some of the thermal power plants in the province were closed temporarily and traffic was reduced due to Covid-19 pandemics. However, the pollutant concentrations including PM_{10} and SO_2 started to increase because of reopening of these power plants according to the study.

Table 6-6: 2021 Air Quality Monitoring Data Collected from the Air Quality Monitoring Stations in Zonguldak Province

Air Quality Monitoring Station	Distance to the Project Area (~km)	Parameters													
		SO_2		NO_x		NO_2		O_3				PM_{10}		$PM_{2.5}$	
		Annual Av. Conc. ($\mu g/m^3$)	Project Standard ($\mu g/m^3$)	Annual Av. Conc. ($\mu g/m^3$)	Project Standard ($\mu g/m^3$)	Annual Av. Conc. ($\mu g/m^3$)	Project Standard ($\mu g/m^3$)	Annual Av. of Max. Daily 8 Hours Conc. ($\mu g/m^3$)	Number of Missing Daily Data	Number of Exceeding Days	Project Standard ($\mu g/m^3$)	Conc. ($\mu g/m^3$)	Project Standard ($\mu g/m^3$)	Conc. ($\mu g/m^3$)	Project Standard ($\mu g/m^3$)
Karadeniz Ereğli Station	60	6.52	**20**	43.89	**30**	15,00	**40**	-	-	-	**100**	64.99	**20**	-	**10**
Kozlu Station	27	4.34		17.23		6.45		23.16	9	0		47.01		21.82	
Zonguldak Station	26	11.57		70.68		38.06		-	-	-		55.31		22.15	
Kilimli Station	20	14.75		53.62		34.88		-	-	-		-		27.95	
Çatalağzı Cumayanı Station	17	16.48		13.40		9.82		57.49	11	60		58.51		25.94	
Çatalağzı Kuzyaka Station	15	15.41		22.80		17.34		64.30	15	39		52.80		23.69	
Muslu Tepeköy Station	10	11.60		8.07		8.04		81.08	35	51		44.61		16.14	
Çaycuma Station	15	6.64		35.06		24.37		-	-	-		46.21		26.19	

Notes:

1: Project standards are given in Appendix C of the ESIA.

2: Red coloured concentration values are above the relevant Project standard.

Local Context (AoI)

Air quality data provided from the monitoring studies in the AoI is provided below.

Filyos Port/Industrial Zone Connections Project ESIA Studies

According to the result of the measurements which were conducted in 2020 within the scope of Filyos Port/Industrial Zone Connections Project ESIA Report, PM_{10} concentrations at monitoring stations which were measured prior to start of the construction works of the Project are below the Project Standards.

Table 6-7: PM_{10} and $PM_{2.5}$ Monitoring Results According to the Monitoring Study Conducted within the Scope of Filyos Port/Industrial Zone Connections Project ESIA Report

Monitoring Point	Monitoring Time	Parameters			
		PM_{10}		$PM_{2.5}$	
		Conc. ($\mu g/m^3$)	Project Standard ($\mu g/m^3$)	Conc. ($\mu g/m^3$)	Project Standard ($\mu g/m^3$)
H-1	2020	25.80	**50**	6.44	**25**
H-2	2020	26.75		6.75	
H-3	2020	27.23		6.88	
H-4	2020	27.55		6.88	
H-5	2020	27.33		6.85	

Notes:

1: Project standards are given in Appendix C of the ESIA.

Baseline Air Quality Measurements Conducted within the Scope of this ESIA

According to the monitoring results which were conducted in 2022 within the scope of this ESIA Report, the measured particulate matter concentrations are below the Project Standards except the PM_{10} concentration at HK-4 point during the 1st monitoring campaign, and at HK-1 and HK-8 during the 2nd monitoring campaign. Slight exceedance of O_3 concentration at all locations and SO_2 concentration at some of the locations is observed for all monitoring intervals. Measured CO, NO_2, H_2S, VOC, settled dust and heavy metal concentrations are below the Project Standards. It should be noted that the monitoring studies in March-April 2022 period were conducted when the onshore construction activities were ongoing and the settled dust concentrations are observed to be higher than the results in the previous monitoring campaign.

When compared with the baseline measurement results in 2020 (Filyos Port/Industrial Zone Connections Project ESIA Report), PM10 concentrations are around 25-27 $\mu g/m^3$ and below the concentration values measured in 2022. The reason of this difference can be the ongoing construction works of the Industrial Zone and Filyos Port in the region. In addition, the measurements in 2020 were conducted for 7 consecutive days and 2022 measurements were conducted for 1 day. This can also create differences between the results. The high-level particulate matter concentrations can also be due to anthropogenic activities at the rural settlement during the monitoring duration. When compared with national air quality measurement stations data, SO_2 and O_3 concentrations at the AoI are slightly higher. The reasons for the higher concentrations may be that the

domestic heating in the rural area is dependent on coal and wood rather than natural gas and the ongoing construction works in the region.

Table 6-8: PM_{10} and $PM_{2.5}$ Monitoring Results of the Monitoring Study Conducted within the Scope of This ESIA Report

Monitoring Point	1st Monitoring Campaign Date	2nd Monitoring Campaign Date	Parameters					
			PM_{10}			$PM_{2.5}$		
			Conc. (µg/m³)		Project Standard (mg/m³)	Conc. (µg/m³)		Project Standard (mg/m³)
			1	2		1	2	
HK-1	16.03.2022	16.04.2022	-	92.0	50	-	36.0	25
HK-2	-	19.04.2022	-	20.1		-	2.1	
HK-3	16.02.2022	13.04.2022	45.7	12.0		16.6	6.7	
HK-4	17.02.2022	13.04.2022	66.4	47.0		8.3	40.6	
HK-5	17.01.2022	17.04.2022	37.3	18.0		5.6	8.4	
HK-6	17.01.2022	17.04.2022	32.8	28.0		7.6	2.9	
HK-7	19.02.2022	14.04.2022	35.1	30.1		5.9	11.5	
HK-8	17.02.2022	12.04.2022	40.1	31.2		12.4	29.0	
HK-9	16.02.2022	14.04.2022	39.1	49.3		21.5	15.2	
HK-10	17.01.2022	16.04.2022	44.7	36.1		9.5	17.1	
HK-11	19.02.2022	12.04.2022	13.6	6.3		16.6	2.2	
HK-12	-	19.04.2022	-	27.0		-	5.1	

Notes:

1: Project standards are given in Appendix C of the ESIA.

2: Red coloured concentration values are above the relevant Project Standards.

Table 6-9: CO Monitoring Results of the Monitoring Study Conducted within the Scope of This ESIA Report

Monitoring Point	1st Monitoring Campaign Date	2nd Monitoring Campaign Date	Hours	CO		
				Conc. (µg/m³)		Project Standard (mg/m³)
				1	2	
HK-1	16.03.2022	16.04.2022	08:00 - 16:00	0.2	0.6	10
			16:00 - 00:00	0.2	0.4	
			00:00 - 08:00	0.1	0.4	
HK-2	-	19.04.2022	-	-	0.4	

Monitoring Point	1st Monitoring Campaign Date	2nd Monitoring Campaign Date	Hours	CO		
				Conc. (µg/m³)		Project Standard (mg/m³)
				1	2	
HK-3	16.02.2022	13.04.2022	08:00 - 16:00	1.5	0.5	
			16:00 - 00:00	1.7	0.5	
			00:00 - 08:00	1.2	0.6	
HK-4	17.02.2022	13.04.2022	08:00 - 16:00	1.6	0.4	
			16:00 - 00:00	2.1	0.3	
			00:00 - 08:00	1.9	0.6	
HK-5	17.01.2022	17.04.2022	08:00 - 16:00	2.6	0.4	
			16:00 - 00:00	2.8	0.3	
			00:00 - 08:00	3.3	0.6	
HK-6	17.01.2022	17.04.2022	08:00 - 16:00	2.8	0.5	
			16:00 - 00:00	2.9	0.5	
			00:00 - 08:00	3.4	0.6	
HK-7	19.02.2022	14.04.2022	08:00 - 16:00	1.4	0.5	
			16:00 - 00:00	1.9	0.5	
			00:00 - 08:00	1.8	0.4	
HK-8	17.02.2022	12.04.2022	08:00 - 16:00	1.1	0.4	
			16:00 - 00:00	1.3	0.3	
			00:00 - 08:00	1.8	0.4	
HK-9	16.02.2022	14.04.2022	08:00 - 16:00	1.6	0.4	
			16:00 - 00:00	2.0	0.4	
			00:00 - 08:00	2.1	0.4	
HK-10	-	20.04.2022	08:00 - 16:00	-	0.5	
			16:00 - 00:00	-	0.4	
			00:00 - 08:00	-	0.5	
HK-11	19.02.2022	12.04.2022	08:00 - 16:00	1.4	0.3	
			16:00 - 00:00	1.8	0.5	
			00:00 - 08:00	1.9	0.4	
HK-12	16.03.2022	15.04.2022	08:00 - 16:00	0.5	0.5	
			16:00 - 00:00	0.2	0.4	
			00:00 - 08:00	0.4	0.4	

Notes:

1: Project standards are given in Appendix C of the ESIA.

2: Red coloured concentration values are above the relevant Project Standards.

Table 6-10: SO_2, NO_2, H_2S, O_3 and VOC Monitoring Results of the Monitoring Study Conducted within the Scope of This ESIA Report

Monitoring Point	1st Monitoring Campaign Interval	2nd Monitoring Campaign Interval	3rd Monitoring Campaign Interval	Parameters																	
				SO_2				NO_2				H_2S				O_3				VOC		
				Conc. (µg/m³)			Project Standard (µg/m³)	Conc. (µg/m³)			Project Standard (µg/m³)	Conc. (µg/m³)			Project Standard (µg/m³)	Conc. (µg/m³)			Project Standard (µg/m³)	Conc. (µg/m³)		Project Standard (µg/m³) (given as TOC)
				1	2	3		1	2	3		1	2	3		1	2	3		1	2	
HK-1	17.01–15.02.2022	15.02–18.03.2022	22.03-19.04.2022	31.6	23.0	15.6	20	10.8	7.25	21.1	40	<0.2	<0.2	<0.2	20	110	106	111	100*	11.7	16.4	280(hourly average)
HK-2	17.01–15.02.2022	15.02–18.03.2022	22.03-19.04.2022	14.5	16.7	12.7		6.85	1.38	8.3		<0.2	<0.2	<0.2		114	102	109		28.8	9.8	
HK-3	18.01–16.02.2022	16.02–18.03.2022	22.03-19.04.2022	21.0	15.4	7.7		11.2	20.1	8.9		<0.2	<0.2	<0.2		105	107	100		4.1	24.2	
HK-4	18.01–16.02.2022	16.02–18.03.2022	22.03-19.04.2022	19.2	13.0	13.3		11.3	7.89	10.2		<0.2	<0.2	<0.2		101	106	110		31.5	16.9	
HK-5	17.01–15.02.2022	15.02–18.03.2022	22.03-19.04.2022	20.7	20.2	12.1		10.1	8.18	10.9		<0.2	<0.2	<0.2		117	114	106		11.4	5.7	
HK-6	17.01–15.02.2022	15.02–18.03.2022	22.03-19.04.2022	18.1	22.4	10.1		7.24	15.6	21.2		<0.2	<0.2	<0.2		106	101	108		16.2	56.5	
HK-7	18.01–16.02.2022	16.02–18.03.2022	22.03-19.04.2022	22.1	21.7	7.6		11.3	13.1	16.9		<0.2	<0.2	<0.2		108	108	105		39.4	15.3	
HK-8	18.01–16.02.2022	16.02–18.03.2022	22.03-19.04.2022	17.4	24.4	8.6		8.03	17.4	12.2		<0.2	<0.2	<0.2		109	103	104		91.6	15.1	
HK-9	18.01–16.02.2022	16.02–18.03.2022	22.03-19.04.2022	21.1	20.2	9.8		6.59	8.33	10.2		<0.2	<0.2	<0.2		116	111	117		4.7	4.8	
HK-10	17.01–15.02.2022	15.02–18.03.2022	22.03-19.04.2022	26.8	14.7	8.4		11.0	7.25	12.8		<0.2	<0.2	<0.2		101	99	114		7.6	13.6	
HK-11	18.01–16.02.2022	16.02–18.03.2022	22.03-19.04.2022	12.4	20.5	10.0		7.57	5.65	7.5		<0.2	<0.2	<0.2		110	112	115		14.7	9.9	
HK-12	18.01–16.02.2022	15.02–18.03.2022	22.03-19.04.2022	20.3	19.5	11.2		13.0	10.5	13.4		<0.2	<0.2	<0.2		106	104	112		4.2	14.6	

Note:

1: Project standards are given in Appendix C of the ESIA.

2: Red coloured concentration values are above the relevant Project Standards.

*: Averaging value for ozone Project Standard is “maximum daily 8-hour mean” (See Appendix C)

Table 6-11: Settled Dust and Heavy Metals Monitoring Results

Monitoring Point	1st Monitoring Campaign Interval	2nd Monitoring Campaign Interval	3rd Monitoring Campaign Interval	Parameters															
				Settled Dust				Cd				Tl				Pb			
				Conc. (µg/m³)			Project Standard (µg/m³)	Conc. (µg/m³)			Project Standard (µg/m³)	Conc. (µg/m³)			Project Standard (µg/m³)	Conc. (µg/m³)			Project Standard (µg/m³)
				1	2	3		1	2	3		1	2	3		1	2	3	
HK-1	17.01–15.02.2022	15.02–18.03.2022	22.03-19.04.2022	50	57	133	390	<0,0282	<0,026	0.309	3.75	<0,0282	<0,026	<0,029	5	31	30	51	250
HK-2	17.01–15.02.2022	15.02–18.03.2022	22.03-19.04.2022	61	19	63		0,149	<0,026	0.700		<0,0282	<0,026	0.081		315	57	97	
HK-3	18.01–16.02.2022	16.02–18.03.2022	22.03-19.04.2022	114	66	63		<0,0282	<0,027	<0.029		<0,0282	<0,027	<0,029		93	48	26	
HK-4	18.01–16.02.2022	16.02–18.03.2022	22.03-19.04.2022	44	40	131		0,439	<0,027	<0.029		<0,0282	<0,027	<0,029		110	52	65	
HK-5	17.01–15.02.2022	15.02–18.03.2022	22.03-19.04.2022	35	38	68		<0,0282	<0,026	<0.029		<0,0282	<0,026	<0,029		20	3	43	
HK-6	17.01–15.02.2022	15.02–18.03.2022	22.03-19.04.2022	135	80	309		<0,0282	<0,026	<0.029		<0,0282	<0,026	<0,029		111	50	61	
HK-7	18.01–16.02.2022	16.02–18.03.2022	22.03-19.04.2022	151	245	335		<0,0282	<0,027	<0.029		<0,0282	<0,027	<0,029		15	28	9	
HK-8	18.01–16.02.2022	16.02–18.03.2022	22.03-19.04.2022	43	54	73		0,958	<0,027	<0.029		<0,0282	<0,027	<0,029		66	82	39	
HK-9	18.01–16.02.2022	16.02–18.03.2022	22.03-19.04.2022	26	36	50		<0,0282	<0,027	0.140		<0,0282	<0,027	<0,029		5	9	6	
HK-10	17.01–15.02.2022	15.02–18.03.2022	22.03-19.04.2022	40	44	160		<0,0282	0,058	0.367		<0,0282	<0,026	<0,029		68	42	103	
HK-11	18.01–16.02.2022	16.02–18.03.2022	22.03-19.04.2022	47	86	175		<0,0282	<0,027	<0.029		<0,0282	0,081	<0,029		41	73	41	
HK-12	18.01–16.02.2022	15.02–18.03.2022	22.03-19.04.2022	28	27	88		<0,0282	<0,026	<0.029		<0,0282	<0,026	<0,029		21	54	72	

Note:

1: Project standards are given in Appendix C of the ESIA.

2: Red coloured concentration values are above the relevant Project Standards.

Sensitivity Assessment

After analysing the baseline data, the sensitivity of the air quality component is given below.

Sensitivity features	Supported by	Sensitivity value
High NOx, PM10 and PM2,5 concentrations in the RSA High PM10, PM2.5, SO_2, and O_3 concentrations in the AoI Close presence of communities, vulnerable targets and sensitive ecological receptors potentially exposed to air emissions Other ongoing projects (under construction and planning stage) around the Project area.	Primary and secondary data	Medium-high

6.2.1.3 Noise and Vibration

Definition	Background noise/vibration or ambient noise/vibration is the sound level of environmental noise/vibration such as water waves, traffic noise, trains and airplanes, alarms, bioacoustic noise from animals, and electrical noise from equipment. During construction and decommissioning activities, noise and vibration may be caused by the operation of pile drivers, earth moving and excavation equipment, concrete mixers, cranes, offshore vessels and the transportation of equipment, materials and people. During operations, the main sources of noise and vibration pollution will be produced by flaring and rotating equipment. Noise sources include flares, pumps, compressors, generators, and heaters.
Study area	**RSA:** Zonguldak Province **Rationale:** Noise and vibration related issues are controlled and managed by the Provincial Directorate of Environment, Urbanization and Climate Change.
	AoI: 1,000 m buffer zone **Rationale:** The nearby receptors (i.e. communities) around the Project area may be affected from potential noise and vibration impacts.
Data sources	**Primary sources** ■ Field work and baseline noise measurements conducted in 2021 during EIA Studies ■ Field work and baseline noise measurements conducted in 2022 During ESIA Studies

	Secondary sources: ■ Data from Filyos Port/Industrial Zone Connections Project ESIA Report

Methodological approach

Baseline data collected in AoI is the only available data for this component since there is not any provincial level noise and vibration information. Details about the methodology used for the noise baseline data collection study are provided below.

Filyos Port/Industrial Zone Connections Project ESIA Studies

In order to determine the baseline noise levels within the scope of Filyos Port/Industrial Zone Connections Project ESIA Report (Çınar, 2020), background noise measurements were performed for 48 hours in 2020. Background noise measurements were carried out at 5 points (noise sensitive receptors) selected along the routes of railway connection lines and highway that have the potential to be adversely affected by construction and operation activities of the above-mentioned Project.

Coordinates of monitoring points and monitoring locations are provided in Table 6-12. Locations are presented in Figure 6-15

Table 6-12: Locations and Coordinates of the Noise Monitoring Points (Filyos Port/Industrial Zone Connections Project ESIA Studies)

Monitoring Point	Location	Coordinates (UTM/WGS) (36T)	
		East	North
G-1	Sefercik Village	420491	4602090
G-2	Gökçeler Village	421818	4601044
G-3	Sazköy Village	422449	4603361
G-4	Sazköy Village	422445	4603400
G-5	Derecikören Village	422560	4600522

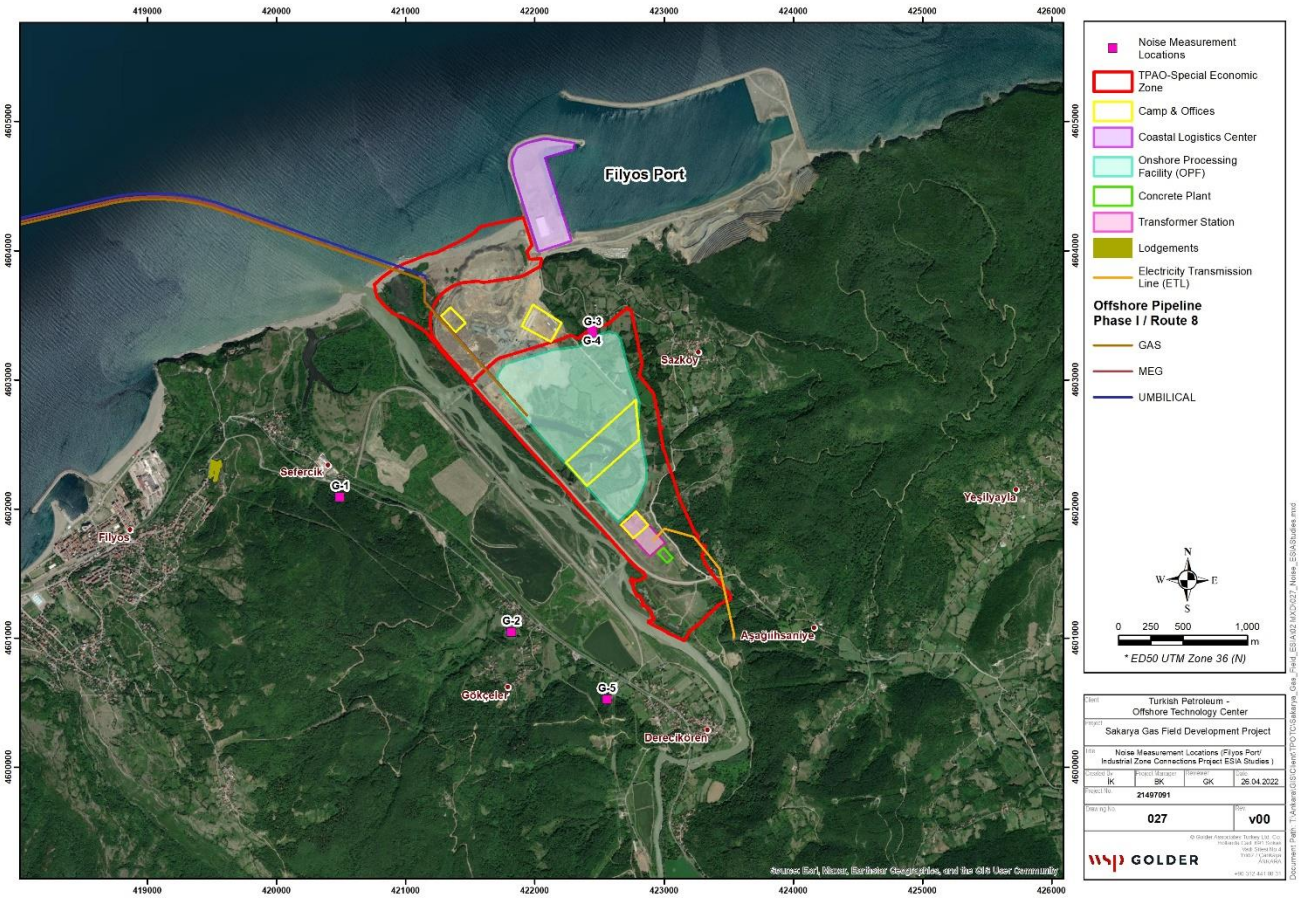


Figure 6-15: Baseline Noise Measurement Locations (Filyos Port/Industrial Zone Connections Project ESIA Studies, 2020)

Project EIA Report

In addition, a baseline noise monitoring campaign was conducted during the EIA study on June 3rd, 2021 and June 4th, 2021. The baseline noise level was measured in 15 residential areas around the Project components. The noise monitoring study was conducted within the time intervals described in the Turkish legislation (day [07:00-19:00], evening [19:00-23:00] and night [23:00-07:00]) time for 5-minute intervals.

Coordinates of monitoring points and monitoring locations are provided in Table 6-13. Locations are presented in Figure 6-16.

Table 6-13: Locations and Coordinates of the Noise Monitoring Points (Project EIA Report)

Monitoring Point	Location	Coordinates (UTM/WGS) (36T)	
		East	North
N-1	Sazköy Village	422453	4603499
N-2	Sazköy Village	423051	4603317

Monitoring Point	Location	Coordinates (UTM/WGS) (36T)	
		East	North
N-3	Sazköy Village	423463	4603049
N-4	Aşağıihsaniye Village	423382	4601491
N-5	Aşağıihsaniye Village	423883	4601472
N-6	Aşağıihsaniye Village	424189	4601127
N-7	Derecikören Village	423315	4600181
N-8	Derecikören Village	422973	4600365
N-9	Derecikören Village	422999	4600626
N-10	Gökçeler Village	421843	4600632
N-11	Gökçeler Village	421869	4600877
N-12	Gökçeler Village	421629	4601417
N-13	Sefercik Village	420490	4602237
N-14	Sefercik Village	419945	4602565
N-15	Sefercik Village	419988	4602736

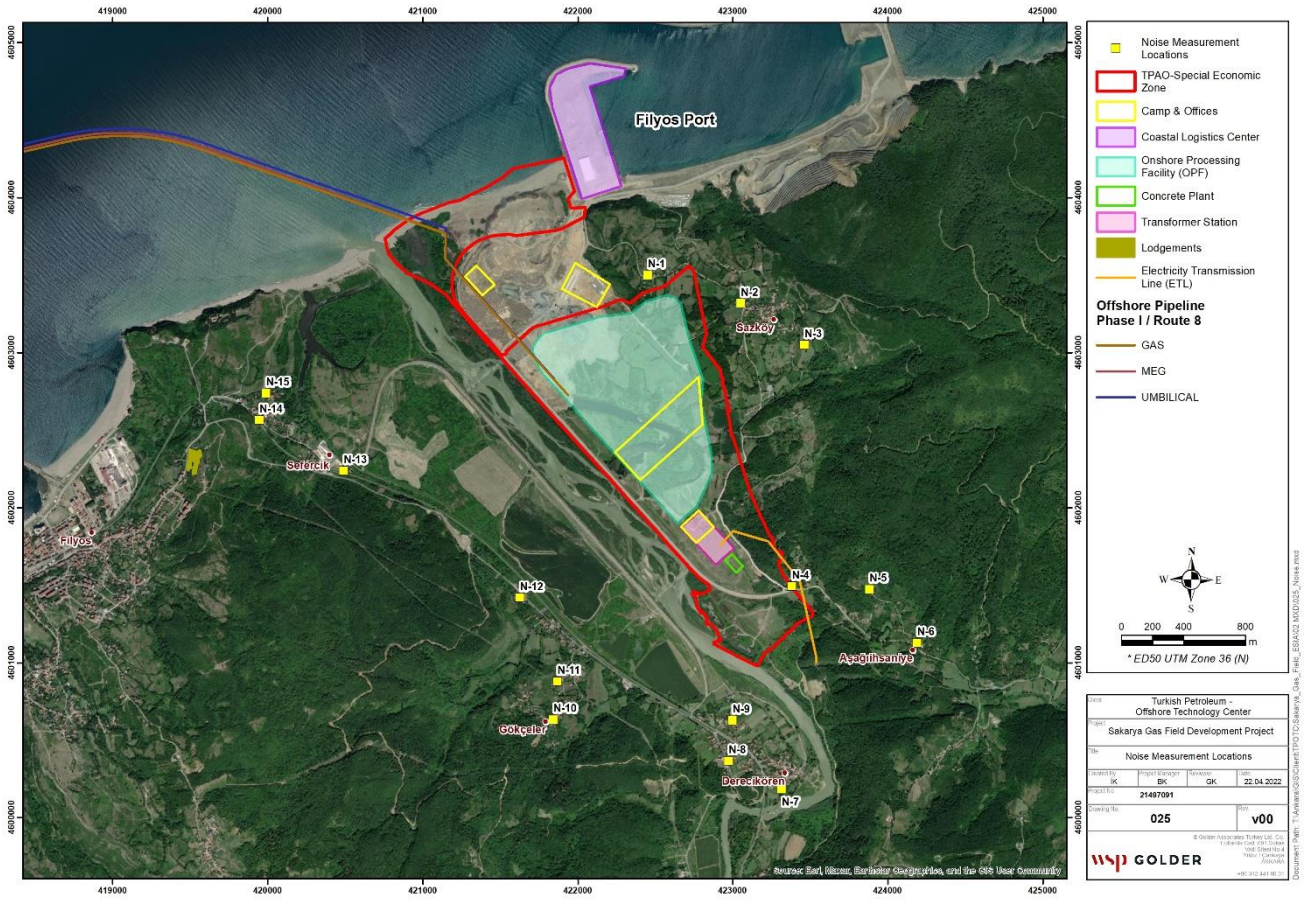


Figure 6-16: Baseline Noise Measurement Locations (Project EIA Report, 2021)

Baseline Noise and Vibration Measurements Conducted within the Scope of this ESIA

Baseline noise and vibration monitoring study within the scope of this ESIA Report has been conducted at 15 points. The noise monitoring study was conducted within the time intervals described in the Turkish legislation and IFC General EHS Guideline for Noise for 48 hours.

Prior to ESIA process, background measurements could not be performed due to ongoing ground reinforcement works within the scope of the industrial zone construction activities. Therefore, they were conducted during the holidays when the construction activities of the Project were stopped. Coordinates of monitoring points including the 15 monitoring locations are provided in Table 6-14. Locations are presented in Figure 6-17.

Table 6-14: Locations and Coordinates of the Noise Monitoring Points Conducted within the Scope of this ESIA

Monitoring Point	Coordinates (UTM/WGS) (36T)	
	Latitude	Longitude
Noise-1	424198	4601108

Monitoring Point	Coordinates (UTM/WGS) (36T)	
	Latitude	Longitude
Noise-2	423895	4601480
Noise-3	420081	4602732
Noise-4	419992	4602549
Noise-5	421984	4601080
Noise-6	421814	4601241
Noise-7	422979	4600751
Traffic-1	425280	4600863
Traffic-2	423386	4601510
Traffic-3	420851	4602890
Activity-1	423062	4603035
Activity-2	423047	4603312
Activity-3	422467	4603513
Activity-4	420538	4602235
Activity-5	423261	4602534

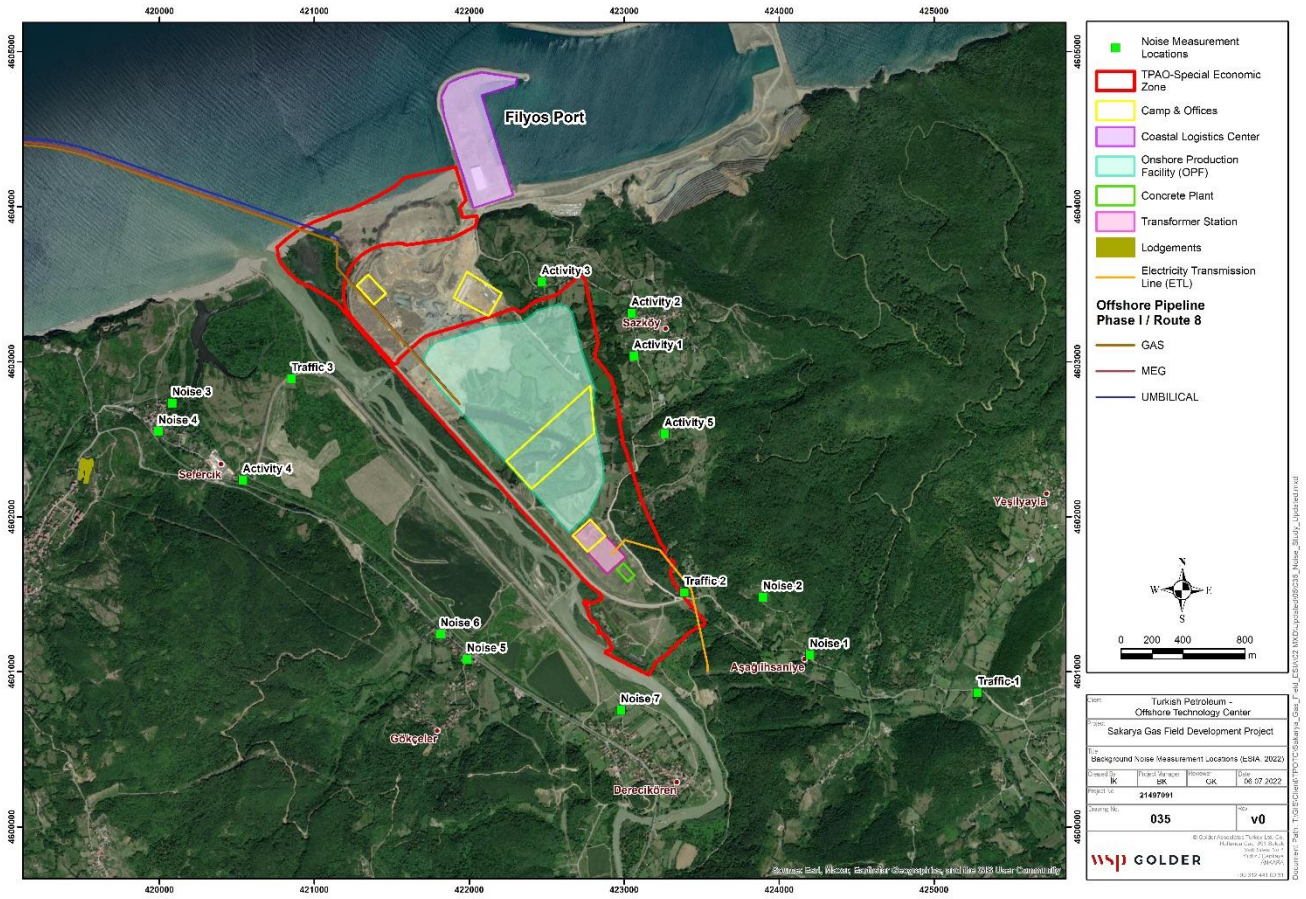


Figure 6-17: Background Noise Measurement Locations (ESIA, 2022)

Methodology of noise monitoring studies are provided from the laboratory (Çınar, 2022) and summarised below.

Environmental noise monitoring studies are conducted according to TS ISO 1996-1 and TS ISO 1996-2 standards.

- TS ISO 1996-1: Acoustic - Definition, Measurement and Evaluation of Environmental Noise -Part 1: Basic Dimensions and Evaluation Procedures
- TS ISO 1996-2: Acoustics - Definition, Measurement and Evaluation of Environmental Noise - Part 2: Determination of Sound Pressure Levels

Measurements are conducted at a height of at least 1.5 m from the ground and at a distance of at least 2 m from the reflective surface. Equivalence continuous noise pressure level (L_{Aeq}) value is provided in accordance with the IFC (day and night) and Turkish legislation (day, evening and night) time intervals.

Devices used to measure sound pressure levels, including microphones, cables, guards, recording devices and other equipment (Figure 6-18), meet the requirements for Class 1 equipment according to IEC 61672 standard. A guard is always be used during outdoor measurements in order to prevent the device from physical impacts (wind, rain, dust etc.).

Figure 6-18: Sound Level Meters (Çınar, Air and Noise Quality Laboratory Methodology, 2022)

Prior to ESIA process, baseline vibration measurements could not be performed due to ongoing ground reinforcement works within the scope of the industrial zone construction. Therefore, the measurements were conducted during the holidays when the construction activities of the Project were stopped.

Local context (AoI)

Filyos Port/Industrial Zone Connections Project ESIA Studies

According to the result of the measurements which were conducted in 2020 within the scope of Filyos Port/Industrial Zone Connections Project ESIA Report, some of the noise levels at monitoring stations which were measured prior to start of the construction works of the Project are above the project standards. It was mentioned in this ESIA Report that G-5 point is adjacent to the existing Zonguldak-Çaycuma road and the existing railway, and the high noise level at this point is thought to be the caused by the existing road and railway. High results at other points are assumed to be caused due to the rural activities at the monitoring points.

Table 6-15: Noise Monitoring Results According to the Monitoring Study Conducted within the Scope of Filyos Port/Industrial Zone Connections Project ESIA Report

Monitoring Point	Monitoring Results (dBA)				
	Turkish Legislation[1]			IFC EHS Guidelines	
	Day (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)	Day (07:00-22:00)	Night (22:00-07:00)
	L_{Aeq} (dBA)	L_{Aeq} (dBA)	L_{Aeq} (dBA)	L_{Aeq} (dBA)	L_{Aeq} (dBA)
G-1	63.2	52.9	53.8	63.1	53.9
G-2	62.9	59.2	48.2	62.8	51.7
G-3	55.8	58.0	50.2	57.6	56.2
G-4	50.5	47.5	38.3	49.8	39.6

Monitoring Point	Monitoring Results (dBA)				
	Turkish Legislation[1]			IFC EHS Guidelines	
	Day (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)	Day (07:00-22:00)	Night (22:00-07:00)
	L_{Aeq} (dBA)	L_{Aeq} (dBA)	L_{Aeq} (dBA)	L_{Aeq} (dBA)	L_{Aeq} (dBA)
G-5	68.8	61.5	65.1	67.4	63.3
Project Standards	**65.0**	**60.0**	**55.0**	**55.0**	**45.0**

Notes:

1 Regulation on the Assessment and Management of Environmental Noise (RAMEN)

2 Project standards are given in Appendix C of the ESIA.

Project EIA Report

Noise data provided from the monitoring study during EIA process in the AoI is provided in Table 6-16. According to the monitoring results, results at some of the points are above the Project Standards. Although the measurements cannot be confirmed since they are 5 minutes long, these high noise measurement results may be related with ongoing construction works of Industrial Zone and Filyos Port.

Table 6-16: Noise Monitoring Results According to the Monitoring Study Conducted within the Scope of the EIA Report

Monitoring Point	Monitoring Results (dBA)					
	Day (07:00-19:00)		Evening (19:00-23:00)		Night (23:00-07:00)	
	Time Interval	L_{Aeq} (dBA)	Time Interval	L_{Aeq} (dBA)	Time Interval	L_{Aeq} (dBA)
G-1	16:30-16:35	52.9	21:34-21:39	44.2	00:19-00:24	40.8
G-2	16:41-16:46	50.8	21:27-21:32	80.9	00:32-00:37	72.0
G-3	16:50-16:55	97.1	21:17-21:22	40.3	00:41-00:46	37.3
G-4	17:01-17:06	38.3	21:05-21:10	51.4	00:54-00:59	38.1
G-5	17:11-17:16	94.9	20:53-20:58	44.5	01:05-01:10	38.0
G-6	17:21-17:16	68.3	20:42-20:47	49.0	01:14-01:19	30.8

Monitoring Point	Monitoring Results (dBA)					
	Day (07:00-19:00)		Evening (19:00-23:00)		Night (23:00-07:00)	
	Time Interval	L_{Aeq} (dBA)	Time Interval	L_{Aeq} (dBA)	Time Interval	L_{Aeq} (dBA)
G-7	17:36-17:41	50.2	20:27-20:32	53.0	01:40-01:45	44.4
G-8	17:46-17:51	50.7	20:17-20:22	50.2	01:50-01:55	38.4
G-9	17:56-18:01	86.6	20:08-20:13	49.2	01:59-02:04	50.6
G-10	18:03-18:08	51.4	20:01-20:06	50.6	02:09-02:14	43.0
G-11	18:12-18:17	51.7	19:52-19:57	98.1	02:18:02:23	36.9
G-12	18:22-18:27	51.8	19:42-19:47	53.3	02:28-02:33	38.5
G-13	18:36-18:41	50.7	19:26-19:31	47.6	02:41-02:46	39.0
G-14	18:46-18:51	58.4	19:16-19:21	85.7	02:50-02:55	37.7
G-15	18:54-18:59	53.8	19:08-19:13	48.2	02:58-03:02	38.4
Project Standard		**65.0**		**60.0**		**55.0**

Notes:

1: Project standards are given in Appendix C of the ESIA.

Baseline Noise and Vibration Measurements Conducted within the Scope of this ESIA

Noise data provided from the monitoring study during ESIA process in the AoI is provided below. Although measurement results are only background measurement results, some of the measurements are above the Project Standards. High noise measurement results specifically at Noise 5, 6 and 7 locations are expected to be due to the ongoing Filyos Port and industrial zone construction works close to these monitoring points. within the scope of Filyos Port and industrial zone projects.

In addition, the vibration levels measured at the monitoring points are below the Project Standard defined in the Regulation on the Assessment and Management of Environmental Noise.

Table 6-17: Noise and Vibration Monitoring Results According to the Monitoring Study Conducted within the Scope of this ESIA Report

Monitoring Point	Date	Noise (dBA)					Vibration (mm/s)		
		Turkish Legislation[1]			IFC EHS Guidelines				
		Day (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)	Day (07:00-22:00)	Night (22:00-07:00)	X direction	Y direction	Z direction
Noise-1	29.04.2022		42.8	47.3	43.6	46.9	0.361	0.438	0.629
	30.04.2022	51.9	50.8	50.0	51.9	49.5			
	01.05.2022	53.5	52.2		53.4				
Noise-2	01.05.2022		41.5	44.5		44.0	0.542	0.317	0.558
	02.05.2022	46.8	39.1	38.3	44.0	46.1			
	03.05.2022	39.9	45.5		38.1	40.9			
Noise-3	29.04.2022		49.2	49.6	48.3	49.7	0.585	0.334	0.478
	30.04.2022	52.9	51.8	49.0	52.7	49.1			
	01.05.2022	48.5	51.2		49.0				
Noise-4	29.04.2022		51.9	49.9	53.4	49.5	0.558	0.433	0.207
	30.04.2022	52.8	51.2	46.3	52.7	46.4			
	01.05.2022	50.2	49.9		50.2				
Noise-5	29.04.2022	61.5	60.5	53.9	61.3	54.5	0.292	0.528	0.084
	30.04.2022	62.3	59.5	54.0	62.0	54.0			
	01.05.2022	60.4			60.4				
Noise-6	29.04.2022	62.2	60.2	55.1	61.3	55.5	0.054	0.047	0.067
	30.04.2022	63.5	61.6	54.3	63.3	54.8			
	01.05.2022	61.6			61.6				
Noise-7	29.04.2022	61.1	58.4	53.9	59.4	54.5	0.031	0.037	0.044
	30.04.2022	59.0	54.0	53.7	58.2	54.3			
	01.05.2022	58.5			58.5				
Traffic-1	01.05.2022		48.0	48.1	48.4	48.1	0.341	0.535	0.779
	02.05.2023	52.6	47.8	46.9	52.0	46.7			
	03.05.2024	51.1	50.4		51.0				
Traffic-2	01.05.2022		51.5	46.3	52.2	47.0	0.56	0.699	0.543
	02.05.2023	49.9	48.4	44.7	49.7	44.9			
	03.05.2024	48.8	53.8		50.0				
Traffic-3	29.04.2022			49.5		49.5	0.542	0.685	0.211
	30.04.2022	50.0	54.5	46.6	51.5	48.2			
	01.05.2022	48.9	50.1	51.7	49.7	52.0			
Activity-1	01.05.2022		38.7	48.1		47.9	0.611	0.581	0.251
	02.05.2022	48.6	45.6	44.5	48.3	44.1			
	03.05.2022	45.8	44.0		45.5	42.3			
Activity-2	01.05.2022			43.9		43.9	0.404	0.672	0.547
	02.05.2022	47.1	40.0	43.7	46.3	43.4			

Monitoring Point	Date	Noise (dBA)					Vibration (mm/s)		
		Turkish Legislation[1]			IFC EHS Guidelines				
		Day (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)	Day (07:00-22:00)	Night (22:00-07:00)	X direction	Y direction	Z direction
	03.05.2022	47.4	48.9	45.5	48.0	45.4			
Activity-3	02.05.2022	54.4	44.8	45.5	53.1	45.3	0.567	0.628	0.425
	03.05.2022	51.3	44.7	49.6	50.6	49.2			
	04.05.2022	47.9			47.9				
Activity-4	29.04.2022		49.2	45.2	49.3	45.8	0.037	0.041	0.053
	30.04.2022	53.0	49.7	47.7	52.6	47.3			
	01.05.2022	51.8	50.2		51.8				
Activity-5	01.05.2022		44.0	42.1		42.3	0.361	0.538	0.629
	02.05.2022	51.0	42.2	46.2	50.2	45.8			
	03.05.2022	54.2	48.8		53.6	37.9			
Project Standard[2]		**65.0**	**60.0**	**55.0**	**55.0**	**45.0**	**5.0**	**5.0**	**5.0**

1: Regulation on the Assessment and Management of Environmental Noise (RAMEN)

2: Project standards are given in Appendix C of the ESIA.

Sensitivity Assessment

After analysing the baseline data, the sensitivity assessment of noise and vibration component is given below.

Sensitivity features	Supported by	Sensitivity value
High noise levels in the AoI Close presence of communities, vulnerable targets and sensitive ecological receptors potentially exposed to noise and vibration emissions Other ongoing projects (under construction and planning stage) around the Project area.	Primary and secondary data	Medium-High

6.2.1.4 Geology, Geomorphology and Seismicity

Definition	In order to provide the necessary data for designing works under maximum safety conditions during construction and production, Geological and Geotechnical Studies were conducted to determine the geo-morphological, geological and geo-technical conditions on the site. A summary of these geological studies is compiled in the following sections.

Study areas	**RSA:** Provincial borders of Zonguldak and Bartın. **Rationale:** Provincial borders of Zonguldak and Bartın has been determined as RSA, Since the regional geology at the project location is related to the provinces of Bartın and Zonguldak.
	AoI: Project Units (Onshore Processing Facility and components, Construction Camp Sites & Permanent Lodgings). **Rationale:** Within the scope of the project, since the areas where the project units are located are likely to be affected by the geological structure, the areas where the project units are located were selected as AoI.
Data sources	**Primary sources**: Primary data from field work conducted by Toker Drillling Co. in April and May 2021.
	Secondary sources: Secondary data from various surveys for the Project, scientific papers, geological literature and databases.

Methodological approach

Information presented in this report regarding the regional geological setting of the TP-OTC Sakarya Gas Field is sourced from geological and geotechnical investigations carried out in the area.

The reports that have been review are:

- Filyos (Zonguldak) Industrial Zone Basis of the Master Plan Geological – Geotechnical Survey Report, Geoteknik Mühendislik, May 2016.
- TP-OTC Filyos Natural Gas Processing Plant Stage 2-3-4 Soil and Foundation Investigations Geotechnical Evaluation Report, TOKER Drilling and Construction Engineering Consulting Co., April 2021.
- Sakarya Gas Field Submarine Production Facilities, Submarine Transport Lines and Gas Processing Facility Integrated Project EIA Report, Armada Danışmanlık, 08.09.2021
- Sakarya Gas Field Development Project Probabilistic Seismic Hazard Assessment, DenAR, December 2021.
- Probabilistic Seismic Hazard Assessment Design Ground Motions for TP-OTC FİLYOS Natural Gas Processing Facility Site, Prof. Dr. Zeynep Gülerce-Middle East Technical University, April 2021.
- Geology of the Black Sea coal basin (Zonguldak, Bartın), MTA, 2019.
- Hydrographic and Oceanographic Survey Report, DenAR, May 2021.

Regional context (RSA)

The Project site is in proximity of the cities of Zonguldak, Çaycuma, and the village of Sazköy. The Middle Ordovician-Lower Devonian aged Ereğli formation forms the Regional Area. It is overlain by the Middle Devonian-Lower Carboniferous Yılanlı formation, the Upper Visian-Upper Namurian aged Alacaağzı formation, and the Westphalian aged Karadon formation. The Permo-Triassic terrestrial Çakra formation and the Triassic Çakraboz formations are transitive with each other. These formations overlie the older units with angular

unconformity. Malm-Apsian aged İnaltı formation, Lower Cretaceous aged Ulus formation, Lower Cretaceous aged Kilimli formation, Upper Cretaceous Yemişliçay formation, Upper Campanian-Lower Eocene aged Akveren formation, Lower-Middle Eocene aged Yığılca formation and Lower-Middle Miocene aged Çaycuma formation unconformably overlies the terrestrial clastics. Quaternary aged current deposits unconformably overlie older units.

- ***Ereğli Formation (Ode)***

  The formation forms a sequence of 250-300m of thicknessand it was named by Serdar and Demir (1983). This formation consists of shale-sandstone, shale-limestone and shale-sandstone alternations from bottom to top.

- ***Yılanlı Formation (DCy)***

  The formation consists of limestone, dolomitic limestone and dolomite and it was named by Saner (1979-1980). The formation starts with shale, siltstone-limestone alternation at the bottom, it continues with limestone, dolomitic limestone and dolomite.

- ***Alacaağzı Formation (Ca)***

  The formation consists of coal veined shale, mudstone and sandstone, and it was named by Ralli (1933). The lower part of the formation contains fossils. The thickness of the formation is about 500 m.

- ***Karadon Formation (Cka)***

  Consisting of conglomerate, sandstone, claystone and diatomite, the formation was named by Ralli (1933). The formation contains yellowish grey coloured conglomerate, sandstone, claystone, shale, diatomite (Dil ve Konyalı, 1978) and refractory clay (Kerey, 1984; Yergök ve diğ., 1987). The formation contains coal veins, and its thickness is around 200 m.

- ***Çakraz Formation (P''Eç)***

  Red coloured terrestrial mudstone, shale, sandstone, and conglomerate are named as Çakraz Sandstone. (Akyol et al. 1974) The formation, which consists of dark red, green-red alternating shale, mudstone and sandstone, also includes conglomerates. Cross-bedded sandstones are observed. The thickness of this formation is approximately 600-700 m.

- ***İnaltı Formation (JKi)***

  İnaltı formation consists of white, beige and grey coloured carbonates. The bottom section consists of sandstone, sandy limestone, dolomitic limestone and dolomite. The middle and upper sections consist entirely of carbonates. The thickness of the formation is approximately 400-500 m.

- ***Ulus Formation (Ku)***

  The formation, which is consisting of alternating turbiditic sandstone and shale, was named by Akyol et al (1974). The formation consists of alternating greyish green, grey and black, medium bedded turbiditic sandstone and shale. The formation contains volcanic blocks. The formation is represented by slope and sub slope basin sediments. The thickness of the formation is about 200 m.

- ***Kilimli Formation (Kk)***

The formation, which consists of shale, marl, sandstone, and sandy-clay limestone alternation, was named by Saner et al (1981). The formation consists of alternating greyish green, thin-medium bedded shale, marl, and yellowish grey coloured thin-medium bedded sandstone. The thickness of the formation is about 250-300 m.

- ***Yemişliçay Formation (Ky)***

  The formation which consistsof volcanogenic sandstone, shale, pyroclastic rocks and pelagic-semi-pelagic limestone was named by Ketin and Gümüş (1963). The formation including brown, thin-medium bedded volcanogenic sandstone, greyish green, thin-medium bedded shale and sandstone alternation, tuff, tuffite at the bottom, beige and red-pink coloured, thin-medium bedded pelagic-semi-pelagic clayey limestones in the middle, brown and dark grey coloured agglomerates at the upper section.

- ***Akveren Formation (Kta)***

  Akveren formation is yellow, white, greyish green, red coloured and thin-medium-thick bedded. It begins with sandstone and clastic limestone. In the upper parts, it continues with clayey limestone and marl. Turbidite deposits are observed in the formation. The thickness of the formation is about 350-400 m.

- ***Yığılca Formation (Tey)***

  The formation which consists of andesite, basalt, tuff, agglomerate and volcanogenic sandstone was named Yığılca formation by Kaya et al (1986). The formation contains agglomerate and tuff in dark grey, brownish grey, red- and green-coloured units. In addition, Nummulites fossils are found in the thin marl between these units. The formation thickness is about 100-150 m.

- ***Çaycuma Formation (Teç)***

  The formation, which consists of alternations of volcanic sandstone, siltstone, claystone, and shale, was named by Tokay (1954-1955). The lower and middle parts of the formation consist of greyish green, thin-medium bedded, carbonate shale and green and purple coloured limestone. In the upper parts, there are tuffite and limestone (inc. Nummulites) interbedded shales. The thickness of the formation is about 350 m.

- ***Quaternary (Qal)***

  It appears as gravel, sand and mud deposits in stream beds.

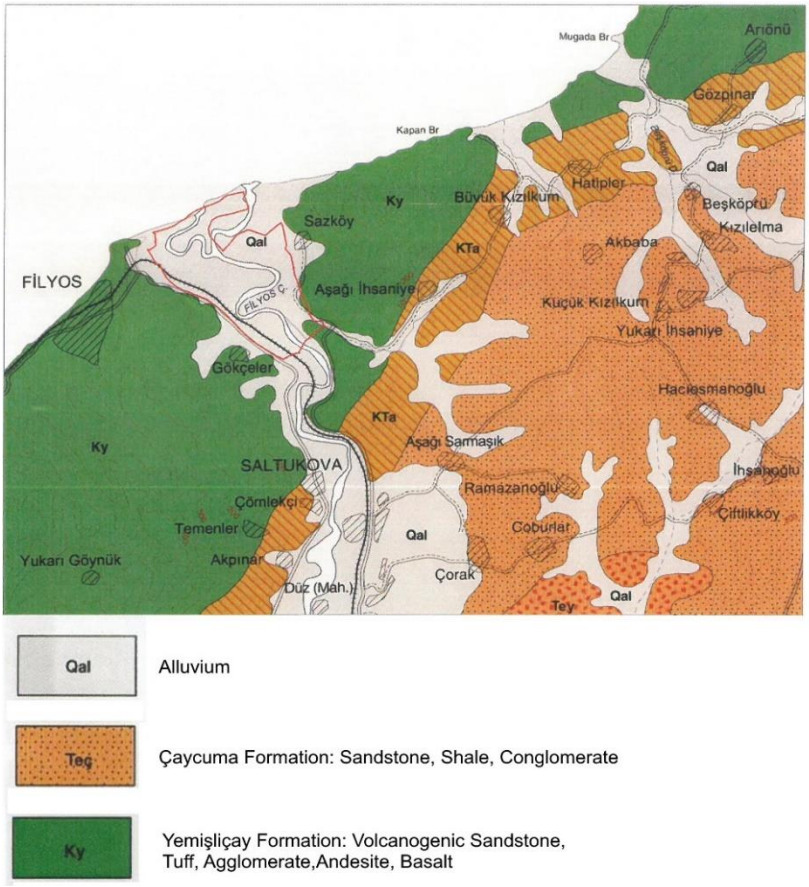


Figure 6-19: Geological map of RSA & AoI and its surroundings. Red circle identifies the AoI (Akbaş ve diğ., 2002)

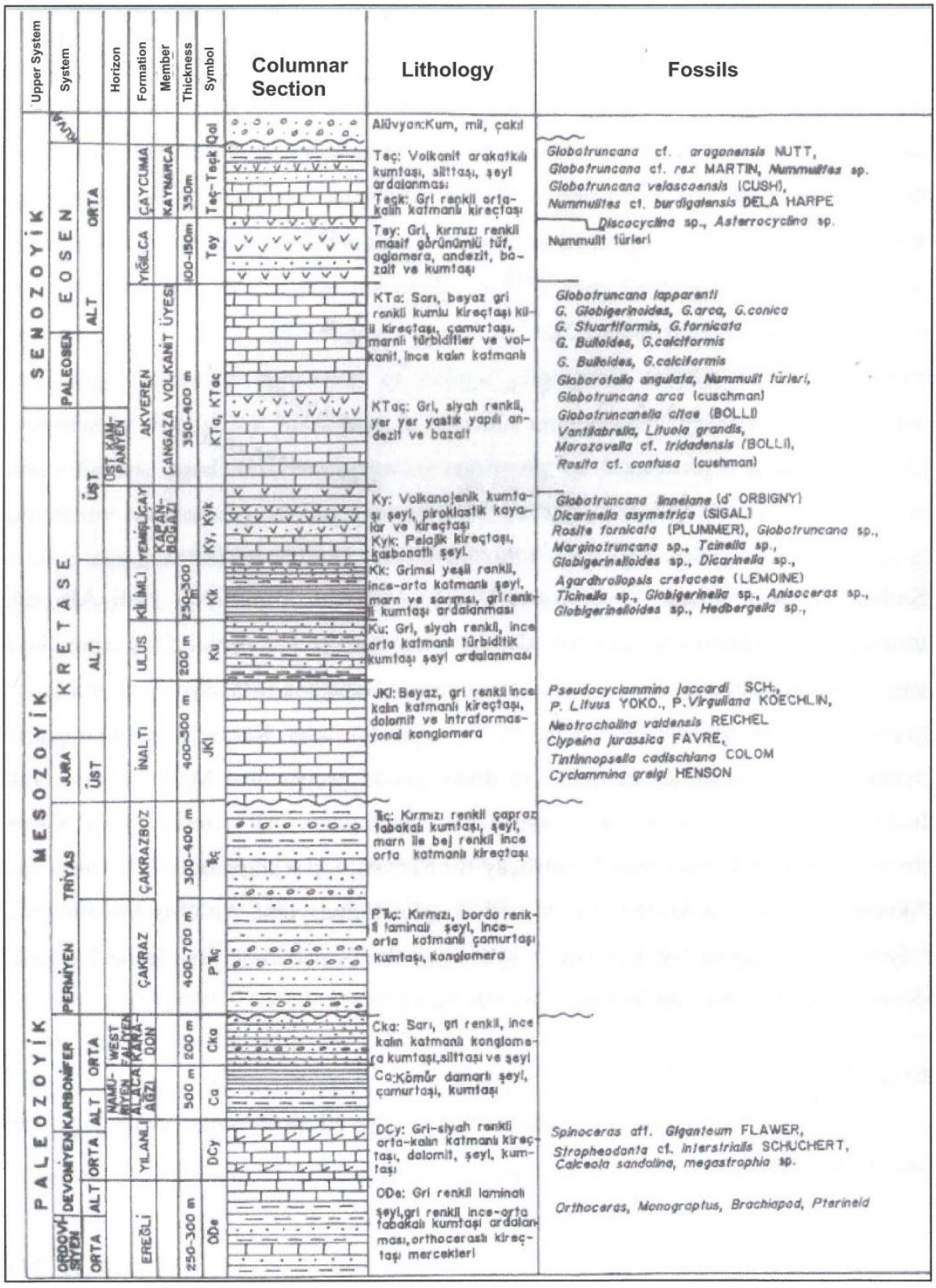


Figure 6-20: Regional Stratigraphy (Akbaş ve diğ., 2002)

Geomorphology

In the section between Karabük and Yenice, Filyos flows rapidly and erodes its base. Another part where it is evident that Filyos has eroded its floor is the slope fracture area around İbrahimce creek. Here Filyos flows from bare rocks.

Collisions have developed and continue to develop, especially in places where the river flows fast. The slopes of the Filyos valley are very affected by the rock type. The steep slopes, especially in the regions formed by metamorphic rocks and granites, are quite stable in the places where they pass through the cut valleys between Karabük and Basilisk.

In the section between Balıkisik and Kayadibi west of Yenice, the slopes of the valley are unstable and landslide since Aptian-Albian claystones cover widespread areas.

Structures located in the south of Gökçebey cut the Filyos-resistant layers vertically by making split valleys. On the other hand, the valley widens, and the steepness of the slopes decreases in the regions composed of relatively unstable rocks located between these resistant levels.

Alluvial fans have developed in some of the side streams flowing into the Filyos River. These, alluvial fans developed at the Kelemen creek mouth in the west of Balıkisik, at the mouth of Çayderesi in the west of Yenice, at the mouth of Kabaklidere, and around the Persembe Kuruderesi. These are related to the severe erosion of the slopes of the side streams, and sometimes to the increase in the amount of material they carry due to landslides.

The Filyos valley is an erosional groove open in N-S direction within the structurally controlled NE-SW trending uplift belts. The bottom is filled with alluvium brought by the river and gained the morphology of the plain. The valley is inserted into the surrounding high relief with plains in the form of valley floors filled with alluvium on the sides. Five black clover landform groups, in which different processes are active, are distinguished in the region. These consist of alluvial plains divided into sub-units, coastal belt, low-level erosional plateaus, high plateau-hills and mountainous areas.

Seismicity

Turkey, along its geological history, formed through development of oceans, convergence-divergence-collision of continents, and by tectonic movements in many different characteristics. Long and continuous thrust faults in the Western Black Sea region are faults in the E-W or NE-SW direction. These faults have occurred due to N-S or NW-SE directional stresses. There is not much information on the deformations that occurred as a result of the pre-Alpine movements. The North Anatolian Fault is located approximately 80 km South of the AoI. It is a seismically active, important tectonic structure that starts from Karlıova in the East and extends to the Saros Gulf in the West. It extends the country in an E-W direction, forming a belt with a length of about 1200 km and a width varying between 100 m and 10 km. It is a right-lateral strike-slip fault that provides the movement between the Black Sea plate and the Anatolian plate. (Saroglu et al, 1987).

Turkey is located on the Alpine orogenic zone and in a region with high earthquake activity. 42% of the country acreage is in 1st grade seismic belt. The Istanbul Zone, which covers Zonguldak and its surrounding provinces, was influenced by the orogenic movements occurred in Neogene. In the region, a compressive regime with a N-S direction dominates the post-collision until the Late Miocene (Pontian).

From the Late Miocene, a NW-SE compressive regime started and this regime continued until the Late Pliocene. In the Late Pliocene period, this compression was replaced by a compression in the N-S direction and an

expansion in the N-S direction was observed in the region throughout the Middle Miocene. Tectonic map of the North-Eastern Mediterranean region presented by Genç and Yilmaz (2000) is given in the Figure 6-21.

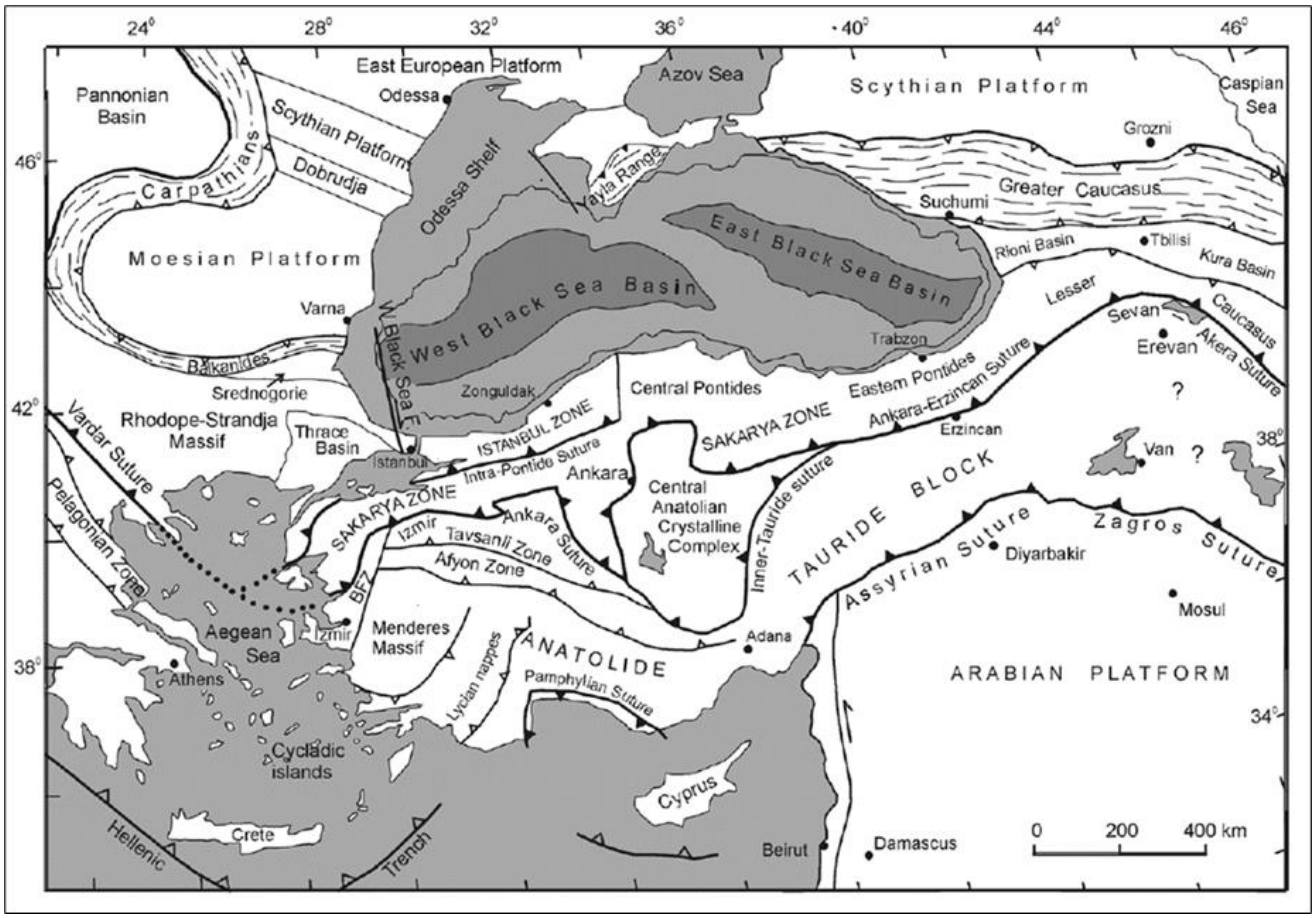


Figure 6-21: Tectonic Map of the north-eastern Mediterranean region showing the major sutures and continental blocks (Genç and Yilmaz. 2000)

In general, Zonguldak is affected by the North Anatolian Fault and the fault systems in Bartın. The province of Zonguldak was lastly affected by the August 17 Kocaeli and Düzce earthquakes. As a result of these earthquakes, heavy, moderate and minor damages occurred to the houses.

The first Earthquake Zoning Map of Turkey was prepared by the Ministry of Public Works and Settlement in 1996. This Map was revised in 2018. In the revised map, unlike the previous version, the maximum ground acceleration values are shown instead of earthquake zones and the concept of “earthquake zone” is eliminated. The earthquake hazard map of the Zonguldak Province according to the Map of Turkey Earthquake Hazard Map is provided below.

According to the big earthquake statistics in the past years, the probability of an earthquake with a magnitude of 7.0 in and around Zonguldak to occur in 49 years is 51%. The return period of the earthquake is 68 years. According to the Earthquake Research Department, the risk of a damaging earthquake in the region every 18-20 years is very high.

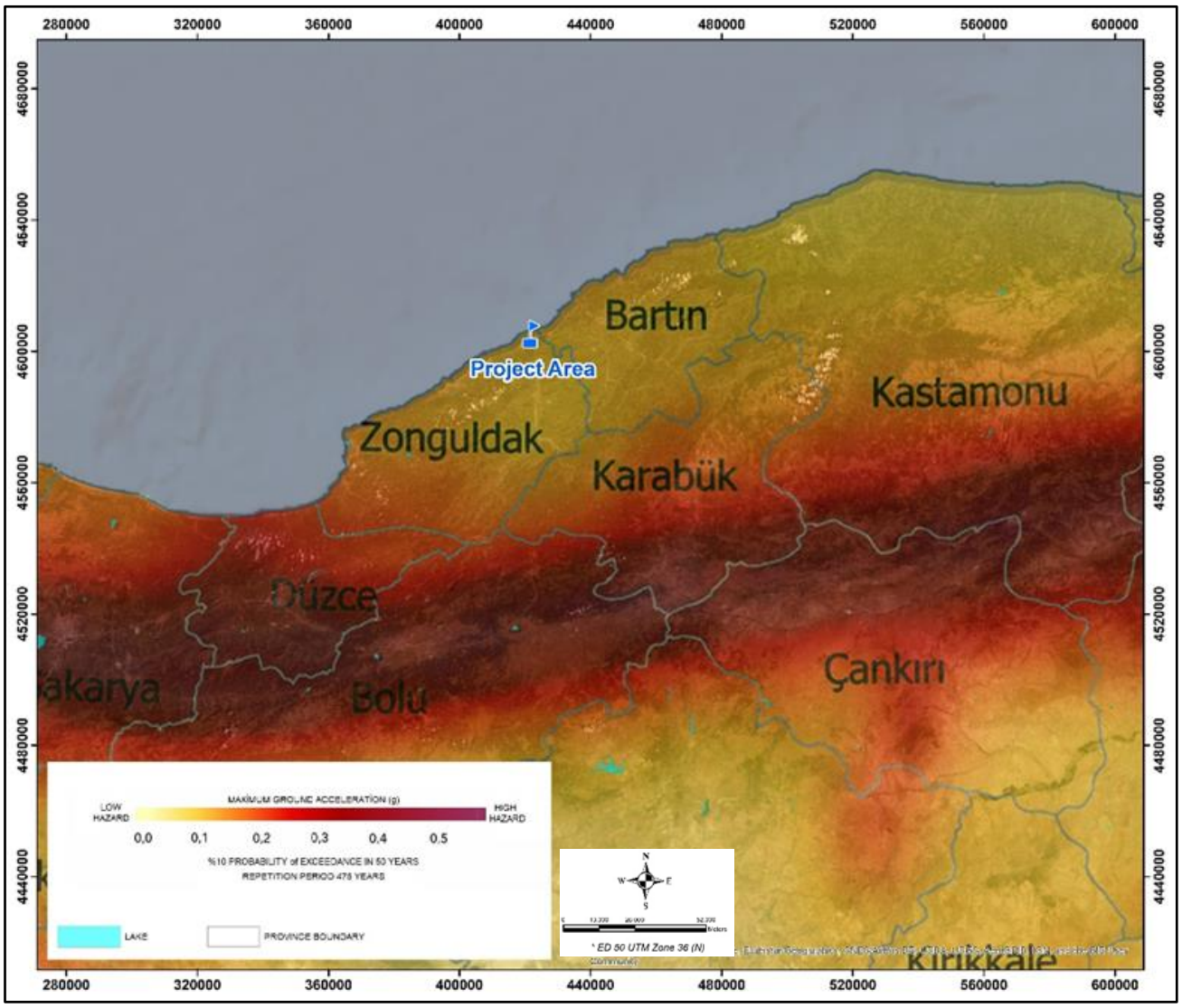


Figure 6-22: The Earthquake Hazard Map of RSA and Surroundings

Local context (AoI)

Information concerning the local geological setting of the AoI is sourced from geological and geotechnical investigations carried out in the area. A comprehensive geotechnical survey was undertaken in 2021 within the Project boundaries by TOKER Drilling and Construction Engineering Consulting Co. The survey includes geological/geotechnical investigations, including boreholes, in-situ and laboratory test results conducted in the scope of Stage 2-3-4 of TP-OTC Filyos Natural Gas Processing Plant Project. The region of the investigation was given in Figure 6-23 (Section of the Geological Investigation Areas (Investigation points from 2021 geotechnical survey). The reports reviewed are:

- TP-OTC Filyos Natural Gas Processing Plant, Geotechnical Evaluation Report, April 2021.
- Filyos (Zonguldak) Industrial area, Geological-Geotechnical Investigation Report, May 2016.

On the basis of this documentation, 67 boreholes with 2771 m total depth were drilled in the AoI between 02.02.2021 – 18.03.2021. In addition, 20 test pits were dug to investigate the geological conditions and to determine the suitability of excavated material for use in filling works. During drillings, samples were taken from soil and in-situ tests were performed. Standard penetration tests were performed, both disturbed (SPT, DS) and undisturbed (UD) samples were collected in accordance with the technical specifications in order to determine strength, stiffness and density of the soil. Borehole drillings at rock formations were performed by continuous coring method.

Liquefaction Analysis have been performed by using laboratory test results and soil profiles encountered in 45 different boreholes where sand/silty sand and non-plastic silt layers observed. Among these regions Region A has relatively small number of soil layers with liquefaction potential whereas Region B and Region C contains considerable amount of soil layers with liquefaction potential.

Groundwater table was observed between 0.50 and 6.00 m depth from the ground surface and between the elevations 0.80 and 6.46 m. Elevations of the water table rise from southwest to northeast (from the Filyos River to hills). The areas where the groundwater table is closest to the sea level are the areas where it approaches the Filyos River (Elevation of the Filyos River is accepted as sea level).

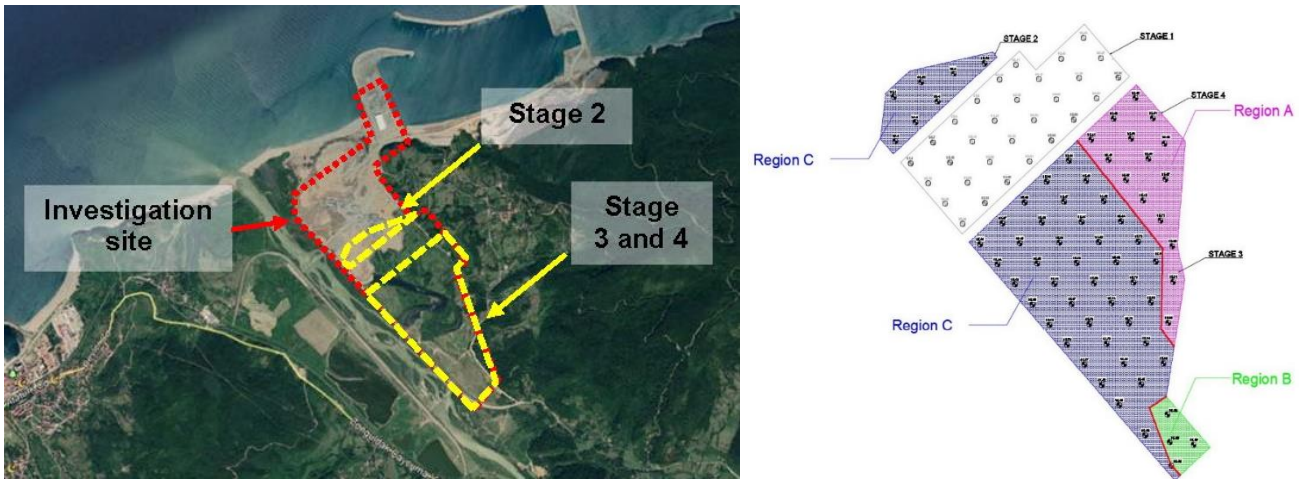


Figure 6-23: Section of the Geological Investigation Areas (Investigation points from 2021 geotechnical survey)

On the basis of this documentation, the site lithostratigraphy is considered to be as follows (from stratigraphic top to bottom).

The general soil profile at the AoI consists of Fill, Alluvium (Silty Clay/Clayey Silt, Sand/Silty Sand), Residual Claystone, Claystone/ Siltstone/ Argillaceous Limestone and Claystone/Siltstone/ Sandstone.

- ***Fill***
  - Fill material with a thickness of 1.2-10.2 m is observed at the top of the soil profile.
  - It is brown-grey-green coloured and generally in the form of coarse-grained blocky material. Fill layer also locally includes clay/topsoil. The blocks that form the fill layer are angular.
- ***Alluvium***

- Alluvium layer observed takes place below the fill layer. Alluvium layer is consisting of Silty Clay / Clayey Silt and Sand / Silty Sand layers. Silty Clay/Clayey Silt layer is green-brown colored usually very soft-soft and stiff-medium stiff in consistency. Sand / Silty Sand layer is grey-greenish grey colored and locally in the form of sand/sandy gravel where gravel content increases.
- Alluvium layer continues up to the elevations between (6.3) – (-63.2) in the investigation areas.

- ***Residual Claystone***
  - This layer is mainly green, brownish green, brown and locally pinkish brown-reddish brown colored, generally in the form of hard Clay/Gravelly Clay. Residual Claystone contains little amount of sand. The gravels within this layer are fine-medium grained and angular-subangular.

- ***Claystone / Siltstone / Argillaceous Limestone***
  - This layer is mainly brown, light brown colored and generally very weak – weak in strength. It is intensely fractured – crushed and generally moderately-highly weathered.

- ***Claystone/Siltstone/ Sandstone***

The bedrock Claystone/Siltstone/Sandstone layer is mainly grey colored, generally moderately -closely-intensely fractured, crushed, and very weak-weak-medium-strong in strength and slightly - moderately weathered. Discontinuities in this layer are dipping at 0-5˚ and filled with locally calcite and clay.

The evaluations on geotechnical parameters of each soil layer, general recommendations about foundation systems and ground improvement methods are presented in TP-OTC Filyos Natural Gas Processing Plant Geotechnical Evaluation Report, April 2021.

Seismicity

There are no faults passing through the AoI. The closest fault to the AoI is the Devrek Fault, which is 45 km away. The active fault map is given below (Figure 6-24). AoI is about 80 kms away from one of the most active fault systems in the world, the North Anatolian Fault Zone. North Anatolian Fault Zone extends along Northern Turkey for more than 1500 kilometers and was ruptured progressively by eight large and destructive earthquakes (Mw>6.7) in the last century. Large magnitude earthquakes that had occurred between years 1939 and 1967 had broken approximately 900 kilometers of a uniform Eastern trace, whereas the Kocaeli and Düzce Earthquakes in 1999 ruptured a total fault range of approximately 200 kilometers on the West. The seismic sources in the surrounding area that would contribute to the design ground motions in TP-OTC Filyos site can be separated into two distinct groups: the seismic sources on the land and the seismic sources off-shore. The seismic sources on the land include different segments of the North Anatolian Fault Zone. the Hendek and Çilimli Faults (Holocene) on the North of the North Anatolian Fault Zone around Sakarya /Düzce and the Quaternary Yığılca, Devrek and Karabük Faults which are the thrust faults formed as a result of continuous N-S shortening during the late Eocene to late Miocene. The off-shore region to the North of the site has a rather complex tectonic structure: considerable seismic activity and faulting due to the convergence between the Arabian and Eurasian plates which gave way to the uplift of the Eastern Anatolia.

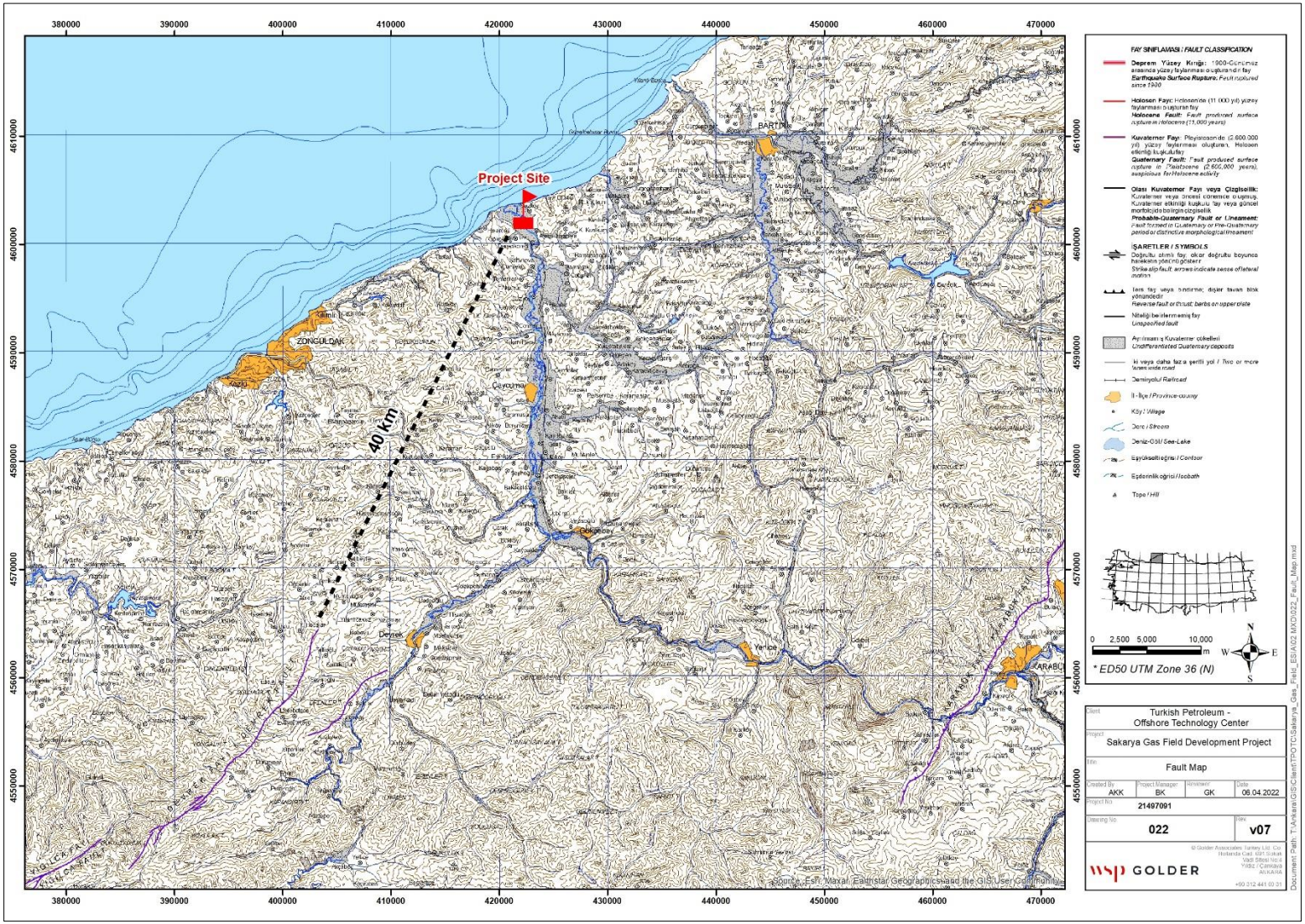


Figure 6-24: Active Fault Map

In the last century, nine big surface ruptures occurred along the North Anatolian Fault Zone in a westward migrating fashion of the earthquake epicenters starting from 1939 Erzincan earthquake in the east and 1942 Niksar – Erbaa, 1943 Tosya, 1944 Bolu – Gerede, 1951 Kurşunlu, 1957 Abant, 1967 Mudurnu Valley (Barka. 1992) and the 1999 İzmit and Düzce Earthquakes (Akyüz et al. 2002) sequentially Westwards. During these 9 major events, 1100 km long surface faulting between Erzincan and the Sea of Marmara was observed (Barka et al. 2002). The closest segments of North Anatolian Fault Zone to the Aol are the rupture zones of 1957 Abant, 1967 Mudurnu Valley, 1999 Düzce. 1944 Bolu-Gerede and 1943 Tosya Earthquakes.

Table 6-18: Earthquake Occurrence within 100 km from the Aol in Historical Instrumented Period (1900-2022)

Instrumented Period	Events recorded separated by intensity and magnitude			
Magnitude range	4 ≤ M < 5	5 ≤ M < 6	6 ≤ M < 7	≥ 7
Number of Events	60	7	2	1

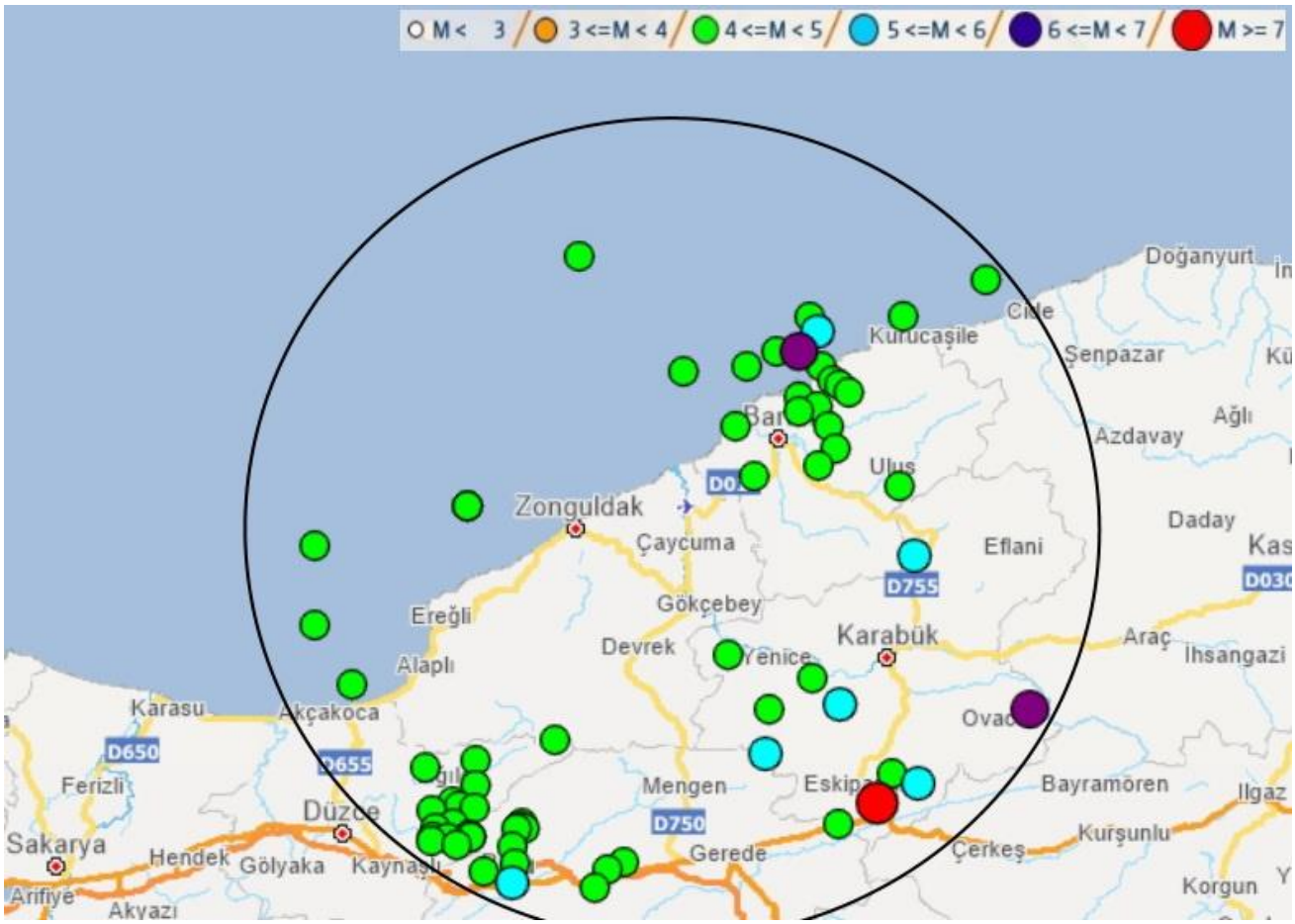


Figure 6-25: Seismicity of Within 100 km of the Aol

A Probabilistic Seismic Hazard Assessment for TP-OTC Sakarya Gas Field pipeline and Natural Gas Processing Facility Site were conducted in December 2021 and April 2021 respectively. These studies defined the seismic hazard through a detailed Probabilistic Seismic Hazard Assessment (PSHA).

Sensitivity Assessment

Sensitivity features	Supported by	Sensitivity value
Absence of rocky outcrops and gently sloping bathymetry upon the continental slope. Presence sedimentary waves in the canyon area. Medium Seismicity.	Primary data (DenAr, 2021) and secondary data	**Medium-High**

6.2.1.5 Soil and subsoil

Definition	Soil is a mixture of organic matter, minerals, gases, liquids, and organisms that together support life. In this section, the characteristics of the existing soil layer at the project location, such as its properties, purposes of use, and contamination status are examined.
Study areas	**RSA:** Project Units (Onshore Processing Facility and components, Construction Camp Sites & Permanent Lodgings). **Rationale:** Since the impact of the project on the soil layer during the project will be limited to the units mentioned in the project, the Project Units (Onshore Processing Facility and components, Construction Camp Sites & Permanent Lodgings) have been determined as RSA and AoI.
	AoI: Project Units (Onshore Processing Facility and components, Construction Camp Sites & Permanent Lodgings). **Rationale:** Since the impact of the project on the soil layer during the project will be limited to the units mentioned in the project, the Project Units (Onshore Processing Facility and components, Construction Camp Sites & Permanent Lodgings) have been determined as RSA and AoI.
Data sources	**Primary sources**: According to the preliminary baseline study data from soil sampling field work conducted by TP-OTC in May 2021 and January-March 2022.
	Secondary sources: Secondary data from various surveys for the Project, scientific papers, literature review and databases.

Methodological approach

This chapter describes the baseline soil and subsoil characteristics related to the AoI and the RSA, as defined above.

Soil sampling analysis results, desktop studies and available reports have been gathered for the information related to soil quality.

Soil baseline characteristics such as land use profile and land use capability have been assessed using literature review.

The reports that have been reviewed are:

- Preliminary Baseline Study Data from Soil Sampling Field Work, TP-OTC, May 2021 and January-March 2022.
- Sakarya Gas Field Submarine Production Facilities, Submarine Transport Lines and Gas Processing Facility Integrated Project EIA Report, Armada Danışmanlık, 08.09.2021

Regional context (RSA)

Since the local and regional context is determined the same, the studies are presented under the section of local context.

Local context (AoI)

Soil Characteristics and Land Use Capability Classification

The detailed evaluation is provided in the EIA Report. In this section, the soil properties within AoI are evaluated by enquiring the land use and soil properties maps of the former General Directorate of Rural Services through GIS as presented in Figure 6-26 and Figure 6-27.

As mentioned in the EIA Report, the total land use area in the Zonguldak province is 318,489.27 hectares. 3.357% of this area is urban settlement areas, 5.226% rural settlements (including villages), 29.595% agricultural areas, 61.088% wooded areas, 0.145% central business areas and 0.413% industrial areas. Also, Erosion distributions of the soil mapping unit of the Zonguldak province are given in Table 6-19. There are moderate and severe erosion problems in 83.8% of the Zonguldak province.

Table 6-19: Erosion Distribution in Zonguldak Province

Erosion	Area (ha)	Area (%)
1 (none)	12768,5	4
2 (Slight)	28126,9	8,9
3 (Medium)	252863	79,9
4 (hard)	12352,1	3,9
non-evaluation areas	10413,9	3,3

One major soil group was identified in the Aol. The largest soil group is “alluvial soil” that is observed at the processing facility, transformer station and onshore pipeline. These soils are young soils that are formed on the transported and stored materials by streams rarely belonging to A-C horizons. Mineral compositions depend on the lithological composition of the river basin and the periods of transportation and accumulation during the soil development in geological periods and have a heterogeneous structure. In alluvial areas, the upper soil imperceptibly penetrates to the lower soil. In areas with fine texture and high ground water, the vertical permeability rate is low, the surface is moist and rich in organic matter. As the rough textured soils are well drained, the surface dries quickly. Vegetation on soils depends on the current climate. They are productive soils suitable for the cultivation of all kinds of plants that can adapt to their climate. Alluvial soils are classified according to their structures, regions, or their evolution. In alluvial areas, the upper soil imperceptibly penetrates to the lower soil. In areas with fine texture and high ground water, the vertical permeability rate is low, the surface is moist and rich in organic matter. A mild reduction event take place in the subsoil. The rough floors are well-drained, so the surface layers dry quickly. Vegetation on soils depends on the current climate. They are productive soils suitable for the cultivation of all kinds of plants that can adapt to their climate.

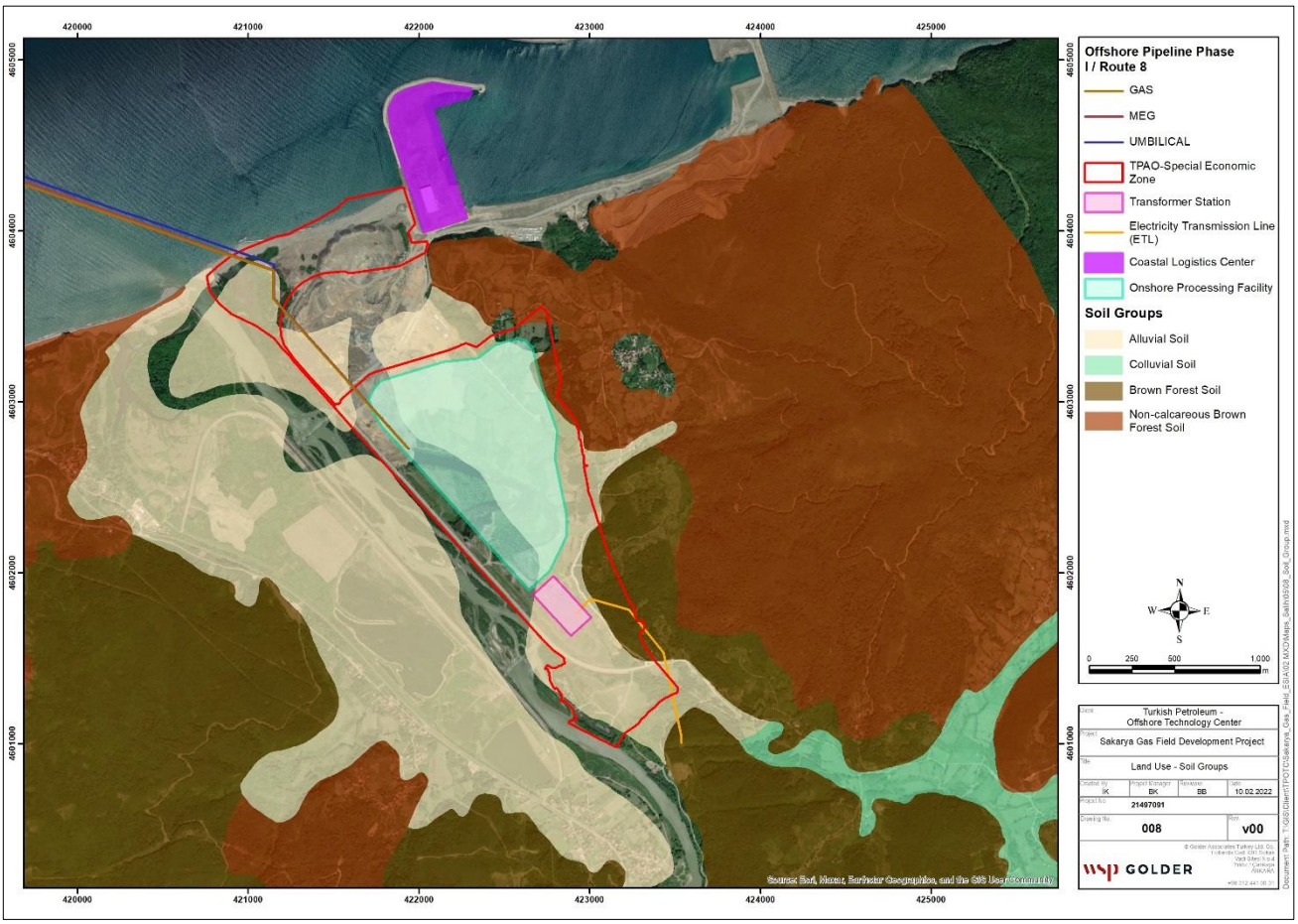


Figure 6-26: Soil Groups of the Aol

Soil classes are defined according to the suitability of soil for cultivation. Soil classes used by the Ministry of Agriculture and Rural Affairs are shown in Table below. Generally, two soil classes were identified at the Aol. Most of the soils are included in class II and class VIII. Class II is suitable for cultivation; while class VIII is not suitable for agriculture.

Table 6-20: Soil Classes according to Suitability for Cultivation

Class	Suitability for Cultivation	Cultivation Limiting factors
I	Suitable for many crop types.	No limitations.
II	Suitable for long term cultivation of various crops	It requires measures against soil and water loss.
III	Suitable for cultivation of certain types of crops for which special protection measures are provided	It is open to erosion and requires artificial drainage for cultivation
IV	Suitable for some crops. It requires special care when used for agricultural purposes	There are limitations in terms of depth of soil, stone content, humidity and slope.
V	Plain or slight slope, stony or lush soil. It is not suitable for ploughing or cultivation. It is grassland or forest area.	It has a weak drainage and a structure that is not suitable for ploughing.
VI	Not suitable for ploughing or cultivation. It is generally used as grazing area or forest area.	There are limitations in terms of slope and shallow soil.
VII	Not economically feasible for agriculture but it is suitable for some grazing or forestation	There are limitations in terms of shallow soil, stone content, slope and erosion
VIII	Not suitable for flora habitats. It may be used for recreational purposes or can be designated as protection area for wild life.	Poor soil content.

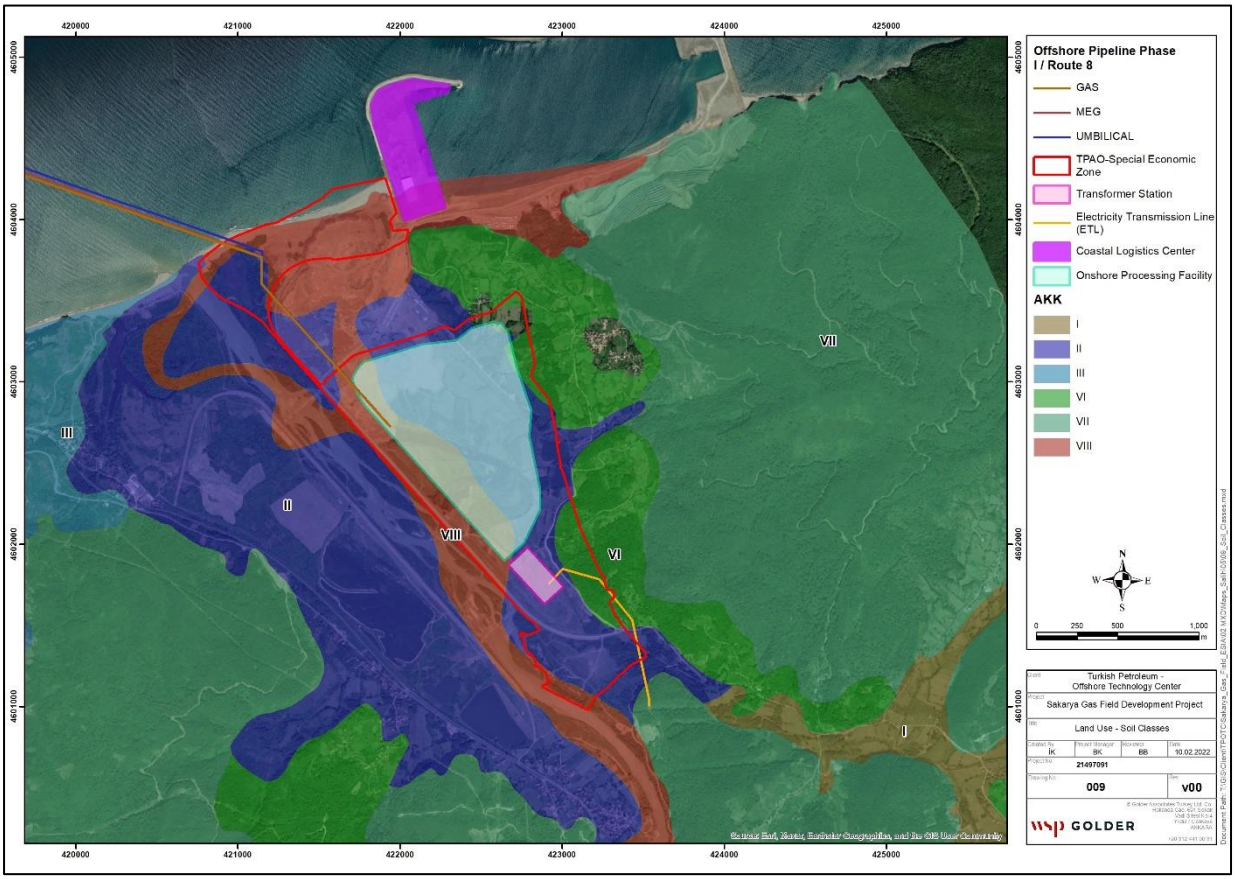


Figure 6-27: Soil Classes around AoI

Soil Quality

In order to source data for the soil quality baseline of the site, a soil sampling was carried out in May 2021 within the scope of the EIA. A total of 7 soil samples were collected throughout the AoI. In addition to the sampling campaign completed in May 2021, other soil samples were collected from 20 more locations on 01-03.2022 within the scope of baseline studies of the ESIA.

Soil samples were collected and analysed, from the locations presented in Figure 6-28.

While determining the parameters to be analysed in soil samples, soil pollution indicator parameters listed in Table-1 of Annex-2 of the Regulation on Soil Pollution Control and Point Source Contaminated Sites were taken into consideration.

Soil samples were analysed for (May 2021):

- TOX
- BTEX
- Speciated TPH
- Oil & Grease
- Heavy Metals (Ag, As, Ba, Be, B, Cd, Cu, Co, Cr, Hg, Mo, Ni, Ti, Tl, Pb, Sb, Se, Sn, U, V, Zn)

Soil samples were analysed for (January-March 2022):

- TOX
- BTEX
- TVOCs
- Speciated TPH
- Heavy Metals (As, Ba, Cd, Cr, Co, Cu, Pb, Hg, Mo, Ni, Sb, Se, U, V, Zn)

The analytical results were compared to the generic limit values mentioned in the Annex I of the Soil Regulation. Annex I of the updated regulation defines different generic limit values depending on the exposure pathways:

- Generic Limit Value-1: Soil ingestion and absorption through skin contact.
- Generic Limit Value-2: Inhalation of volatile matter in external environment.
- Generic Limit Value-3: Inhalation of fugitive dust in the external environment.
- Generic Limit Value-4: Transport of pollutants into groundwater and drinking of groundwater (Safety Factor (SF) = 1 or 10).

The Generic Limit Value-1 and Generic Limit Value-3 are used for the surface/shallow soil samples and Generic Limit Value-2 and Generic Limit Value-4 are used for sub-soil samples.

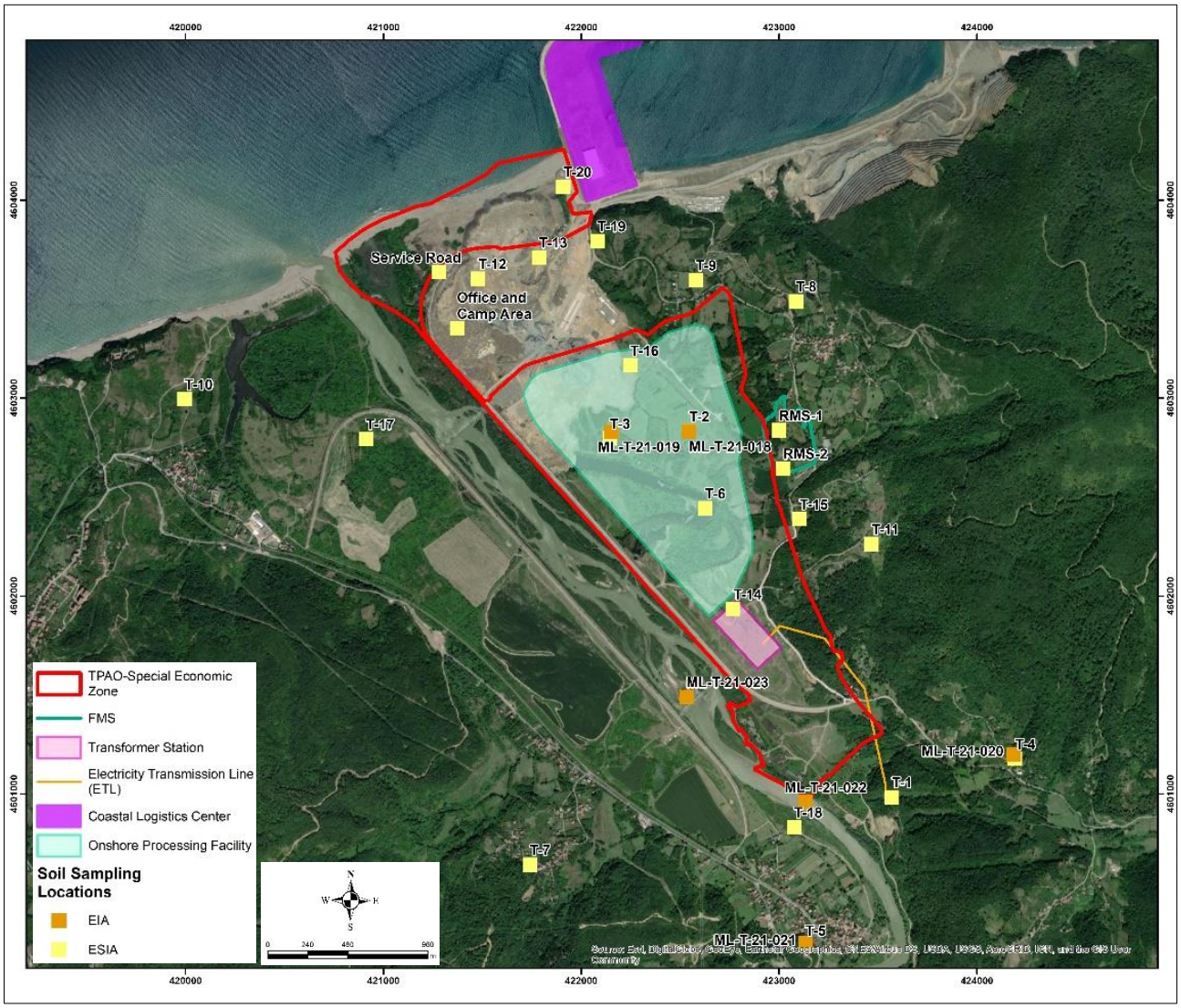


Figure 6-28: Soil Sampling Locations

Soil Sampling Study Results **(May 2021)**

Chemical analyses results show that Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl benzene and Xylenes (BTEX) and Total Organic Halogens (TOX) concentrations for all samples are below their respective laboratory detection limits.

The Oil & Grease concentrations at ML-T-21-017, ML-T-21-018, ML-T-21-019, ML-T-21-020, ML-T-21-021 and ML-T-21-023 were reported as 0.071, 0.078, 0.051, 0.102, 0.053 and 0.075 mg/kg respectively.

Table 6-21: Heavy Metal Anaytical Results (May 2021)

Parameter	Unit	GLV:1 Soil ingestion and absorption through skin contact	GLV:3 Inhalation of fugitive dust in the external environment	ML-T-21-017	ML-T-21-018	ML-T-21-019	ML-T-21-020	ML-T-21-021	ML-T-21-022	ML-T-21-023
Antimony (Sb)	mg/kg	31	-	0.39	0.495	0.45	0.415	0.508	0.626	0.409
Arsenic (As)	mg/kg	0.4	471	5.38	4	5.23	3.45	3.4	5.359	3.364
Barium (Ba)	mg/kg	15643	433702	182.3	170.5	162.9	110.42	187.52	127.46	312.76
Berylium (Be)	mg/kg	0.1	843	<0.05	0.102	0.099	0.28	0.166	0.121	0.234
Boron (B)	mg/kg	-	-	<4.3	<4.3	<4.3	<4.3	<4.3	<4.3	<4.3
Cadmium (Cd)	mg/kg	70	1124	0.173	0.117	0.128	0.146	0.205	0.171	0.19
Chromium (Cr)	mg/kg	235	24	5.89	4.27	3.82	3.52	10.934	4.32	4.43
Cobalt (Co)	mg/kg	23	225	2.4	1.69	1.82	1.94	2.247	2.07	2.42
Copper (Cu)	mg/kg	3129	-	5.65	3.87	-	8.92	5.34	4.907	9.516
Lead (Pb)	mg/kg	400	-	16.79	11.22	-	17.44	12.36	14.47	27.242
Mercury (Hg)	mg/kg	23	-	0.593	0.334	0.122	0.091	0.184	0.1	0.069
Molybdeium (Mo)	mg/kg	391	-	0.5	0.5	0.37	0.357	0.691	0.471	0.531
Nickel (Ni)	mg/kg	1564	-	4	2.76	-	2.12	9.01	3.761	6.643
Selenium (Se)	mg/kg	391	-	0.91	0.706	0.78	0.598	0.804	0.917	1.288
Silver (Ag)	mg/kg	391	-	0.59	0.22	0.169	0.512	0.578	0.181	0.209
Talyum (Tl)	mg/kg	5	-	0.25	0.158	<0.125	0.137	0.152	0.131	0.15
Tin (Sn)	mg/kg	46929	-	2.76	1.69	166	1.49	2.51	1.79	4.02
Titanium (Ti)	mg/kg	312857	-	272.306	301.7	353.937	755.503	450.197	295.558	391.585
Uranium (U)	mg/kg	-	-	0.37	0.364	0.304	1.35	0.624	0.283	0.663
Vanadium (V)	mg/kg	548	-	16.96	11.5	11.73	30.59	13.344	12.76	15.57
Zinc (Zn)	mg/kg	23464	-	38.87	26.32	28.66	26.91	44.67	34.348	28.617

Arsenic: All samples exceed the regulatory limit concentration for Arsenic which is 0.4 mg/kg and the exceeding concentrations vary between 3.364 to 5.38 mg/kg.

Beryllium: All samples but ML-T-21-017 and ML-T-21-019 slightly exceed the regulatory limit concentration for Beryllium which is 0.1 mg/kg and the exceeding concentrations vary between 0.102 to 0.28 mg/kg, where 0.05 mg/kg is also the laboratory detection limit for this parameter.

Soil Sampling Study Results **(January – March 2022)**

Chemical analyses results show that Total Volatile Organic Compounds (TVOCs), Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl benzene and Xylenes (BTEX) concentrations for all samples are below their respective laboratory detection limits.

Arsenic: All samples exceed the regulatory limit concentration for Arsenic which is 0.4 mg/kg. where 0.05 mg/kg is also the laboratory detection limit for this parameter.

Chromium: S45873 (Service Road1) exceed the regulatory limit concentration for Chromium which is 24 mg/kg and the exceeding concentration is 31.3 mg/kg.

Table 6-22: Heavy Metal Analytical Results (January-March 2022).

Parameter	Unit	LOQ	GLV:1 Soil ingestion and absorption through skin contact	GLV:3 Inhalation of fugitive dust in the external environment	S45873 - S	S45874 -	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10	T-11	T-12	T-13	T-14	T-15	T-16	T-17	T-18	T-19	T-20	RMS-1	RMS-2
Antimony (Sb)	mg/kg	<0,05	31	-	0,14	0,23	<0.05	0,73	0,13	0,14	0,14	0,24	0,16	0,18	0,17	0,19	0,22	0,12	<0,05	0,27	0,27	0,68	0,16	0,24	<0,05	<0,05	0,23	0,18
Arsenic (As)	mg/kg	<0,05	0,4	471	4,95	11,06	8,24	66,50	13,64	4,08	3,92	10,32	7,94	9,03	11,54	5,47	7,23	5,58	4,46	18,99	6,68	22,66	7,94	6,53	4,08	3,61	9,48	7,28
Barium (Ba)	mg/kg	<2	15643	433702	33,90	43,10	562,69	147,95	93,44	183,52	103,10	105,28	302,10	195,01	141,29	196,97	167,30	27,94	15,45	107,24	259,99	126,55	175,80	110,38	158,62	21,69	197,93	146,10
Cadmium (Cd)	mg/kg	<0,05	70	1124	<0,05	<0,05	<0,05	<0,05	0,11	0,17	0,17	0,12	<0,05	0,15	0,14	0,12	<0,05	<0,05	<0,05	0,22	0,32	0,12	0,11	0,14	0,05	<0,05	0,15	0,22
Chromium (Cr)	mg/kg	<0,05	235	24	31,30	0,63	7,03	2,95	5,13	11,21	11,82	7,23	15,34	9,04	13,56	8,39	12,32	27,16	17,43	0,87	10,45	3,14	20,05	20,87	5,36	6,11	19,65	10,68
Cobalt (Co)	mg/kg	<0,05	23	225	6,53	7,76	6,97	8,73	8,76	10,78	8,39	8,01	9,58	11,14	13,23	9,20	10,57	6,29	5,01	9,02	15,24	7,45	11,05	9,37	4,22	3,65	16,82	10,73
Copper (Cu)	mg/kg	<0,1	3129	-	8,76	32,50	22,22	44,90	37,68	35,31	21,39	33,49	51,75	36,64	21,98	29,75	26,16	6,10	4,76	47,41	29,07	40,18	24,86	20,86	17,66	5,20	16,62	32,47
Lead (Pb)	mg/kg	<0,05	400	-	8,43	7,09	17,96	12,37	12,23	21,57	16,86	13,67	30,96	15,67	17,15	22,68	21,25	5,28	4,06	12,56	28,05	14,41	18,21	10,19	6,83	2,58	22,17	15,95
Mercury (Hg)	mg/kg	<0,1	23	-	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
Molybdeium (Mo)	mg/kg	<0,05	391	-	0,25	0,52	0,22	0,79	0,38	0,62	0,28	0,34	0,14	0,24	0,22	0,17	0,50	0,23	0,16	0,63	0,61	0,32	0,21	0,36	0,12	0,11	0,39	0,67
Nickel (Ni)	mg/kg	<0,1	1564	-	18,30	2,08	10,35	5,00	13,56	14,62	41,04	9,88	21,67	17,70	22,72	11,67	16,77	18,39	13,63	4,57	19,97	6,97	32,84	37,41	6,89	9,94	26,68	20,04
Selenium (Se)	mg/kg	<0,05	391	-	0,66	0,91	1,36	0,71	0,87	1,06	5,60	0,70	0,82	1,03	1,02	0,88	1,00	0,81	0,72	0,87	1,11	0,90	1,04	1,01	0,76	0,69	1,10	1,14
Uranium (U)	mg/kg	<0,05	-	-	0,40	0,32	2,04	0,36	0,34	1,15	0,75	0,32	0,86	0,44	0,39	0,53	1,03	0,45	0,28	0,39	0,86	0,40	0,65	0,46	0,28	0,16	0,35	1,23
Vanadium (V)	mg/kg	<0,05	548	-	45,50	17,80	34,65	26,56	21,43	44,96	37,37	28,94	34,37	33,60	28,41	32,66	43,97	37,21	32,93	25,74	40,29	24,70	30,10	25,86	20,65	13,12	33,09	29,05
Zinc (Zn)	mg/kg	<0,5	23464	-	29,30	37,50	47,72	46,04	49,53	57,62	32,98	44,59	42,91	60,51	60,30	39,68	39,01	26,13	20,80	57,28	55,32	59,57	50,61	54,53	28,36	15,86	33,04	131,24
BTEX	mg/kg	<0,1	-	-	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
TVOCs (w/ PID)	ppm	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TPH (speciated fractions)	mg/kg	<100	-	-	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
TOX	mg/kg	-	-	-	39.3	29,30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Sensitivity Assessment

Sensitivity features	Supported by	Sensitivity value
Limited presence of soil with agricultural potential. Presence of some zones with soil potential erosion. Limited soil contamination.	Primary data and secondary data	**Medium**

6.2.1.6 Hydrology and surface water quality

Definition	Hydrology is the scientific study of the movement, distribution, and management of water on Earth and other planets, including the water cycle, water resources, and environmental watershed sustainability. Hydrology subdivides into surface water hydrology, groundwater hydrology (hydrogeology), and marine hydrology. Domains of hydrology include hydrometeorology, surface hydrology, hydrogeology, drainage-basin management, and water quality, where water plays the central role.
Study areas	**RSA:** Water catchment of the Filyos River. **Rationale:** Catchment of the Filyos River has been determined as RSA, since the drainage of the sub-basins associated with the Project Site and the AoI is to Filyos River.
	AoI: AoI is defined as sub-catchments (micro catchments) of Filyos River where the project units are in a relation with. The border of this area is also used as a boundary of the groundwater flow model. **Rationale:** Since the physical factors affecting the direction and accumulation of the movement of surface waters are the basin boundaries, the sub-basin boundaries are determined as the hydrological AoI.
Data sources	**Primary sources**: Primary data from field works conducted by Golder and Çınar Laboratories in January and March 2022.
	Secondary sources: Secondary data from scientific papers, grey literature and government agency reports & databases.

Methodological approach

Baseline hydrological characterizations and surface water quality assessments were made according to the primary and secondary data sources. Primary data were sourced from the fieldworks involving a hydrocensus survey in the AoI which aims at determining the groundwater and surface water resources and stakeholder water users in and around the AoI. Based on this hydrocensus survey a comprehensive water sampling study was conducted in the AoI.

All fieldworks including hydrocensus and water sampling study were conducted according to local and international standards and guidelines where applicable.

The following regulations and guidelines were taken into consideration during the baseline hydrological characterization and surface water quality assessment studies:

- Surface Water Quality Regulation "YSKY"
- Irrigation Water Classification by US Salinity Laboratory
- IFC General EHS Guideline for Effluent Discharge Limits

During the baseline studies, the reports which were used as secondary data sources are listed below:

- Western Black Sea Basin Flood Management Plan, Ministry of Agriculture and Forestry General Directorate of Water Management, Akar-Su Mühendislik Müşavirlik Ltd. Şti., July 2019.
- Preparation of Basin Protection Action Plans Project West Black Sea Basin, TUBITAK - The Scientific and Technological Research Council of Turkey, Marmara Research Center, November 2013.
- Sakarya Gas Field-Onshore Production Facility Flood Risk Analysis, SUİŞ Proje Engineering and Consulting Co. Ltd., January 2022.
- Renewable Energy List, EPDK - Energy Market Regulatory Authority of Turkey, 2022.
- Filyos River (ID:1335) – Derecikivan, Stream Gauge Data, Elektrik İşleri Etüt İdaresi, 2009.

The regional hydrology and the baseline of the TP-OTC Sakarya Gas Field Project are discussed herein.

Regional context (RSA)

Hydrology and Surface Water Quality

The Project Site is located in the Filyos Basin, which is the sub-basin of the Western Black Sea Basin. The length of the Filyos River, located in the Filyos Basin, is 360 km. A map showing the Filyos River and other surrounding streams in the Western Black Sea Basin and their classifications according to Surface Water Quality Management Regulation is presented in Figure 6-29.

The Filyos River originates from the Benli Mountain, in the north of Seben Town, under the name Ulusu. The stream descends to the Gerede Plateau and merges with the Gerede Stream. The stream flows in northeast direction. It turns northwest by merging with many streams on the foothills of the Ilgaz Mountains. The Araç Stream and Soğanlı Stream merge in Karabük City Center and downstream takes the name Yenice Stream and, passing through Yenice, turns north and descends to the Çaycuma Plain. In this part, it is named Filyos River, which arises from Efteni Lake in the Bolu Mountains, joins with Devrek Stream and reaches the Black Sea in Hisarönü. Filyos River splits into many tributaries upstream. For this reason, it has been called by different names in many regions. Some of its names are Yenice River, Köroğlu Stream, Ulusu, Gerede Stream, Melan Stream, Akçay, Soğanlı Stream etc.[2]

[2] Akar-Su Mühendislik Müşavirlik Ltd. Şti., (July 2019). Ministry of Agriculture and Forestry General Directorate of Water Management. Western Black Sea Basin Flood Management Plan, Ankara.

Water quality assessments between 2000 and 2011 were reported by TUBITAK for the more important streams in the Filyos sub-basin.[3] Evaluations were made in accordance with the Water Pollution Control Regulation and the Surface Water Quality Management Regulation. The evaluations in the sub-basin are summarized below.

Important parameters showing organic matter, nitrogen and phosphorus pollution were evaluated according to the aforementioned regulations. For what concerns COD (Chemical Oxygen Demand) and BOD (Biochemical Oxygen Demand), which are important parameters indicating organic pollution in the Western Black Sea Basin, streams are predominantly classified as Class I (very good) or II (good). However, while the COD parameter falls in Class III for the Gerede Stream in Bahçedere, the BOD parameter sometimes is Class III or IV (poor) for the streams Gerede, Büyüksu, Devrek Stream, Markusa Stream, Mudurnu, Ulusu and Zonguldak Acılık.

Although the water quality in the sub-basin is either in Class I or Class II in terms of important nitrogen parameters (NH_4-N and NO_3-N), NH_4-N parameter in the Gerede Stream and the Filyos River, and NO_3-N parameter in the Devrek Stream and in the Yenice Stream is in Class III and Class IV. On the other hand, as for NO_2-N streams mostly fall in Class III and Class IV throughout the sub-basin. Total Phosphorus parameter generally varies between Class II and Class III along the sub-basin.

According to group A parameters showing physical and inorganic chemical pollutants, it is observed that water quality is predominantly in Class III and Class IV. Dissolved oxygen was classified as Class III in the Devrek Stream, the Yenice Stream and the Filyos River. In the Gerede Stream, sodium, chloride, sulfate, total dissolved matter, and dissolved oxygen parameters were measured as Class III and Class IV, and water quality problems in terms of salinity and dissolved matter were determined in the Gerede Stream.

Group B (organic) parameters, which are related with organic matter pollution, are predominantly in Class I and Class II throughout the sub-basin. However, in terms of organic substances, the water quality decreases to class III in the Devrek Stream and to class IV in the Gerede Stream.

Group C, which shows inorganic pollution, is mostly between Class II and Class III throughout the sub-basin. It is calculated as Class IV only in the Gerede Stream due to chromium concentration. In the Filyos River, the Yenice Stream, the Ilgaz Stream and the Devrek Stream, it falls to Class III due to iron concentration.

When evaluated for the general conditions in the Surface Water Quality Management Regulation, the Gerede Stream was observed as Class III due to its color, and the other streams as Class II, for temperature, pH, conductivity and color parameters. The conductivity in the Gerede Stream is Class IV, while in the remaining streams it is predominantly Class II. The temperature parameter varies between Class III in the Filyos River and between Class I and Class II in other streams. In all streams in the Filyos sub-basin, the pH parameter is at Class I level.

In the Surface Water Quality Management Regulation, group A is defined as oxygenation parameters and includes dissolved oxygen, COD and BOD parameters. BOD parameter is Class IV in the Gerede Stream, Class III in the Devrek Stream and the Filyos River, and Class II in other streams. The COD parameter was observed as Class I across the sub-basin. Alternatively, dissolved oxygen is Class IV in the Gerede Stream and Class II in the remaining streams.

In the Surface Water Quality Management Regulation, group B is defined as nutrient parameters and includes ammonium, nitrite, nitrate, total Kjeldahl nitrogen and total phosphorus parameters. NH_4-N parameter varies

[3] TUBITAK - The Scientific and Technological Research Council of Turkey. (November 2013). Marmara Research Center, Preparation of Basin Protection Action Plans Project West Black Sea Basin.

between Class IV in the Gerede Stream and between Class I and Class II in other streams. NO_3-N parameter is at Class I level throughout the sub-basin. Insufficient data are available for classification of total Kjeldahl nitrogen.

In the Surface Water Quality Management Regulation, group C parameters are defined as trace elements (metals) and include mercury, cadmium, lead, copper, nickel and zinc parameters. In this parameter group, there is no measurement in most stations, and the cadmium parameter in the Filyos River and the Yenice Stream is at Class II level. Lead parameter is Class III in the Yenice Stream and Class II in the Filyos River. The copper parameter, on the other hand, varies between Class II and Class III over the Gerede Stream and is at Class II level in the Filyos River.

There are not sufficient measurements for group D (bacteriological parameters) in both Water Pollution Control Regulation and the Surface Water Quality Management Regulation.

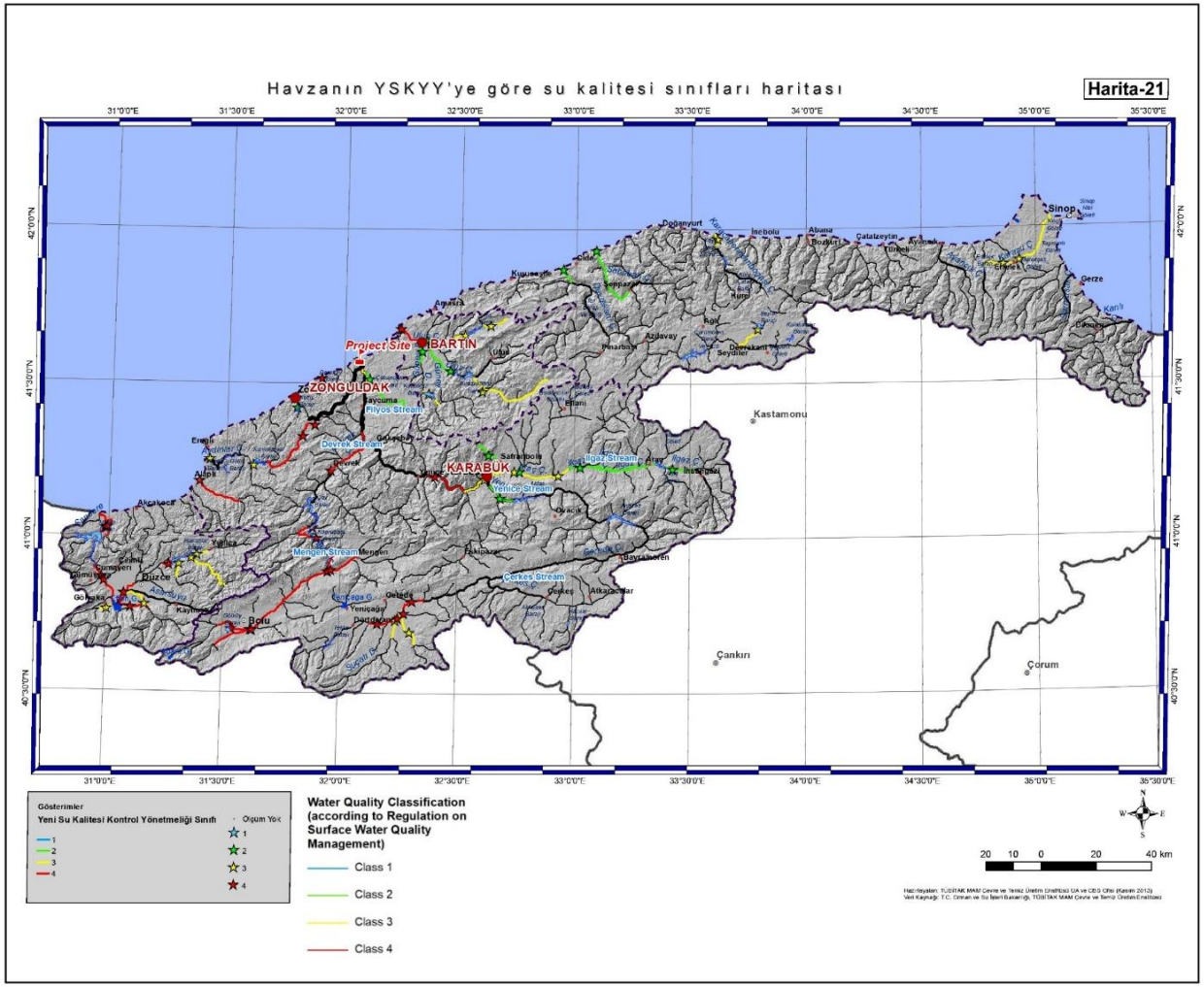


Figure 6-29: Streams in Western Black Sea Basin and their Classifications according to Surface Water Quality Management Regulation[4]

[4] TUBITAK - The Scientific and Technological Research Council of Turkey. (November 2013). Marmara Research Centre, Preparation of Basin Protection Action Plans Project West Black Sea Basin.

- ***Surface Water Resources***

There is no hydroelectric power plant (HEPP) or dam located within the AoI. Distances from HEPPs or dams in the RSA are shown in Figure 6-30 and related information is given in Table 6-23 below. The Kışla Dam, the Kozcağız Dam and the Kirazlıköprü Dam do not affect the sub-basin where the Project is located. They are included because of their proximity to the Project Site. The other dams are located upstream of the Filyos River.

Table 6-23: Heavy Metal Analytical Results

ID	Type	Status	Operation Start Year	Operation End Year
Çayaltı	HEPP	In Operation	2016	2026
Tefen	HEPP	In Operation	2011	-*
Pirinçlik	HEPP	In Operation	2014	2025
Eren	HEPP	In Operation	2014	2025
Kirazlıköprü	HEPP & Dam	In Operation	2020	2030
Araç	HEPP & Dam	In Operation	2021	2030
Köprübaşı	HEPP	In Operation	2012	2022
Yalnızca	HEPP	In Operation	2009	-*
Aktaş	HEPP	In Project Planning	-	-
Aldeğirmen	HEPP	In Project Planning	-	-
Kışla	Dam	In Operation	2018	-*
Kozcağız	Dam	In Project Planning	-	-
Akhasan	Irrigation Pond	In Operation	2016	-*
Hacılar	Dam	In Project Planning	-	-
Tekke	Dam	In Project Planning	-	-
Çay	Dam	In Project Planning	-	-
Andıraz	Dam	In Project Planning	-	-
* Operation end year information is not available				

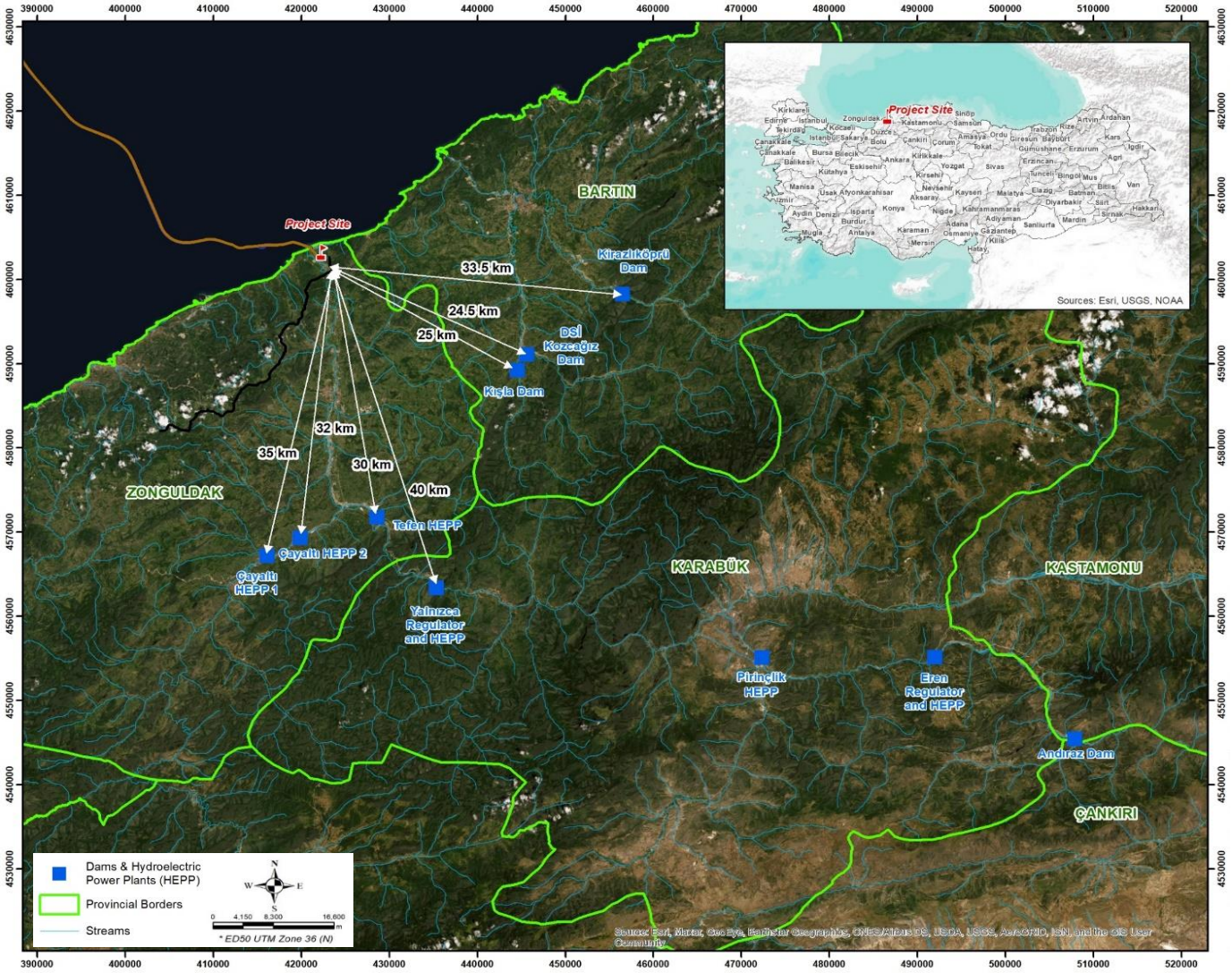


Figure 6-30: Location Map of the Nearby Dams and HEPPs

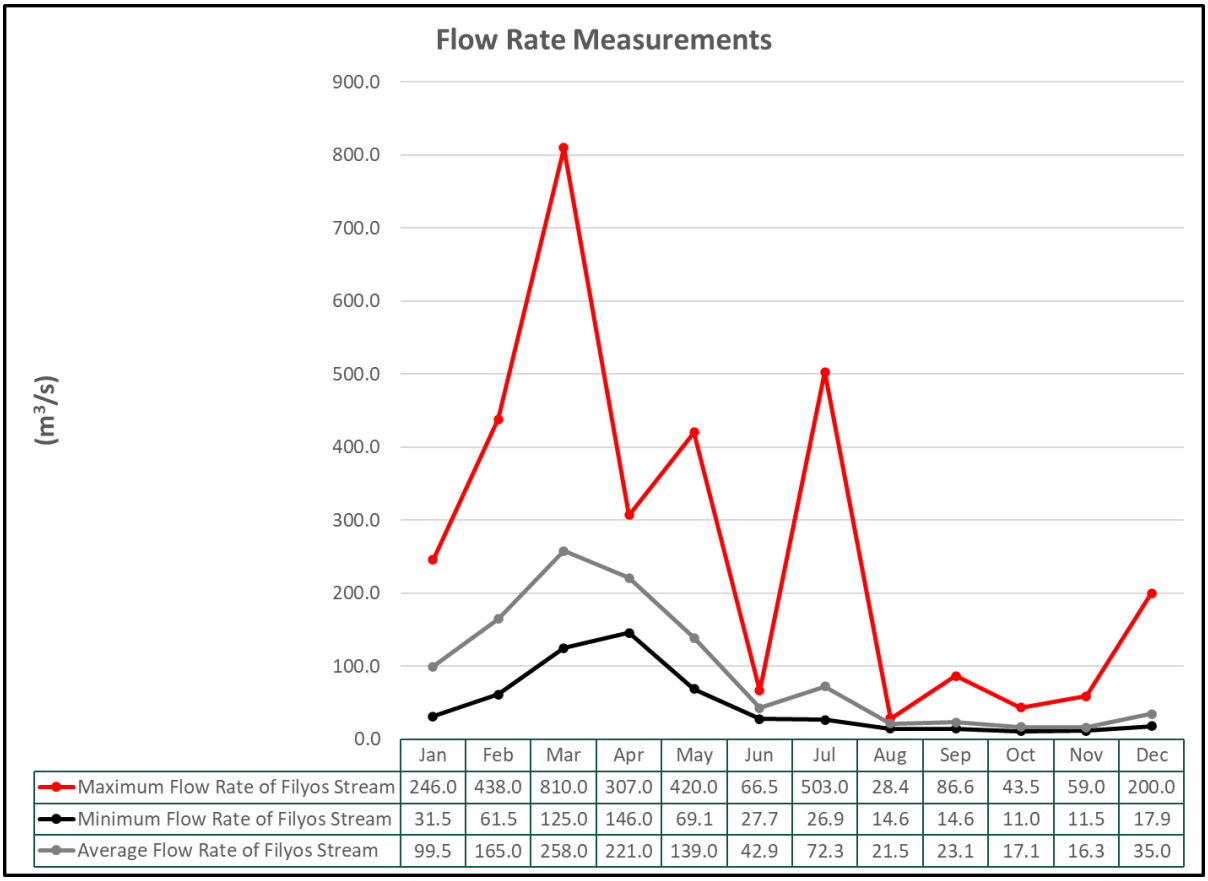
- ***Flow Rate Measurement***

Continuous surface water flow measurements of the Filyos River were recorded at stream gauge ID 1335. Information about stream gauge is given in Table 6-24 below.

Table 6-24: The Information about the Stream Gauge

ID	UTM ED50 (m) Zone 36		Elevation	Stream Name	Catchment Area in km²	Description
	X	Y	(m)			
1335	423169.27	4600002.82	2.0	Filyos	13,300.4	Upstream of Project Site (South EIA)

The stream gauge was operated from 1963 to 2009[5]. A graph showing the monthly flow rate measurements from the stream gauge is presented in Figure 6-31. The maximum flow rate was 810.0 m³/s in March and the minimum flow rate was 16.3 m³/s in November. A map showing the location of the stream gauge is presented in Figure 6-32.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Maximum Flow Rate of Filyos Stream	246.0	438.0	810.0	307.0	420.0	66.5	503.0	28.4	86.6	43.5	59.0	200.0
Minimum Flow Rate of Filyos Stream	31.5	61.5	125.0	146.0	69.1	27.7	26.9	14.6	14.6	11.0	11.5	17.9
Average Flow Rate of Filyos Stream	99.5	165.0	258.0	221.0	139.0	42.9	72.3	21.5	23.1	17.1	16.3	35.0

Figure 6-31: Graph showing the Flow Rate Measurements at the Stream Gauge on the Filyos River

[5] Elektrik İşleri Etüt İdaresi. (2009). Filyos Stream (ID:1335) – Derecikivan, Stream Gauge Data (1963 – 2009)

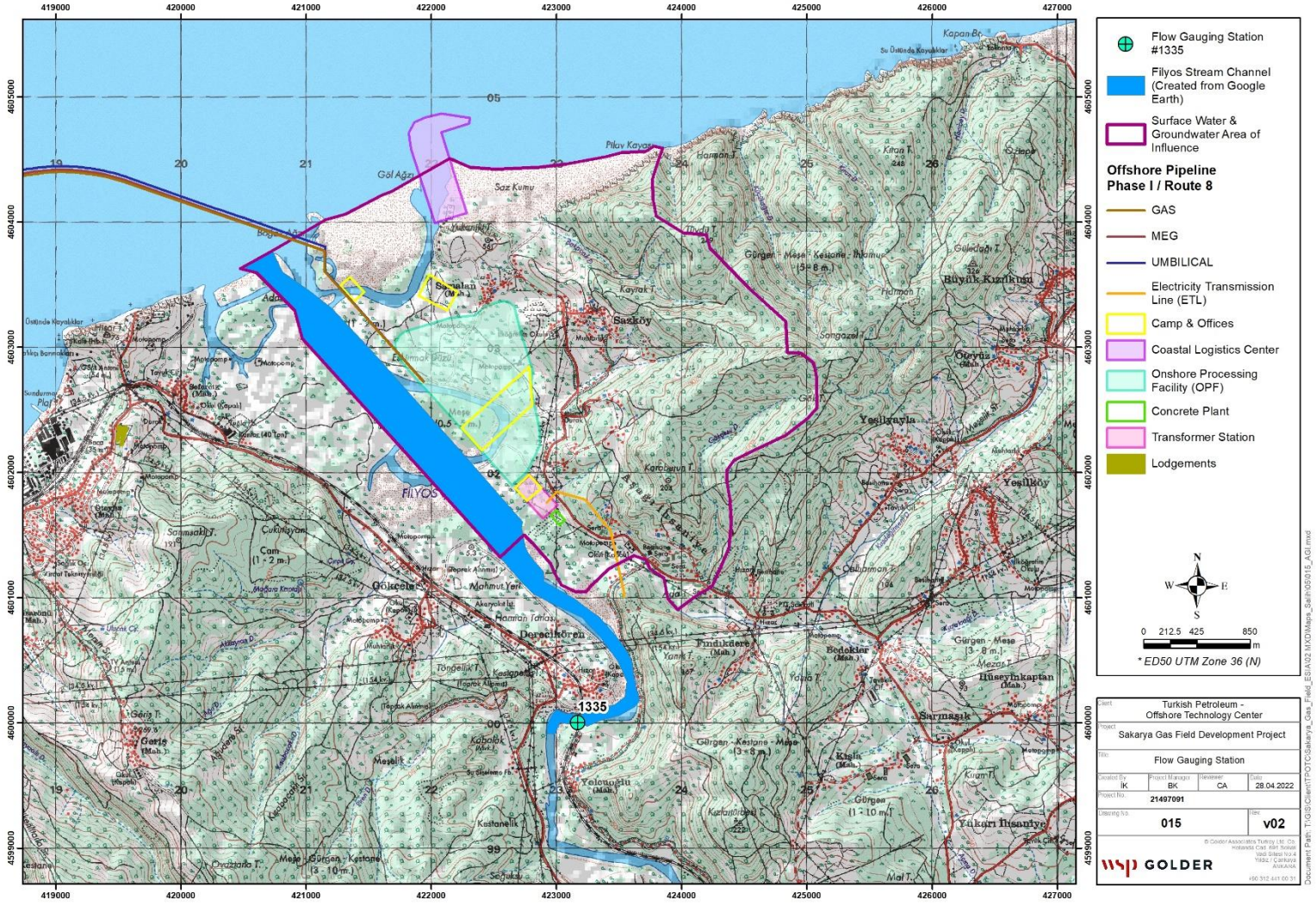


Figure 6-32: Location of the Stream Gauge on the Filyos River

Local context (AoI)

Hydrology and Surface Water Quality

- ***Hydrologic Characteristics***

The Project Site is located in the Filyos Sub-basin, which is one of the sub-basins of the Western Black Sea Basin. The Filyos sub-basin covers an area of about 13,300 km².

Catchment Characteristics:

The Filyos River flows into the Black Sea from the west of the Project Site. Other streams around the Project Site are mostly dry streams with seasonal flow. The AoI is divided into seven (7) micro-catchments according to the creeks in and around it. The sub-basins and their physical characteristics such as maximum elevation, minimum elevation, average elevation, and slope grades are presented in Table 6-25. The map of the micro-catchments is presented in Figure 6-33.

The stream located in micro-catchment #1 flows into the Black Sea from the northeast. The streams in micro-catchments #2, #3, #4 and #5 flow into the Filyos River with the surface water diversion channel. The diversion starts from the south of the FMS, passes through the southeast of the Onshore Processing Facility (OPF) and directing to the southeast of the Transformer Station. It collects surface water from the upstream and diverts to the Kuşdeğirmeni Stream. The stream in micro-catchment #6 joins the Kuşdeğirmeni Stream from micro-catchment #7 and then flows into the Filyos River.

The highest and lowest elevation values in the micro-catchments were observed at 316.0 m in micro-catchment #7 and 0.0 m in micro-catchment #2, respectively. Elevation decreases from southeast to northwest.

The steepest slope values were observed in micro-catchment 1#, whereas the gentlest slope values were observed in micro-catchment #2 and #7.

Table 6-25: The Information about the Stream Gauge

Micro Catchment ID	Surface Area (km^2)	Elevation			Slope Degree				
		Minimum Elevation (m asl)	Maximum Elevation (m asl)	Mean Elevation (m asl)	0°–10° (%)	10°–20° (%)	20°–30° (%)	30°–40° (%)	>40° (%)
1	1.18	3.6	310.7	135.6	5.9	14.1	26.3	26.7	27.0
2	2.69	0.0	292.7	48.7	46.3	22.8	13.5	12.2	5.3
3	0.32	4.3	196.6	86.6	15.8	39.4	23.3	13.6	8.0
4	0.20	5.1	201.8	76.8	9.3	45.4	17.5	8.2	19.5
5	0.26	3.8	205.5	63.9	32.9	23.0	14.2	13.7	16.3
6	1.08	10.1	310.9	179.1	5.0	23.1	33.9	25.4	12.6
7	19.59	4.5	316.0	81.8	22.7	41.0	21.9	9.7	4.8

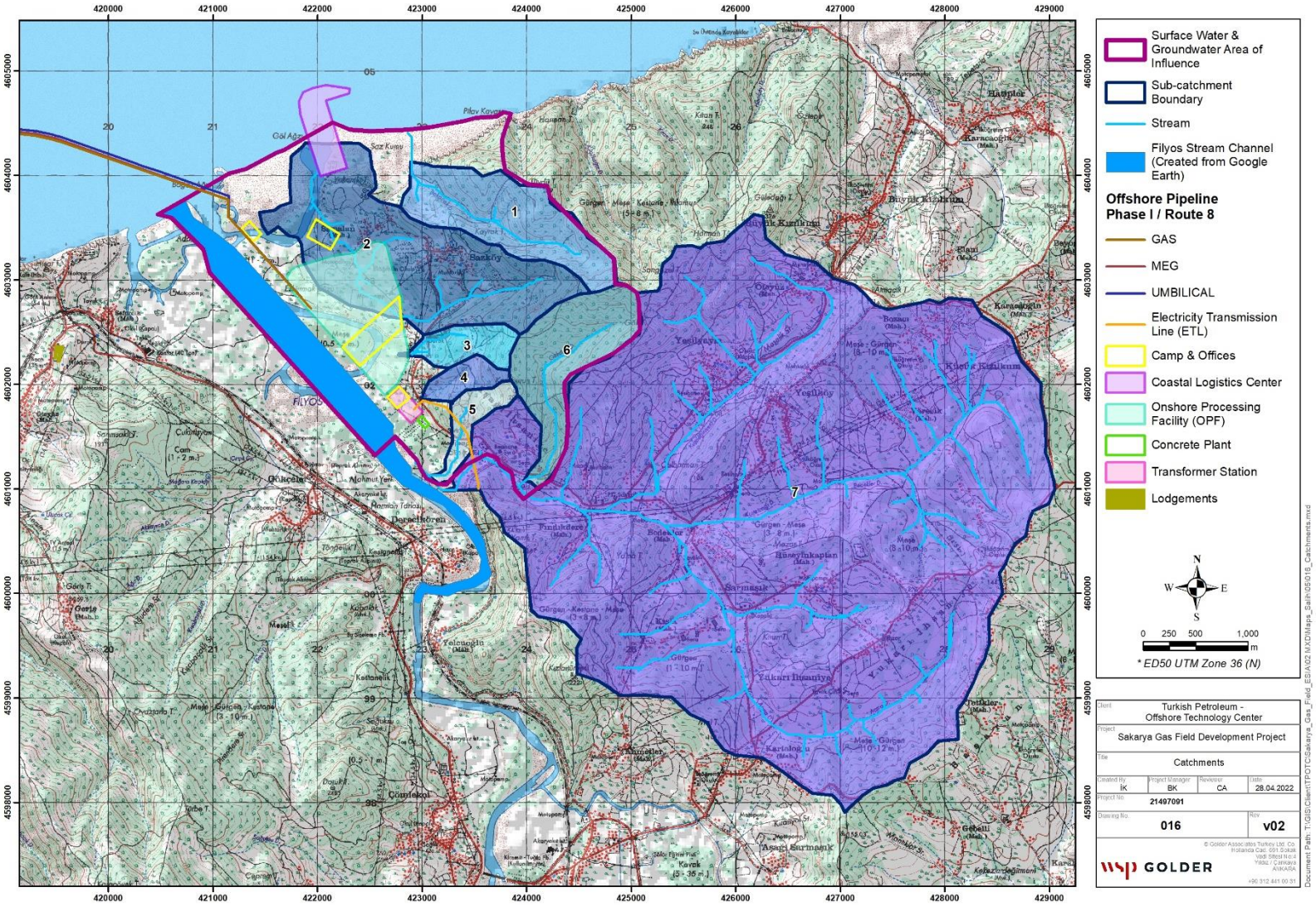


Figure 6-33: Map of the Micro-catchments

- ***Hydrometeorological Conditions***

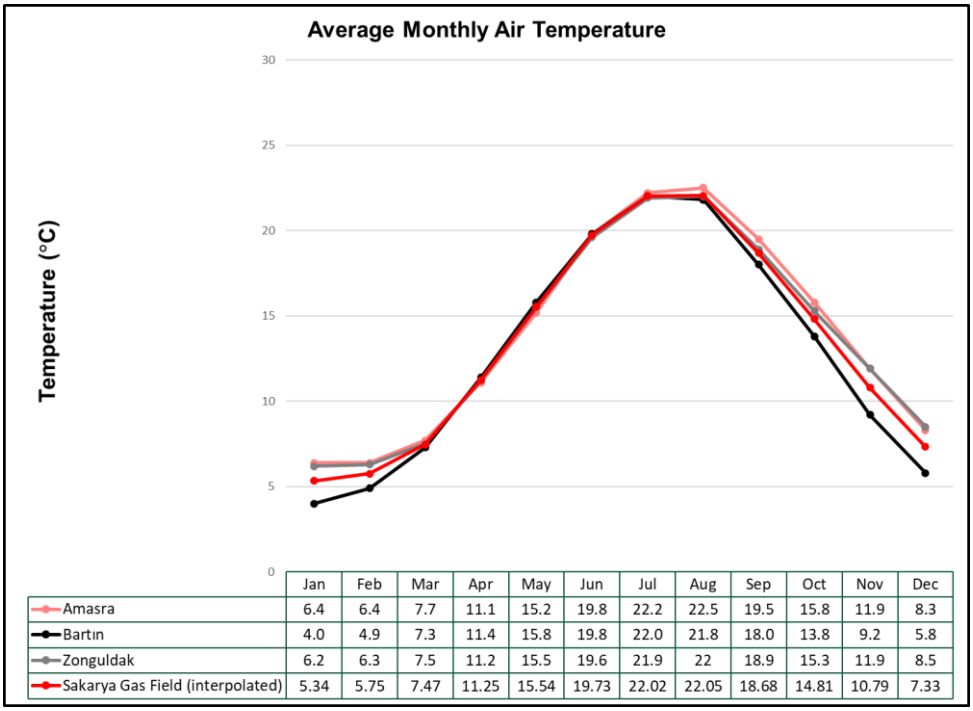
Meteorological data were obtained from the Amasra, Bartın and the Zonguldak Automatic Meteorological Observation Stations located around the Project Site. The recorded data is available for long periods at the Amasra Station between 1970 and 2021, at the Bartin Station between 1961 and 2021 and at the Zonguldak Station between 1939 and 2021. Stations details are provided in Table 6-26 below. Data from these stations were interpolated to obtain hydrometeorological data of the Sakarya Gas Field Project Site.

Table 6-26: Information about nearby Meteorological Stations

Station Number	Station Name	Latitude	Longitude	Elevation (m asl)	Data Interval
17602	Amasra	41.7526	32.3827	73.0	1970-2021
17020	Bartın	41.6248	32.3569	33.0	1961-2021
17022	Zonguldak	41.4492	31.7779	135.0	1939-2021

Air Temperature:

According to the Automatic Meteorological Observation Stations around the Project Site, the average monthly air temperature varies between 4.0 °C and 22.5 °C, and the annual average air temperature varies between 12.8 °C and 13.9 °C. The warmest months are between June and September, and the coldest months are between December and March. The data obtained from three (3) Meteorological Observation Stations was used to produce interpolated data of the Sakarya Gas Field Project. The average monthly air temperature graph for the Project Site and nearby districts are shown in Figure 6-34.

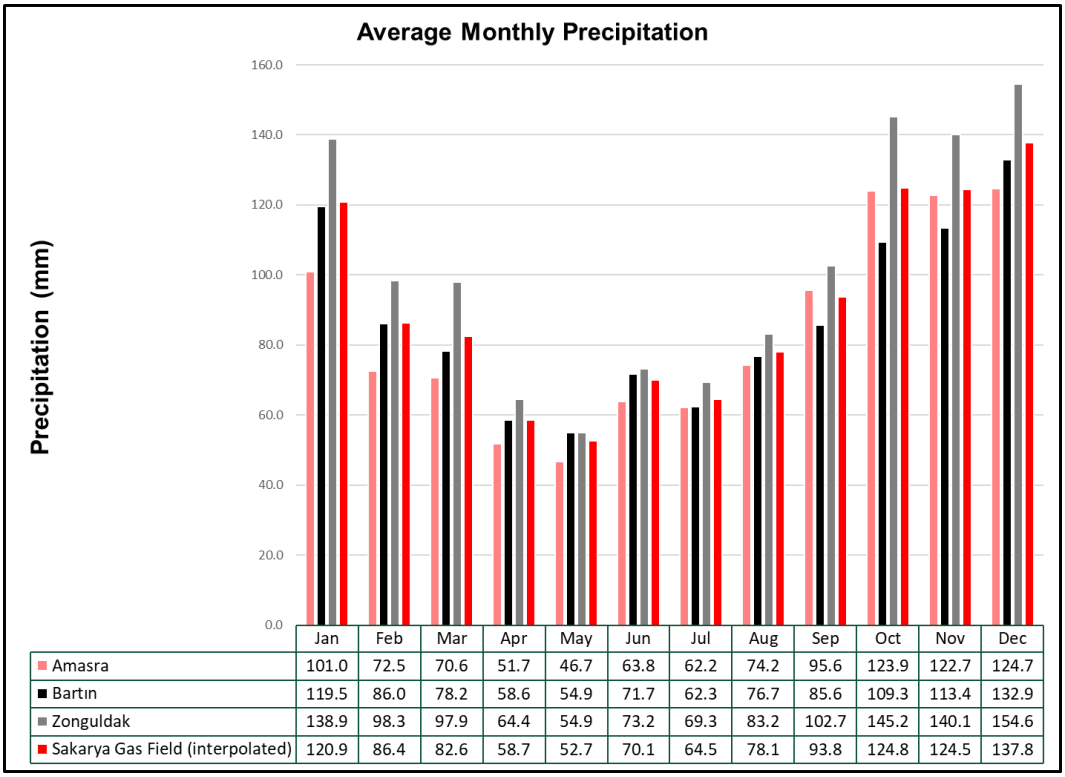


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Amasra	6.4	6.4	7.7	11.1	15.2	19.8	22.2	22.5	19.5	15.8	11.9	8.3
Bartın	4.0	4.9	7.3	11.4	15.8	19.8	22.0	21.8	18.0	13.8	9.2	5.8
Zonguldak	6.2	6.3	7.5	11.2	15.5	19.6	21.9	22	18.9	15.3	11.9	8.5
Sakarya Gas Field (interpolated)	5.34	5.75	7.47	11.25	15.54	19.73	22.02	22.05	18.68	14.81	10.79	7.33

Figure 6-34: Average Monthly Air Temperature

Precipitation:

The average annual precipitation around the Project Site was measured between 1009.6 mm and 1222.7 mm. The wettest month is December with an average monthly precipitation between 124.7 mm and 154.6 mm, and the driest month is May with an average precipitation between 46.7 mm and 54.9 mm. The data obtained from three (3) Meteorological Observation Stations was used to produce interpolated data for the Sakarya Gas Field Project. The average monthly precipitation graph for the Project Site and nearby districts are shown in Figure 6-35.



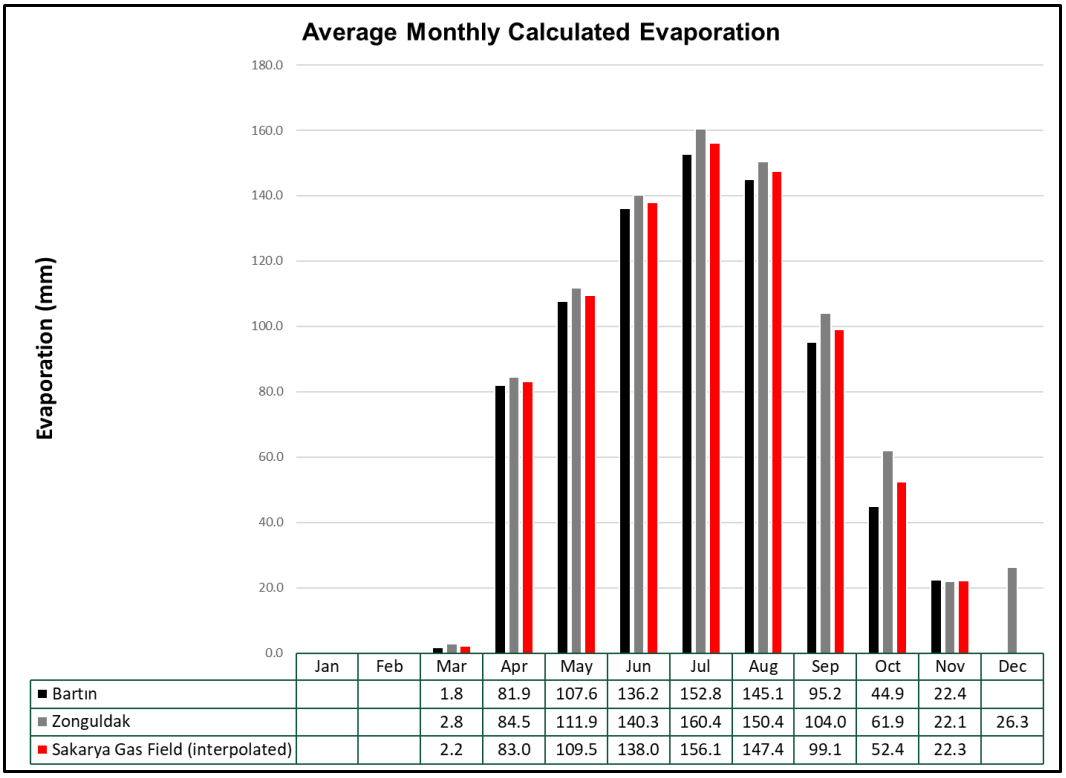
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Amasra	101.0	72.5	70.6	51.7	46.7	63.8	62.2	74.2	95.6	123.9	122.7	124.7
Bartın	119.5	86.0	78.2	58.6	54.9	71.7	62.3	76.7	85.6	109.3	113.4	132.9
Zonguldak	138.9	98.3	97.9	64.4	54.9	73.2	69.3	83.2	102.7	145.2	140.1	154.6
Sakarya Gas Field (interpolated)	120.9	86.4	82.6	58.7	52.7	70.1	64.5	78.1	93.8	124.8	124.5	137.8

Figure 6-35: Average Monthly Precipitation

Evaporation:

No evaporation data could be found for the Amasra station, while in the Bartın and the Zonguldak Stations January and February data were not recorded, like for December data in the Bartın station.

The maximum evaporation amount was calculated between 152.8 mm and 160.4 mm in July, and the minimum evaporation amount was calculated between 1.8 mm and 2.8 mm in March. The available data from two (2) Meteorological Observation Stations was used to derive interpolated data of the Sakarya Gas Field Project. The graph of the average monthly evaporation for the Project Site and nearby districts are shown in Figure 6-36.

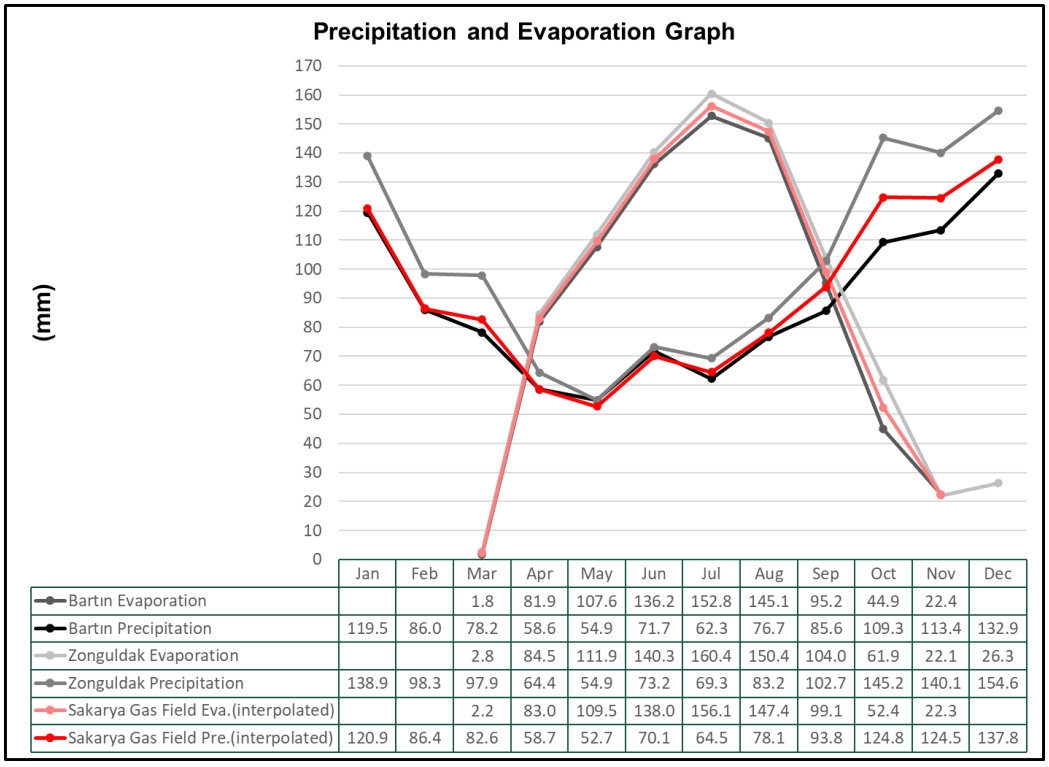


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bartın			1.8	81.9	107.6	136.2	152.8	145.1	95.2	44.9	22.4	
Zonguldak			2.8	84.5	111.9	140.3	160.4	150.4	104.0	61.9	22.1	26.3
Sakarya Gas Field (interpolated)			2.2	83.0	109.5	138.0	156.1	147.4	99.1	52.4	22.3	

Figure 6-36: Average Monthly Calculated Evaporation

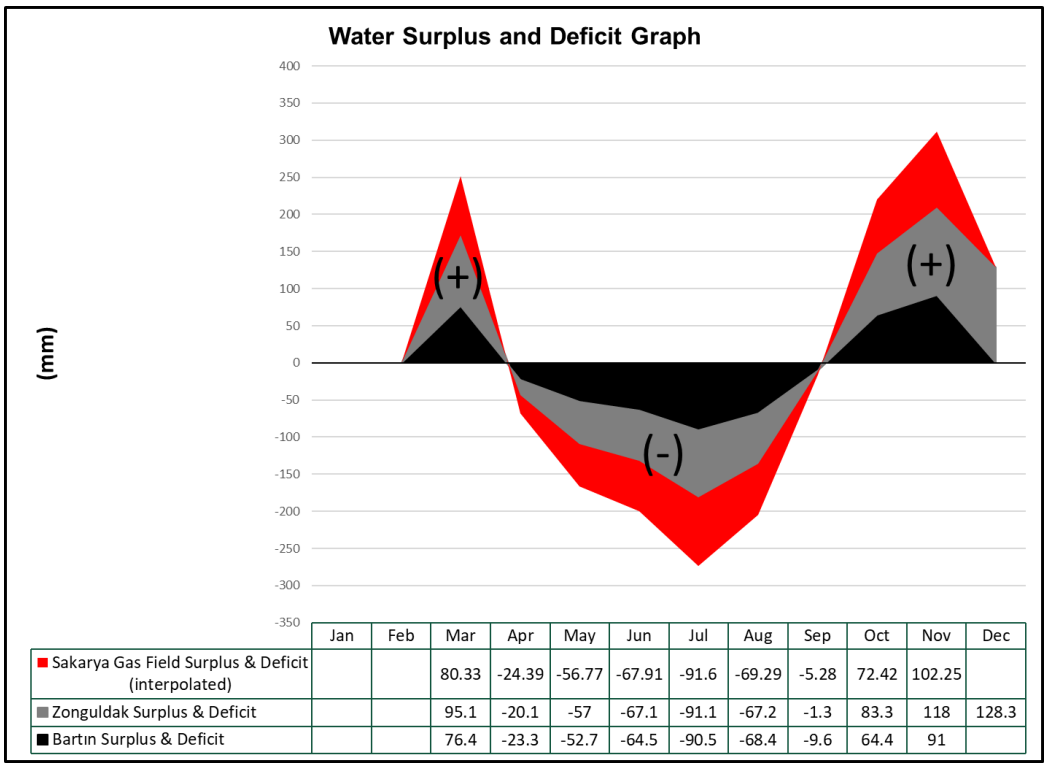
Evaporation:

Monthly average precipitation and monthly average evaporation values were assessed together to determine the water surplus and deficit budget for the Project Site. According to this evaluation, the water budget has positive water amount (surplus) in three (3) months, March, October, and November, in a year. In six (6) months, April, May, June, July, August, and September, the water intake in the around of the Project Site has negative values (deficit). Three (3) months, January, February and December, could not be evaluated since the evaporation data is missing for these months. Also, the Amasra Station is not included in the graphs because evaporation data is completely missing. The monthly average precipitation and monthly average evaporation data derived for the Project Site by the interpolation method are shown in Figure 6-37 and the water surplus & deficit graph is shown in Figure 6-38.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bartın Evaporation			1.8	81.9	107.6	136.2	152.8	145.1	95.2	44.9	22.4	
Bartın Precipitation	119.5	86.0	78.2	58.6	54.9	71.7	62.3	76.7	85.6	109.3	113.4	132.9
Zonguldak Evaporation			2.8	84.5	111.9	140.3	160.4	150.4	104.0	61.9	22.1	26.3
Zonguldak Precipitation	138.9	98.3	97.9	64.4	54.9	73.2	69.3	83.2	102.7	145.2	140.1	154.6
Sakarya Gas Field Eva.(interpolated)			2.2	83.0	109.5	138.0	156.1	147.4	99.1	52.4	22.3	
Sakarya Gas Field Pre.(interpolated)	120.9	86.4	82.6	58.7	52.7	70.1	64.5	78.1	93.8	124.8	124.5	137.8

Figure 6-37: Precipitation and Evaporation Values



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sakarya Gas Field Surplus & Deficit (interpolated)			80.33	-24.39	-56.77	-67.91	-91.6	-69.29	-5.28	72.42	102.25	
Zonguldak Surplus & Deficit			95.1	-20.1	-57	-67.1	-91.1	-67.2	-1.3	83.3	118	128.3
Bartın Surplus & Deficit			76.4	-23.3	-52.7	-64.5	-90.5	-68.4	-9.6	64.4	91	

Figure 6-38: Water Surplus & Deficit Graph

- ***Flow Rate Measurements***

Estimated flow rate values were noted during the hydrocensus fieldwork conducted in February 2022 (see Table 6-27). YS-04 and YS-05 sampling points are upstream and downstream of the stream located south of the Sazköy Village. YS-06 is located downstream of the stream located east of the Transformer Station (see 3.1.1.1 Project Components). These streams are diverted from the Project Site to Filyos River with a diversion channel. YS-08 is located at the outlet section of the diversion channel. Finally, YS-09 is located downstream the Kuşdeğirmeni Stream before it mixes with the Filyos River. More information about the locations and the location map of the surface sampling points are presented in the following section.

Table 6-27: Estimated Flow Rate Values of Streams Around the Project Site

Measurement Date	ID	Flow Rate (liter/second)
Feb 2022	YS-04	~ 5
	YS-05	~ 10
	YS-06	~ 3
	YS-08	~ 25
	YS-09	~ 125

- ***Hydrochemical Characteristics of the Surface Water Resources***

During the EIA, three (3) surface water points, namely YU-1, YU-2 and YU-3, were sampled along the Filyos River in May 2021. YU-1 and YU-3 are downstream and upstream of the Filyos River, respectively. YU-2 can be derived being it placed in the middle of the two.

In February 2022, a sampling campaign was also carried out at two (2) surface-water points, YU-2 and YU-3, by Çınar Çevre Laboratuvarı A.Ş. (“Çınar”) accredited by the Ministry of Environment, Urbanization and Climate Change of Turkey.

A hydrocensus fieldwork was conducted by Golder in and around the Project Site in February 2022 and then a sampling program was established for the ESIA. Within the scope of the sampling program, seven (7) surface water points, namely YS-04, YS-05, YS-06, YS-08, YS-09, YS-13 and YS-14, were identified. Sampling activities were conducted at these seven (7) points in March 2022 by Çınar.

In terms of representativeness, both YS-13 and YU-3 locations represent the upstream of the Filyos River and both YS-14 and YU-1 locations represent the downstream. YS-04 point represents the upstream and YS-05 point represents the downstream of the stream located south of Sazköy. The downstream of the stream located at the east of the Transformer Station is the YS-06 point. The discharge point of the surface water divergent channel is YS-08. The downstream of the Kuşdeğirmeni Stream, located in the southeast of the Project Site, is the YS-09 point.

The information regarding the ESIA sampling locations is reported in Table 6-28, and the map showing the sampling locations of 2022 sampling program is presented in Figure 6-39.

The results of physico-chemical parameters measured in the field and the hydrochemical characteristics of surface water resources at the Project Site are discussed in the following sections.

Table 6-28: ESIA Surface Water Sampling Locations

Type	ID	Coordinates*		Scope	Location
		X (Easting)	Y (Northing)		
Surface Water	YS-04	423809	4602880	ESIA	Upstream of the stream located south of the Sazköy village.
	YS-05	423192	4602661	ESIA	Downstream of the stream located south of the Sazköy village. Water is diverted into a drainage channel after this point.
	YS-06	423102	4601915	ESIA	Downstream of the stream located at the eastern part of transformer station. Water is diverted into a drainage channel after this point.
	YS-08	423382	4601432	ESIA	Downstream of surface water divergent channel before it mixes with the Filyos River.
	YS-09	423717	4601252	ESIA	Downstream of the Kuşdeğirmeni stream.
	YS-13	423432	4600566	ESIA	Upstream of the Filyos River.
	YS-14	421317	4602951	ESIA	Downstream of the Filyos River.
* ED 50 UTM Zone 36					

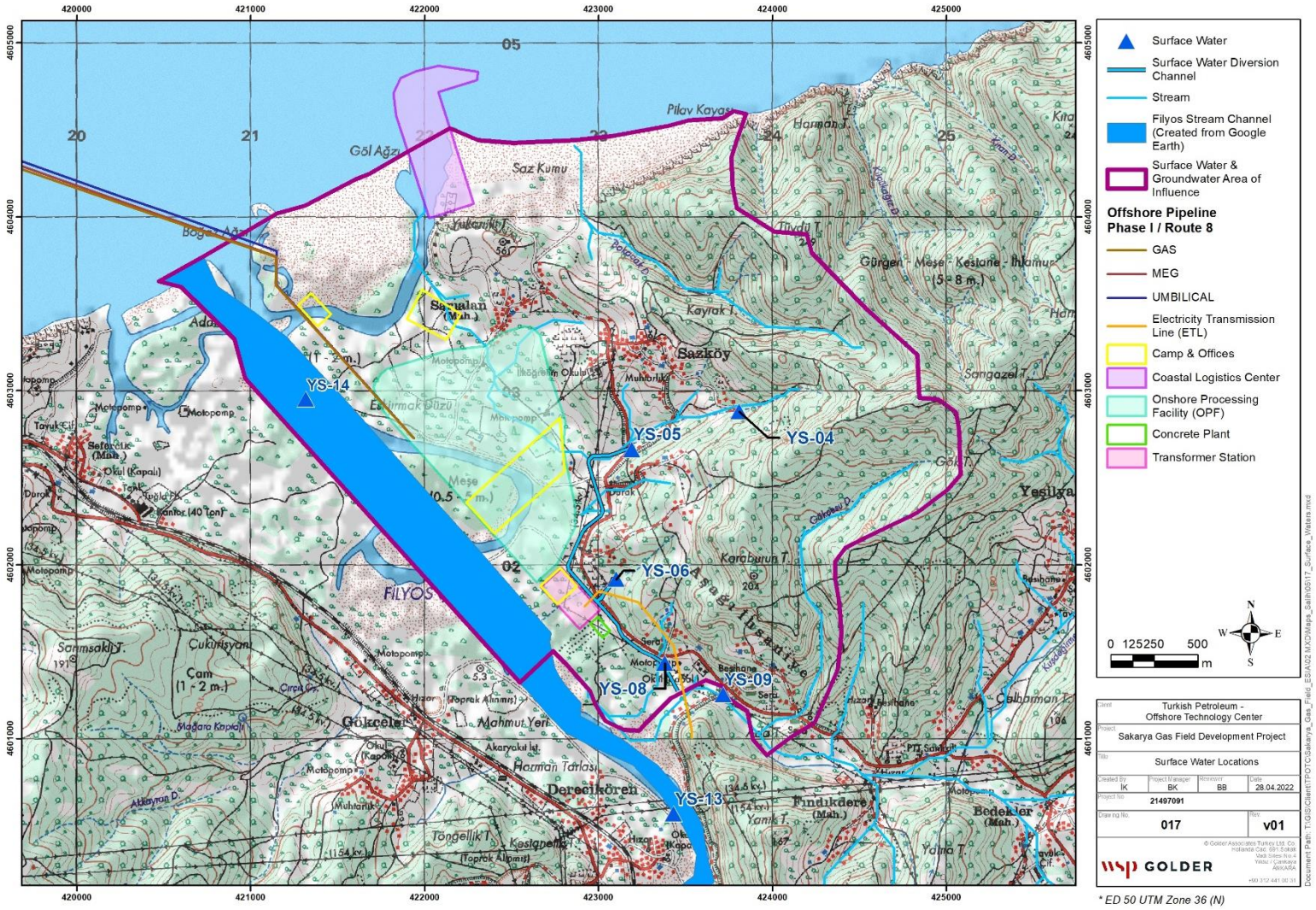


Figure 6-39: ESIA Surface Water Sampling Locations

Field Parameters of Surface Water:

The monitoring measurements recorded on site in 2021 and 2022 from the surface water locations are presented in Table 6-29.

It is noteworthy that the pH values of all water points, except YU-2 in February 2022 and YS-04 in March 2022, were above 7.0 which indicates non-acidic water characterization. The lowest pH value (6.74) was measured at YS-04 location in March 2022 among all monitoring periods. While the highest EC value (921.0 µS/cm) was measured at YU-3 (upstream of the Filyos River), the lowest EC value (103.9 µS/cm) was measured at YS-04. Positive (+) ORP values, which demonstrate an oxidized environmental characteristic, were observed at YS-04, YS-05, YS-06, YS-13 and YS-14 whereas negative (-) ORP values, which demonstrate a reduced environmental characteristic, were observed at YS-08 and YS-09. Dissolved Oxygen values above 9.6 mg/l were measured for all surface water.

Table 6-29: Field Parameters of Surface Water Points

Type	ID**	Date	Field Parameters*				
			T (°C)	pH	EC (µS/cm)	ORP (mV)	DO (mg/l)
Surface Water	YU-1	Jun 2021	22.4	7.69	482.0	-	9.68
	YU-2	Jun 2021	19.9	9.08	433.0	-	9.79
		Feb 2022	7.2	6.99	476.0	-	11.10
	YU-3	Jun 2021	20.7	8.49	389.0	-	9.99
		Feb 2022	15.6	7.29	921.0	-	10.90
	YS-04	Feb 2022	6.1	7.94	103.9	56.7	11.98
		Mar 2022	6.7	6.74	178.2	-	12.40
	YS-05	Feb 2022	6.9	8.29	238.0	10.1	11.76
		Mar 2022	6.8	7.57	396.0	-	12.48
	YS-06	Feb 2022	6.6	7.89	104.5	75.8	11.71
		Mar 2022	4.9	7.93	132.4	-	13.49
	YS-08	Feb 2022	6.9	8.99	175.6	-13.7	12.56
		Mar 2022	4.9	8.97	315.0	-	17.16
	YS-09	Feb 2022	4.9	8.36	227.0	-6.9	11.98
		Mar 2022	6.5	8.37	381.0	-	12.98
	YS-13	Feb 2022	5.2	8.42	321.0	35.3	12.36
		Mar 2022	6.0	8.36	434.0	-	12.76

Type	ID**	Date	Field Parameters*				
			T (°C)	pH	EC (µS/cm)	ORP (mV)	DO (mg/l)
	YS-14	Feb 2022	5.3	8.66	317.0	24.2	11.97
		Mar 2022	5.5	8.38	434.0	-	12.58
* Q: Flow Rate / T: Temperature / EC: Electrical Conductivity / ORP: Oxidation-Reduction Potential / DO: Dissolved Oxygen							
** In terms of representativeness, both YS-13 and YU-3 locations represent the upstream of the Filyos River and both YS-14 and YU-1 locations represent the downstream of the Filyos River.							

Hydrochemical Descriptions of Surface Water:

The major ions obtained from the chemical analysis were used to plot the Piper and Schoeller Diagrams to define the water chemistry. These diagrams show the distribution of cation and anion values and are used to attribute a water type based on differences in the ions (cations: Ca^{2+}, Mg^{2+}, Na^{+} and K^{+}, anions: CO_3^{2-}, HCO_3^{-}, Cl^{-} and SO_4^{2-}). It is likely that the surface-water class may be affected by the lithological units it interacts with.

The water types obtained from Piper and Schoeller Diagrams are presented in Table 6-30. The Piper Diagram plotted on the base of the anion-cation values from the laboratory is presented in Figure 6-40 and the Schoeller Diagram is presented in Figure 6-41 for 2022.

According to the diagrams, calcium ion (Ca^{2+}) is the major cation and bicarbonate ion (HCO_3^{-}) is the major anion of all surface-waters. Additionally, chloride ion (Cl^{-}) is the second most abundant anion in YS-06. Therefore, YS-04, YS-05, YS-08, YS-09, YS-13 and YS-14 were classified as Ca-HCO_3 type of waters, and YS-06 was classified as Ca-Mixed (HCO_3-Cl) type of water.

Table 6-30: Water Type Classification of Surface Water Samples

Surface-water Locations	EC Field (µS/cm)	TDS (mg/l)	Cations (mg/l)				Anions (mg/l)				Water Type
			Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Cl^{-}	HCO_3^{-}	CO_3^{2-}	SO_4^{2-}	
YS-04	178.2	84.6	20.5	3.8	13.1	0.8	13.7	65.4	<2.0	19.9	Ca-HCO3
YS-05	396.0	190.5	65.8	5.7	13.1	1.5	18.9	192.6	<2.0	24.5	Ca-HCO3
YS-06	132.4	62.6	15.5	2.2	9.4	2.1	16.4	35.8	<2.0	20.5	Ca-Mixed(HCO3-Cl)
YS-08	315.0	150.8	49.7	4.2	13.5	1.6	18.5	114.2	38.0	24.0	Ca-HCO3
YS-09	381.0	183.0	69.8	11.0	10.0	1.9	50.8	175.4	<2.0	73.9	Ca-HCO3
YS-13	434.0	209.4	70.7	11.9	12.7	2.4	31.5	194.6	7.2	91.1	Ca-HCO3
YS-14	434.0	209.0	68.3	10.4	13.8	2.3	29.2	185.6	8.0	88.5	Ca-HCO3

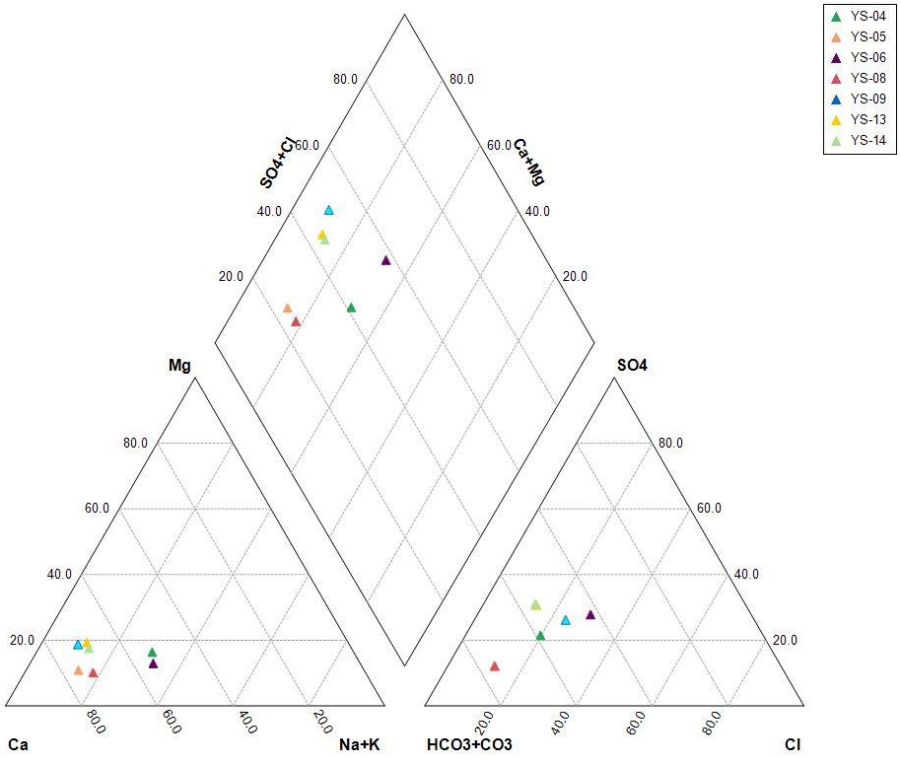


Figure 6-40: Piper Diagram for Surface Water Locations

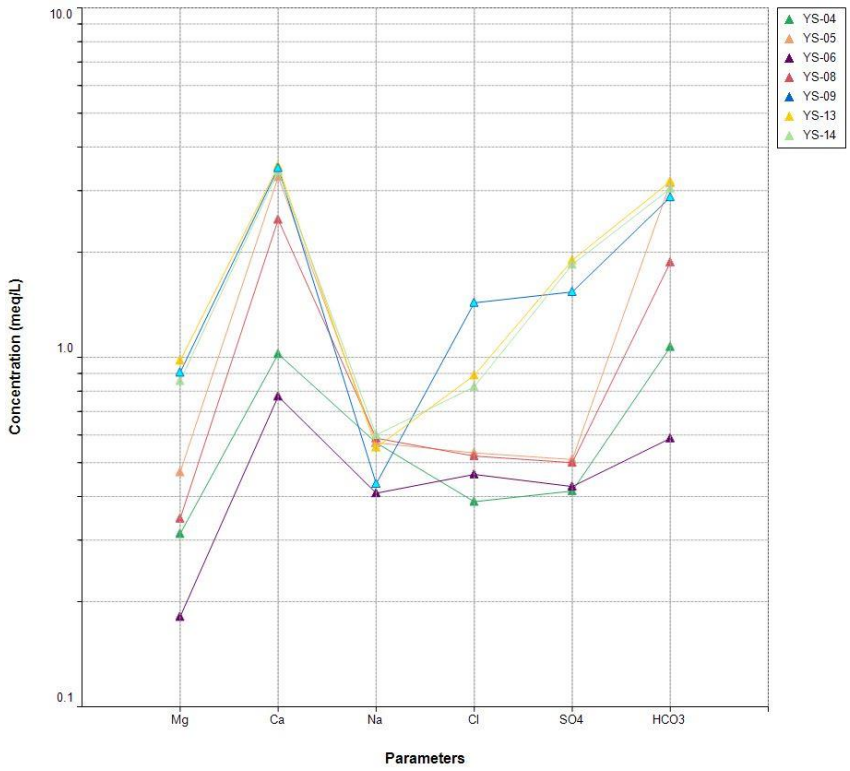


Figure 6-41: Schoeller Diagram for Surface Water Locations

- ***Surface Water Quality***

The surface water quality standards are given in Appendix C.

The laboratory results of surface waters sampling were assessed in terms of quality classification in comparison with the Surface Water Quality Regulation "YSKY". The results are presented in Table 6-31.

In May 2021, three (3) surface water points, namely YU-1, YU-2 and YU-3, were sampled at the Filyos River. YU-1 (due to high sulphide concentration) and YU-2 (due to high pH value and TKN-N concentration) were classified as Class III or Medium Quality Water. YU-3 was classified as Class II or Good Quality Water due its high concentrations of BOD, Total-N-N, Total-P. Similarly in February 2022, YU-2 (due to high TKN concentration) and YU-3 (high conductivity value and TKN concentration) were also classified as Class III and Class II, respectively.

In March 2022, chemical analysis showed that all surface water points, including YS-13 and YS-14 from the Filyos River, were such that it was classified as Class II or good water quality. TKN concentrations of all surface waters fall into Class II. Additionally, BOD concentration of YS-04, YS-06, YS-08, YS-09 and YS-13, conductivity values and ammonium concentrations of YS-13 and YS-14, Total N-N concentration of YS-13 tested as Class II.

In March 2022 water points were tested against the irrigation water quality standards (see Figure 6-42). YS-04 and YS-06 proved to be C1S1, Low Salinity - Low Sodium whereas the remaining surface water points, namely YS-14, YS-13, YS-05, YS-09, and YS-08, proved to be C2S1, Medium Salinity – Low Sodium.

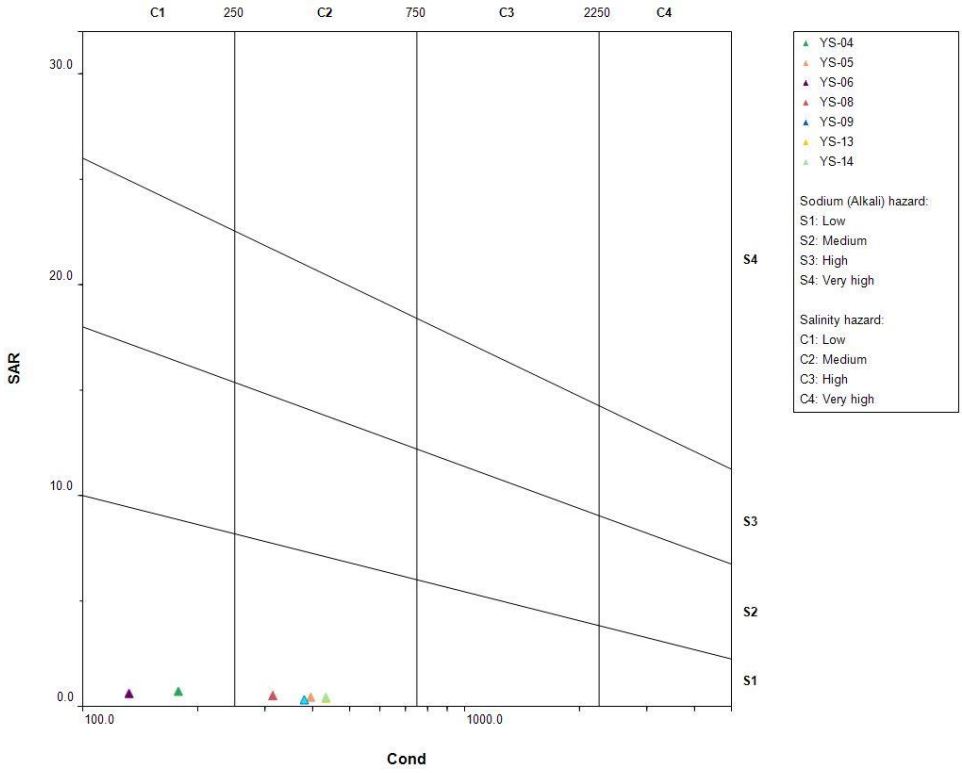


Figure 6-42: Wilcox Diagram for Surface Water Locations

Table 6-31: Surface Water Quality Classification Assessment according to YSKY Annex-5 Table-2

PARAMETERS	Unit	Water Quality Classes			YU-1	YU-2	YU-3	YU-2	YU-3	YS-04	YS-05	YS-06	YS-08	YS-09	YS-13	YS-14
		I (very good)	II (good)	III (medium)	May 2021			Feb 2022		Mar 2022						
pH	-	6.0-9.0	6.0-9.0	6.0-9.0	7.69	9.08	8.49	6.99	7.29	6.74	7.57	7.93	8.97	8.37	8.36	8.38
Color	*(m^{-1})*	RES 436 nm: ≤ 1.5	RES 436 nm: 3.0	RES 436 nm: > 4.3	-	-	-	0.2	0.3	0.1	0.4	0.9	0.6	0.7	0.2	0.3
		RES 525 nm: ≤ 1.2	RES 525 nm: 2.4	RES 525 nm: > 3.7	-	-	-	<0,1	0.1	0.3	0.1	0.3	0.1	0.2	<0.1	0.1
		RES 620 nm: ≤ 0.8	RES 620 nm: 1.7	RES 620 nm: 2.5	-	-	-	<0,1	<0,1	0.8	<0.1	0.1	<0.1	0.1	<0.1	<0.1
Conductivity	*µS/cm*	< 400	1000	> 1000	482	433	389	476	921	178.2	396.0	132.4	315.0	381.0	434.0	434.0
Oil and Grease	*mg/l*	< 0.2	0.3	> 0.3	0.01	0.15	0.07	<10	<10	<0.05	<0.05	<0.05	0.2	<0.05	<0.05	<0.05
Dissolved Oxygen	*mg/l*	> 8	6	< 6	9.68	9.79	9.99	11.06	10.91	12.4	12.5	13.5	17.2	13.0	12.8	12.6
Chemical Oxygen Demand (COD)	*mg/l*	< 25	50	> 50	<25	<25	<25	<10	<10	17.5	11.7	19.5	11.3	14.5	12.5	<10
Biochemical Oxygen Demand (BOD)	*mg/l*	< 4	8	> 8	3.90	4.12	4.60	<3	<3	6.30	3.70	7.40	4.20	6.00	4.60	<3
Ammonium as N (NH_4^+-N)	*mg/l*	< 0.2	1	> 1	0.80	<0.1	<0.1	<0.016	<0.016	<0.016	0.06	<0.016	<0.016	<0.016	0.36	0.33
Nitrate as N (NO_3^--N)	*mg/l*	< 3	10	> 10	1.77	1.30	0.78	1.06	0.11	0.13	0.50	0.36	0.13	1.85	2.29	2.17
Total Kjeldahl as N	*mg/l*	< 0.5	1.5	> 1.5	0.91	1.68	0.84	1.66	0.63	1.39	0.83	1.15	0.81	0.82	1.48	0.97
Total Nitrogen as N (N)	*mg/l*	<3.5	11.5	> 11.5	2.57	3.36	4.04	3.04	0.74	1.52	1.32	1.51	0.94	2.67	3.79	3.16
Orthophosphate Phosphorus (o-PO_4-P)	*mg/l*	< 0.05	0.16	> 0.16	<0.05	0.045	0.036	<0.01	<0.01	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total Phosphorus (P)	*mg/l*	< 0.08	0.2	> 0.2	-	0.081	0.084	0.052	<0.005	0.012	0.043	0.023	0.061	0.059	0.067	0.056
Fluoride (F-)	*µg/l*	≤ 1000	1500	> 1500	136.0	124.3	<50	118.0	117.0	<100	<100	<100	<100	<100	<100	<100
Manganese (Mn)	*µg/l*	≤ 100	500	> 500	3.64	33.76	6.05	61.86	6.13	23.11	27.93	36.82	11.58	37.42	67.64	57.20
Selenium (Se)	*µg/l*	≤ 10	15	> 15	2.50	<2.5	<2.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulphide	*µg/l*	≤ 2	5	> 5	36	<2	<2	-	-	<2	<2	<2	<2	<2	<2	<2
Water Quality Classes					III	III	II	III	II	II	II	II	II	II	II	II

Table 6-32: Evaluation of Surface Water Locations according to IFC Effluent Discharge Limits

Parameter	Units	IFC Effluent Discharge Limits (1)	YU-2	YU-3	YS-04	YS-05	YS-06	YS-08	YS-09	YS-13	YS-14
			Feb 2022		Mar 2022						
pH	**-**	6-9	6.99	7.29	6.74	7.57	7.93	8.97	8.37	8.36	8.38
BOD	**mg/L**	25	<3	<3	6.30	3.70	7.40	4.20	6.00	4.60	<3
COD	**mg/L**	125	<10	<10	17.5	11.7	19.5	11.3	14.5	12.5	<10
TSS	**mg/L**	35	-	-	<10	14.9	23.5	14.4	20.9	81.2	57.1
Phenols	**mg/L**	0.5	-	-	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Arsenic	**mg/L**	5	-	-	0.0008	<0.0005	<0.0005	0.0008	<0.0005	0.0012	0.0012
Cadmium	**mg/L**	5	-	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Chromium	**mg/L**	5	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	**mg/L**	5	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	**mg/L**	5	-	-	<0.0005	<0.0005	0.0008	<0.0005	<0.0005	0.0015	0.0012
Mercury	**mg/L**	5	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Nickel	**mg/L**	5	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver	**mg/L**	5	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Vanadium	**mg/L**	5	-	-	0.0047	0.0026	0.0020	0.0039	0.0015	0.0017	0.0016
Zinc	**mg/L**	5	-	-	0.0668	0.0300	0.0735	0.0226	0.1231	0.0347	0.0828
Chlorides	**mg/L**	600 (average), 1200 (maximum)	-	-	13.7	18.9	16.4	18.5	50.8	31.5	29.2

(1) IFC EHS Gudelines on Onshore Oil and Gas Development (2007)

Surface water points were also evaluated in comparison with the effluent guide of IFC (2007). The discharge water standards are shown in Appendix C. The sampling results of surface waters were assessed against the limit values in the Environmental, Health, and Safety Guidelines for Onshore Oil and Gas Development. The results are presented in Table 6-32. According to the results, Total Suspended Solids (TSS) parameter of YS-13 (upstream of Filyos River) and YS-14 (downstream of the Filyos River) above the IFC Effluent Discharge Limits.

Sensitivity Assessment

Sensitivity features	Supported by	Sensitivity value
Presence of waterbody (Filyos River) in AoI. Presence of water/sediment pollution. Presence of hydrological changes in sub-catchments of Creeks in AoI.	Primary and secondary data	High

6.2.1.7 Hydrogeology and Groundwater Quality

Definition	Hydrogeology is the area of geology that deals with the distribution and movement of groundwater in the soil and rocks of the Earth's crust (commonly in aquifers). The terms groundwater hydrology, geohydrology, and hydrogeology are often used interchangeably.
Study areas	**RSA:** The Filyos Basin. **Rationale:** The Filyos Basin is considered as RSA since the regional groundwater flow is towards the Black Sea along the Filyos Basin.
	AoI: The AoI is defined as the groundwater flow model area. **Rationale:** In order to represent the shallow aquifer system and its flow towards the Filyos River and the Black Sea, an AoI was defined by considering the basin boundaries of the Project Site and its immediate surroundings as no-flow boundary conditions in the conceptual and numerical model.
Data sources	**Primary sources**: Primary data from field works conducted by Toker, Golder, and Çınar Laboratories in 2021 and 2022.
	Secondary sources: Secondary data from scientific papers, grey literature and government agency reports & databases.

Methodological approach

Baseline hydrogeological characterization and groundwater quality assessment were made according to the primary and secondary data sources. Primary data is sourced from the fieldworks involving a hydrocensus survey in the AoI which aims at determining the groundwater and surface water resources and stakeholder water users in and around the AoI. Based on this hydrocensus survey; a comprehensive water sampling study was conducted in the AoI. Additionally, groundwater exploration and testing program were conducted by Toker in 2021. The findings from these studies were also used as primary data source during the baseline characterization studies.

All fieldworks including hydrocensus and water sampling were conducted according to the local and international standards and guidelines where applicable.

The following regulations and guidelines were taken into consideration during the baseline hydrogeological characterisation and groundwater quality assessment studies.

- Regulation on the Protection of Groundwater against Pollution and Deterioration (YSKBKKHY) (Official Gazette No. 28257 Date: 07.04.2012).
- "Regulation of Water intended for Human Consumption" (İTASHY), Official Gazette No: 25730, Dated: 17.02.2005.
- "European Union Directive on the Quality of Water Intended for Human Consumption" no. 98/83/EC dated 3 November 1998.
- "Drinking Water Quality Guidelines" developed by the World Health Organization (2011).
- "Irrigation Water Standards" of the US Salinity Laboratory (1954).
- During the baseline studies, the reports used as secondary data sources are listed below.
- Sakarya Gas Field Submarine Production Facilities, Submarine Transmission Lines and Onshore Natural Gas Processing Facility Integrated Project Report, AREN MÜŞAVİRLİK MÜHENDİSLİK LTD. ŞTİ., September 2021.
- TP-OTC Filyos Natural Gas Processing Plant Analysis of Step-Drawdown Tests. TOKER Drilling and Construction Engineering Consulting. Co., July 2021.

The regional hydrogeological characteristics and the baseline hydrogeological conditions of the TP-OTC Sakarya Gas Field Project are discussed herein.

Regional context (RSA)

The structural and lithological features of the geological formations outcropping throughout the Filyos Basin, which is the sub-basin of the Western Black Sea Basin, where the Project Site is located, have been evaluated in terms of hydrogeology, permeability and aquifer properties.

There is no unit that shows impermeable characteristic in the project impact area and in its immediate vicinity. However, the permeability of the very fine-grained levels forming the upper parts of the alluvium is quite low, and there is very little infiltration into the ground after precipitation, and therefore flooding and ponding occur in the region.

The Çaycuma Formation, which consists of alternations of sandstone, siltstone, claystone and shale intercalated with volcanic rocks, and the Yemişliçay Formation, which consists of volcanic sandstone, siltstone, claystone, shale and pyroclastic rocks, and pelagic-semi-pelagic limestones, are the units that show low permeability characteristics.

Units showing aquifer characteristics in and around the Project Site are Quaternary alluvium and Maestrichtian-Lower Eocene aged Akveren formations.[6]

Local context (Aol)

Hydrology and Surface Water Quality

- ***Hydrologic Characteristics***

  The Project Site and its surroundings mainly consist of Quaternary aged Alluviums and Upper Createse aged Yemişliçay formation, the upper parts of which are composed of very fine-grained materials. The Project Site is mainly located on Quaternary aged alluvium.

  Quaternary aged alluvium, which covers a large part of the RSA, is considered a permeable unit. The Upper Cretaceous Yemişliçay formation, which occupies less space in and around the Project Site compared to the alluvium unit, consists of volcanic sandstone, siltstone, claystone, shale and pyroclastic rocks and pelagic-semi-pelagic limestones, and it is defined as semi-permeable.

  Many studies have been carried out to determine the hydrogeological and hydraulic characteristics of the Project site by utilizing the groundwater monitoring wells drilled in and around the Project site.

  The hydrogeological map of the Project Site is presented in Figure 6-43.

  Groundwater Wells:

  Information regarding the wells is given below and summarized in Table 6-33.[7]

  WaterWell-1: It is located southwest of the Onshore Processing Facility. The diameter of the well is 12.5-inches (316 mm), and it reaches a depth of 71 meters. A gravelous silty sand was identified as the target unit and a well casing with a screen between 53-69 meters was installed. In order to determine the hydrogeological data, a step pump test was carried out.

  WaterWell-2: It is located at the west of the Onshore Processing Facility. The diameter of the well is 12.5-inches (316 mm), and it reaches a depth of 75 meters. Gravelous silty sand was identified as the target unit and a well casing with a screen between 49-69 meters was installed. In order to determine the hydrogeological data, a step pump test was carried out.

  WaterWell-3: It is located at the northeast of the Onshore Processing Facility. The well is 12.5 inches (316 mm) in diameter, and it reaches a depth of 35 meters. Claystone and siltstone were identified as the target

[6] AREN MÜŞAVİRLİK MÜHENDİSLİK LTD. ŞTİ., (September 2021). Sakarya Gas Field Submarine Production Facilities, Submarine Transmission Lines and Onshore Natural Gas Processing Facility Integrated Project Report

[7] TOKER Drilling and Construction Engineering Consulting. Co., (July 2021). TP-OTC Filyos Natural Gas Processing Plant Analysis of Step-Drawdown Tests

unit and a well casing with a screen between 11-31 meters was installed. In order to determine the hydrogeological data, a step pump test was carried out.

WaterWell-4: It is located at the south of the Onshore Processing Facility. The well is 12.5 inches (316 mm) in diameter, and it has a depth of 55 meters. Clay and gravelly sand, volcanogenic sandstone and conglomerate units were reaches as target units and a well casing with a screen between 43-51 meters was installed. In order to determine the hydrogeological data, a step pump test was carried out.

WaterWell-5: It is located east of the Onshore Processing Facility. The well is 12.5 inches (316 mm) in diameter, and it reaches a depth of 43 meters. To determine the hydrogeological data, a step pump test was carried out. It was aimed to collect data from all clayey formations. Well screens were placed between 11-39 meters.

The information about the aquifer tests that were conducted in the wells are presented at Table 6-34.

Table 6-33: Information About the Groundwater Wells

Well ID	UTM ED50 (m) Zone 36		Elevation	Start Date	End Date	Drilling Method	Well Diameter	Pipe Diameter	Well Depth	Filtered Range	Static Water Level
	X	Y	(m)				(mm)	(mm)	(m)	(m)	(m)
WATERWELL-1	422133.42	4602471.20	5.98	01-06-21	08-06-21	Rotary	316	200	71	59-68	5.54
WATERWELL-2	421944.91	4602681.16	6.21	22-05-21	25-05-21	Rotary	316	200	75	47.25-67.25	5.36
WATERWELL-3	422605.21	4603167.79	7.15	21-06-21	24-06-21	Rotary	316	200	35	11-31	1.86
WATERWELL-4	422649.72	4601923.42	5.95	10-07-21	14-07-21	Rotary	316	200	55	43-51	5.26
WATERWELL-5	422824.18	4602502.35	6.2	30-06-21	09-07-21	Rotary	316	200	43	11-39	0.91

Table 6-34: Information About the Aquifer Tests of Groundwater Wells

Well ID	Well Depth (m)	Static Water Level (m)	Average Flow Rate (L/s)	Drawdown (m)	Pump Test Duration (min)	Test Type	Hydraulic Conductivity (m/s)	Geological Formation
WATERWELL-1	71	5.54	10.96	1.62	480	Step Pump Test	2.E-04	Gravelly Silty Sand
WATERWELL-2	75	5.36	9.98	0.69	500	Step Pump Test	2.72E-04	Gravelly Silty Sand
WATERWELL-3	35	1.86	2.81	19.93	480	Step Pump Test	4.98E-06	Claystone and Siltstone
WATERWELL-4	55	5.26	6.70	25.76	480	Step Pump Test	3.44E-06	Clayey and Gravelly Sand & Volcanogenic Sandstone and Conglomerate
WATERWELL-5	43	0.91	1.1875	17.69	480	Step Pump Test	1.24E-06	Clay and Silty Clay

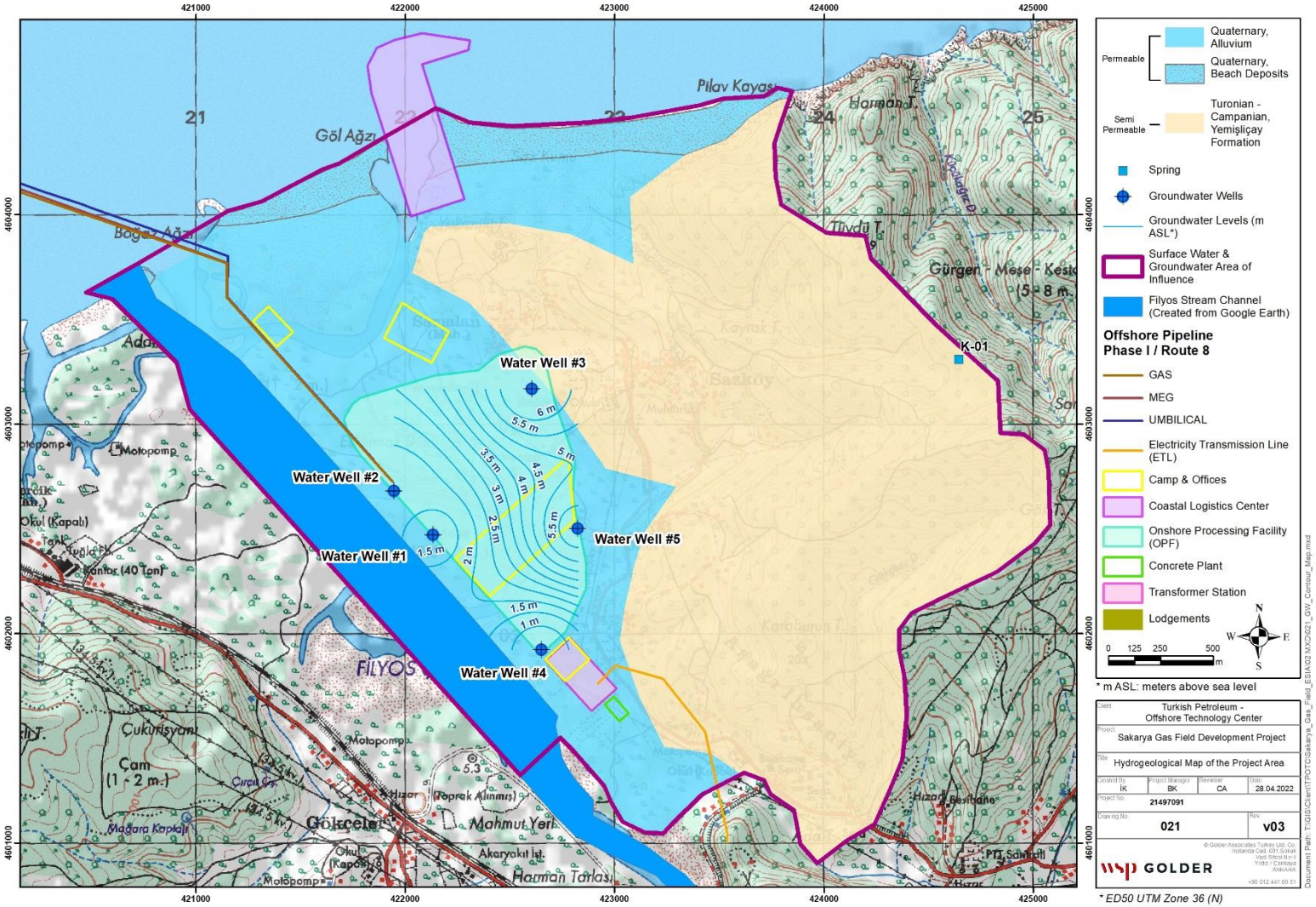


Figure 6-43: Hydrogeological Map of the Project Area

- ***Hydrogeochemical Characteristics of the Groundwater Resources***

During the EIA studies, only one (1) groundwater point, SK-02, was sampled in May 2021. SK-02 well was located in between the Filyos River and Onshore Processing Facility of the Project.

In February 2022, sampling was also carried out at six (6) groundwater points, namely WaterWell-1, WaterWell-2, WaterWell-3, WaterWell-4, WaterWell-5 and SK-1, by Çınar Çevre Laboratuvarı A.Ş. ("Çınar") accredited by the Ministry of Environment, Urbanization and Climate Change of Turkey.

A hydrocensus fieldwork was conducted by Golder in and around the Project site in February 2022 and then a sampling program was established for the ESIA. Within the scope of the sampling program, twelve (12) groundwater points (eight (8) groundwater wells, one (1) spring point and three (3) developed springs, namely WaterWell-1, WaterWell-2, WaterWell-3, WaterWell-4, WaterWell-5, SK-01, SK-03, SK-04, K-01, Ç-01, Ç-02 and Ç-03, were identified. Sampling activities were conducted at eight (8) points out of twelve (12) points in March 2022 by Çınar.

In terms of representativeness, both SK-02 and WaterWell-2 locations represent a groundwater monitoring well between the Filyos River and the Onshore Processing Facility of the Project. Moreover, Water Well-1, Water Well-3, Water Well-5 are the other monitoring wells located at the Project Site. Water Well-4 and SK-01 well are in operation as a water supply wells for construction works of the main contractor. SK-03 is the water supply well of the Sazköy village. It is understood that SK-03 will be replaced with SK-04 in the future. K-01 is the only spring well of the Sazköy Village. Developed spring wells of the Sazköy village are Ç-01 and Ç-02. Ç-01 is being fed by K-01 spring and Ç-02 is being fed by SK-03 well. On the other hand, Ç-03 is the developed spring well of the Aşağıihsaniye Village but its spring could not be reached.

The information regarding the ESIA sampling locations is given in Table 6-35, and the map showing the sampling locations of 2022 sampling program is presented in Figure 6-44.

The results of the physico-chemical parameters measured at the site and the hydrogeochemical characteristics of the groundwater resources in the Project site are discussed in the following sections.

Table 6-35: ESIA Groundwater Sampling Locations

Type	ID	Coordinates*		Scope	Location
		X (Easting)	Y (Northing)		
Groundwater Well	WaterWell-1	422133.42	4602471.20	ESIA	Project Site Observation Well
	WaterWell-2	421944.91	4602681.16	ESIA	Project Site Observation Well
	WaterWell-3	422605.21	4603167.79	ESIA	Project Site Observation Well
	WaterWell-4	422649.72	4601923.42	ESIA	Project Site Water Supply Well

Type	ID	Coordinates*		Scope	Location
		X (Easting)	Y (Northing)		
	WaterWell-5	422824.18	4602502.35	ESIA	Project Site Observation Well
	SK-01	422314.00	4603279.00	ESIA	Project Site Water Supply Well
	SK-03	422723.00	4602881.00	ESIA	Sazköy Water Supply Well. It will be replaced with SK-04 in the future.
	SK-04	423681.00	4602903.00	ESIA	Sazköy New Water Supply Well. Not in use yet. It will be used instead of SK-03 in the future.
Spring	K-01	424645.85	4603309.13	ESIA	Sazköy Spring.
Developed Spring	Ç-01	423062.00	4603249.00	ESIA	Sazköy Fountain. (Being fed from K-01 spring).
	Ç-02	423079.00	4603349.00	ESIA	Sazköy Fountain. (Being fed from the SK-03 well).
	Ç-03	423541.00	4601484.00	ESIA	Aşağı İhsaniye Fountain. (Spring could not be reached).
* ED 50 UTM Zone 36 N					

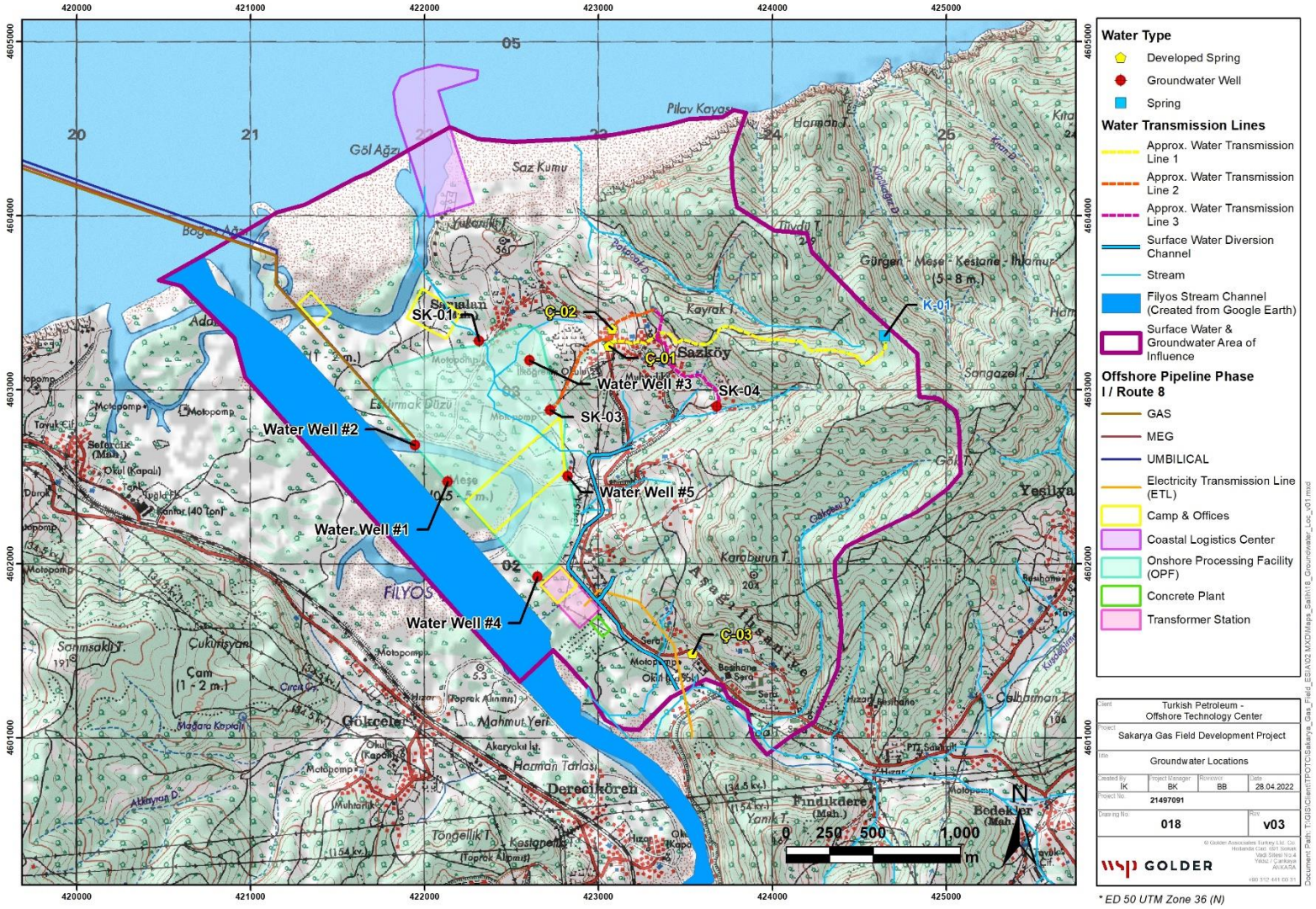


Figure 6-44: ESIA Groundwater Sampling Locations

Field Parameters of Groundwater:

The monitoring measurements taken on site in 2021 and 2022 from the groundwater wells are presented in Table 6-36. It is noteworthy that the pH values of all water points, except WaterWell-2 in February 2022 and SK-01 in February 2020, were above 7.0 which indicates non-acidic water characterization. The highest pH value (12.47) was measured at WaterWell-1 in February 2022. While the highest EC value (2690.0 µS/cm) was measured at WaterWell-1, EC values at WaterWell-1 and WaterWell-2 were above 1000 µS/cm for both February 2022 and March 2022 periods. Negative (-) ORP values, which demonstrate a reduced environmental characteristic, were observed at WaterWell-1 and WaterWell-2 whereas positive (+) ORP values, which demonstrate an oxidized environmental characteristic, were observed at the remaining wells. Dissolved Oxygen values were less than 2.0 mg/l at WaterWell-1, WaterWell-2 and Water Well-5 for at least one time.

Table 6-36: Field Parameters of Groundwater Points

Type	ID	Date	Field Parameters*				
			T (°C)	pH	EC (µS/cm)	ORP (mV)	DO (mg/l)
Groundwater Well	Water Well #1	Feb 2022 (Golder)	13.9	10.10	1346.0	-1.3	1.61
		Feb 2022 (Cinar)	13.3	12.47	2690.0	-	2.69
	Water Well #2	Feb 2022 (Golder)	9.8	7.66	1148.0	-116.4	1.68
		Feb 2022 (Cinar)	11.4	6.24	1119.0	-	4.30
		Mar 2022	8.4	7.11	1026.0	-	5.18
	Water Well #3	Feb 2022 (Golder)	11.1	7.26	731.0	63.2	6.82
		Feb 2022 (Cinar)	12.4	8.25	705.0	-	6.72
		Mar 2022	10.1	7.18	678.0	-	9.37
	Water Well #4	Feb 2022 (Golder)	11.3	7.75	816.0	46.9	5.46
		Feb 2022 (Cinar)	13.4	8.70	861.0	-	5.04
		Mar 2022	12.1	7.47	768.0	-	10.37
	Water Well #5	Feb 2022 (Golder)	14.3	7.32	741.0	42.7	0.92
		Feb 2022 (Cinar)	14.4	7.98	714.0	-	3.02
		Mar 2022	13.3	7.07	682.0	-	1.84
	SK-01	Feb 2022 (Golder)	6.5	8.08	503.0	95.1	10.78
		Feb 2022 (Cinar)	-	6.95	684.0	-	-
		Mar 2022	10.6	7.66	569.0	-	8.33
	SK-02	May 2021	18.9	7.09	728.0	-	6.31
	SK-03	Feb 2022 (Golder)	13.2	7.42	813.0	15.1	4.55
	SK-04	Feb 2022 (Golder)	Not in use yet.				
Spring	K-01	Feb 2022 (Golder)	Could not be reached due to adverse road conditions.				
Developed Spring	Ç-01	Feb 2022 (Golder)	6.5	7.94	375.0	50.3	9.69
		Mar 2022	4.2	7.67	365.0	-	9.20
	Ç-02	Feb 2022 (Golder)	11.9	7.44	824.0	48.5	6.79
		Mar 2022	11.8	7.04	815.0	-	7.19

Type	ID	Date	Field Parameters*				
			T (°C)	pH	EC (µS/cm)	ORP (mV)	DO (mg/l)
	Ç-03	Feb 2022 (Golder)	13.3	7.04	555.0	42.1	5.79
		Mar 2022	13.6	7.18	595.0	-	6.93
* T: Temperature / EC: Electrical Conductivity / ORP: Oxidation-Reduction Potential / DO: Dissolved Oxygen							

Field Parameters of Groundwater:

The major ions obtained from the chemical analysis results were used to plot the Piper and Schoeller Diagrams in order to determine the water chemistry. These diagrams show the distribution of cation and anion values and are used to determine water classification according to differences in the major ions (cations: Ca^{2+}, Mg^{2+}, Na^{+} and K^{+}, anions: CO_3^{2-}, HCO_3^{-}, Cl^{-} and SO_4^{2-}). It is likely that the groundwater may be affected by the lithological units it interacts with and may change its class.

The water types obtained from Piper and Schoeller Diagrams are presented in Table 6-37. The Piper Diagram which has been plotted according to the anion-cation values of the laboratory results of the surface water samples is presented in Figure 6-45 and the Schoeller Diagram is presented in Figure 6-46 for 2022 period.

According to the diagrams, calcium ion (Ca^{2+}) is the major cation and bicarbonate ion (HCO_3^{-}) is the major anion of all groundwaters similar to surface waters. Additionally, manganese ion (Mg^{2+}) is the second most abundant cation in WaterWell-2. Therefore, WaterWell-3, WaterWell-4, WaterWell-5, C-01, C-02, CO-3 and SK-01 were classified as Ca-HCO_3 type of waters, and WaterWell-02 was classified as Mixed (Ca-Mg)-HCO_3 type of water.

Table 6-37: Water Type Classification of Surface Water Samples

Groundwater Locations	EC Field (µS/cm)	TDS (mg/l)	Cations (mg/l)				Anions (mg/l)				Water Type
			Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Cl^{-}	HCO_3^{-}	CO_3^{2-}	SO_4^{2-}	
WW #2	1026.0	505.0	96.1	41.7	70.8	4.0	53.7	497.6	<2.0	9.9	Mixed(Ca-Mg)-HCO3
WW #3	678.0	331.0	120.5	9.3	13.4	0.9	27.9	355.6	<2.0	20.5	Ca-HCO3
WW #4	768.0	376.0	110.3	13.7	29.2	1.5	24.3	394.8	<2.0	4.3	Ca-HCO3
WW #5	682.0	332.0	107.6	15.1	18.2	0.9	26.9	388.6	<2.0	5.3	Ca-HCO3
C-01	365.0	176.5	49.7	6.4	21.2	1.2	42.4	160.8	<2.0	46.5	Ca-HCO3
C-02	815.0	399.0	138.8	7.6	18.1	2.3	34.7	379.2	<2.0	57.2	Ca-HCO3
C-03	595.0	289.0	74.3	19.0	20.3	3.1	24.3	290.4	<2.0	6.1	Ca-HCO3
SK-01	569.0	276.0	71.2	6.9	41.5	0.7	13.6	272.0	<2.0	21.4	Ca-HCO3

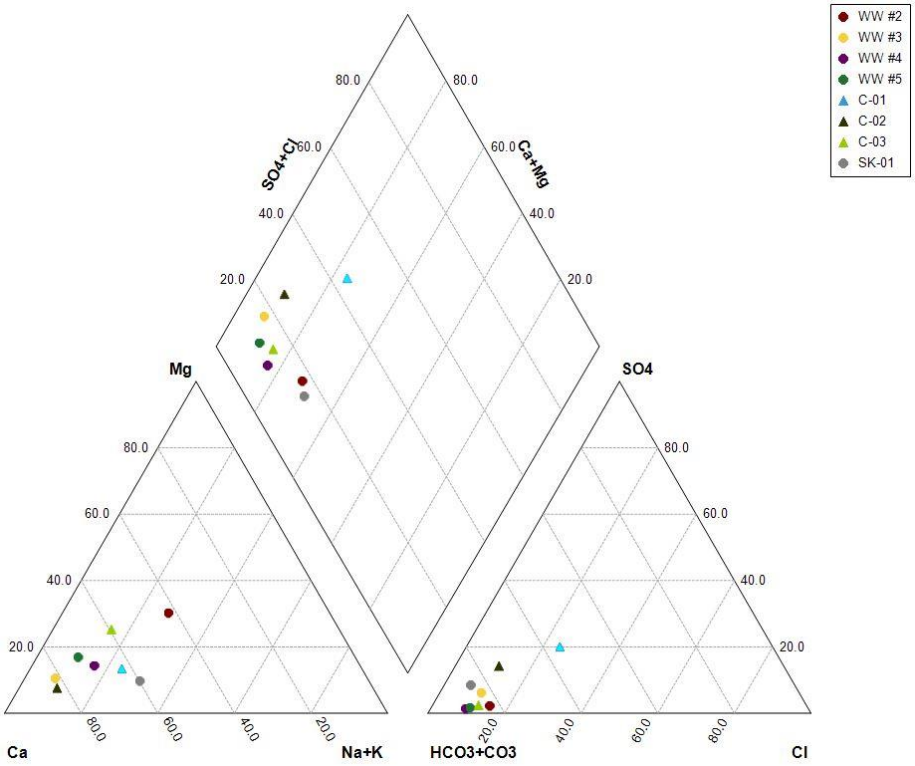


Figure 6-45: Piper Diagram for Groundwater Locations

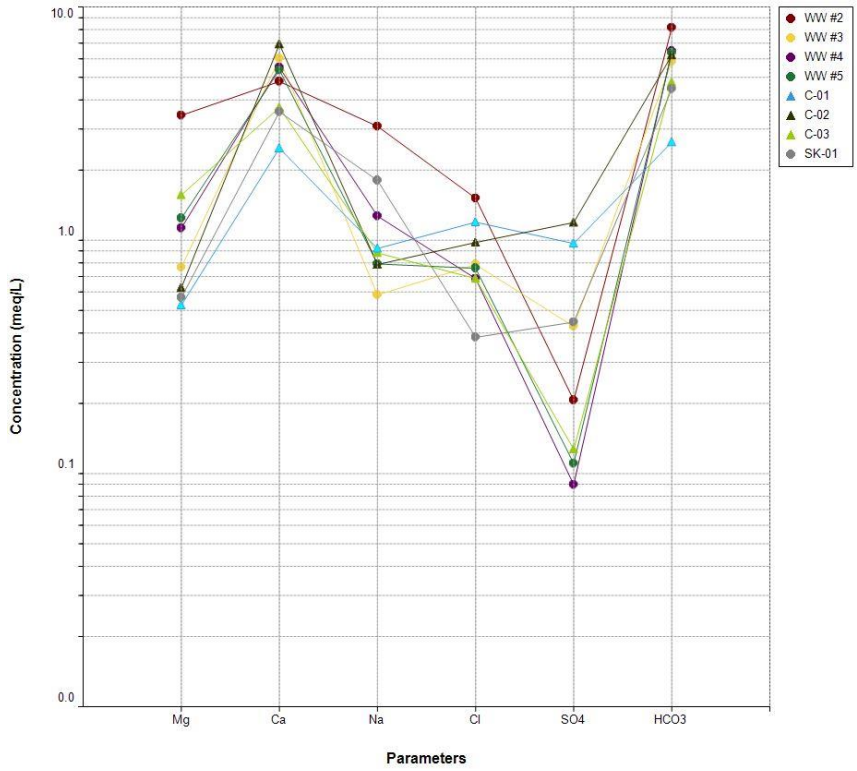


Figure 6-46: Schoeller Diagram for Groundwater Locations

- ***Groundwater Quality***

  The groundwater quality standards are given in Appendix C.

  Groundwater, samples have been assessed in accordance with the Regulation on the Protection of Groundwater against Pollution and Deterioration “YSKBKKHY” in Table 6-38. Noteworthy observations are described as follows.

  The parameters on cadmium, lead, mercury, tetrachloroethylene and trichloroethylene, measured from all locations are below the reporting limit for all sampling campaigns.

  The maximum concentrations for ammonia with 11.6 mg/l, and the maximum electrical conductivity value with 6280 µS/cm were observed at WaterWell-1. Moreover, the maximum concentrations were observed for arsenic with 0.0143 mg/l, chloride with 102 mg/l, and total phosphorus as P with 0.116 mg/l at WaterWell-2 and for nitrites with 0.055 mg/l at WaterWell-5, and for sulphate with 61.3 mg/l at SK-01.

  The groundwater samples were also tested against the Drinking Water Standards (see Table 6-39). The groundwater well points WaterWell-1, WaterWell-2, WaterWell-5 and SK-01, were beyond the drinking water limits for at least one parameter in all sampling campaign. Aluminum, ammonium, conductivity and pH parameters were measured above the limits at WaterWell-1. Furthermore, arsenic, ammonium, pH (in February 2022), iron (in March 2022), and manganese parameters were beyond the drinking water limits at WaterWell-2 location. Finally, manganese concentration at WaterWell-5, and aluminum and iron concentrations at SK-01 were measured beyond the drinking water limits. On the other hand, the remaining groundwater points, namely WaterWell-3, WaterWell-4, C-01, C-02 and C-03, met the drinking water limits.

Table 6-38: Assessment of the List of Minimum Parameters to be considered as per the YSKBKKHY

Parameters	Unit	WaterWell-1	WaterWell-2		WaterWell-3		WaterWell-4		WaterWell-5		SK-01		Ç-01	Ç-02	Ç-03
		Feb 2022	Feb 2022	Mar 2022	Feb 2022	Mar 2022	Feb 2022	Mar 2022	Feb 2022	Mar 2022	Feb 2022	Mar 2022	Mar 2022	Mar 2022	Mar 2022
Arsenic	*mg/l*	0.0026	0.0143	0.0138	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0035	0.0040	<0.0005	<0.0005	<0.0005
Cadmium	*mg/l*	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Lead	*mg/l*	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Mercury	*mg/l*	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Ammonia (as N)	*mg/l*	11.6	8.75	5.56	<0.021	<0.016	<0.021	<0.016	<0.021	<0.016	<0.021	<0.016	<0.016	<0.016	<0.016
Chloride	*mg/l*	31.6	102	53.7	25.4	27.9	45.3	24.3	24.9	26.9	29.9	13.6	42.4	34.7	24.3
Sulphate as SO_4	*mg/l*	-	-	9.87	-	20.5	-	4.31	-	5.33	61.3	21.4	46.5	57.2	6.13
Nitrites	*mg/l*	-	-	0.0190	-	<0.002	-	<0.002	-	0.0550	<0.32	<0.002	<0.002	<0.002	<0.002
Tetrachloroethylene	*mg/l*	-	-	<0.0001	-	<0.0001	-	<0.0001	-	<0.0001	<0.1	<0.0001	<0.0001	<0.0001	<0.0001
Trichloroethylene	*mg/l*	-	-	<0.0001	-	<0.0001	-	<0.0001	-	<0.0001	<0.1	<0.0001	<0.0001	<0.0001	<0.0001
Total Phosphorus as P	*mg/l*	-	-	0.1160	-	<0.005	-	<0.005	-	<0.005	<0.1	<0.005	<0.005	<0.005	<0.005
Electrical Conductivity @25°C	*µS/cm*	2690	1119	1026	705	678	861	768	714	682	684	569	365	815	595

Table 6-39: Assessment of Groundwater Sampling Locations against Drinking Water Standards

	Parameters	Units	ITASHY	EU Standards	WHO Standards	WaterWell-1	WaterWell-2		WaterWell-3		WaterWell-4		WaterWell-5		SK-01		Ç-01	Ç-02	Ç-03
						Feb 2022	Feb 2022	Mar 2022	Feb 2022	Mar 2022	Feb 2022	Mar 2022	Feb 2022	Mar 2022	Feb 2022	Mar 2022	Mar 2022	Mar 2022	Mar 2022
Chemical Parameters	Antimony	µg/l	5	5	20	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Acrylamide	µg/l	0.1	0.1	0.5		-	<0.1	-	<0.1	-	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Arsenic	µg/l	10	10	10	2.58	14.29	13.84	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.52	3.95	<0.5	<0.5	<0.5
	Benzene	µg/l	1	1	10	-	-	<0.1	-	<0.1	-	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Benzopyrene	µg/l	0.01	0.01	0.7	-	-	<0.005	-	<0.005	-	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Boron	mg/l	1	1	2.4	-	-	0.2685	-	<0.02	-	<0.02	-	<0.02	0.1080	0.0712	<0.02	0.0237	<0.02
	Bromate	µg/l	10	10	10	-	-	<10	-	<10	-	<10	-	<10	<10	<10	<10	<10	<10
	Cadmium	µg/l	5	5	3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Chromium	µg/l	50	50	50	<1	<1	<1	<1	<1	<1	<1	<1	<1	3.88	<1	<1	<1	<1
	Copper	mg/l	2	2	2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0014	<0.001	<0.001	<0.001	<0.001
	Cyanide	µg/l	50	50	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	1.2-Dichloroethane	µg/l	3	3	30	-	-	<0.1	-	<0.1	-	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Epichlorohydrin	µg/l	0.1	0.1	0.4	-	-	<0.1	-	<0.1	-	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Fluoride (F-)	mg/l	1.5	1.5	1.5	0.51	0.20	<0.1	0.38	0.1890	0.20	<0.1	0.26	0.4110	0.306	0.1520	0.1640	0.1910	<0.1
	Lead	µg/l	10	10	10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Mercury	µg/l	1	1	6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Nickel	µg/l	20	20	70	6.44	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
	Nitrate (NO3)	mg/l	50	50	50	-	-	<0.45	-	13.9	-	6.34	-	0.7510	15.4	7.49	0.8220	34.2	0.5380
	Nitrite (NO2)	mg/l	0.5	0.5	3	-	-	0.0190	-	<0.002	-	<0.002	-	0.0550	<0.32	<0.002	<0.002	<0.002	<0.002
	Pesticides	µg/l	0.1	0.1	-	-	-	<0.005	-	<0.005	-	<0.005	-	<0.005	<0.1	<0.005	<0.005	<0.005	<0.005
	Total Pesticides	µg/l	0.5	0.5	-	-	-	<0.1	-	<0.1	-	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Polycyclic Aromatic Hydrocarbons	µg/l	0.1	0.1	-	-	-	<0.005	-	<0.005	-	<0.005	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Selenium	µg/l	10	10	40	1.40	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.22	0.61	<0.5	<0.5	<0.5
	Tetrachloroethane and Trichloroethane	µg/l	10	10	40. 20	-	-	<0.1	-	<0.1	-	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Trihalomethanes-Total	µg/l	100	100	-	-	-	<0.1	-	<0.1	-	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Vinyl Chloride (C2H3CL /H2C)	µg/l	0.5	0.5	0.3	-	-	<0.1	-	<0.1	-	<0.1	-	<0.1	-	<0.1	<0.1	<0.1	<0.1
Indicator Parameters	Aluminium (Al)	µg/L	200	200	-	320.24	26.30	120.98	<20	20.32	<20	<20	<20	<20	275.00	466.78	60.66	<20	91.59
	Ammonium (NH4)	mg/L	0.5	0.5	-	11.6	8.75	7.17	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021	<0.021
	Chloride (Cl)	mg/L	250	250	-	31.6	102.0	53.7	25.4	27.9	45.3	24.3	24.9	26.9	29.9	13.6	42.4	34.7	24.3
	Conductivity 20°C	µS/cm	2500	2500	-	2690	1119	1026	705	678	861	768	714	682	684	569	365	815	595
	pH	pH unit	6.5 - 9.5	6.5 - 9.5	-	12.5	6.24	7.11	8.25	7.18	8.70	7.47	7.98	7.07	6.95	7.66	7.67	7.04	7.18
	Iron (Fe)	µg/L	200	200	-	-	-	1250.3	-	25.3	-	12.2	-	25.6	209.0	745.1	32.1	<5	53.1
	Manganese (Mn)	µg/L	50	50	-	2.2	225.7	232.3	<0.5	1.8	31.3	31.7	1104.0	1026.7	2.9	23.3	0.9	<0.5	1.0
	Sulphate (SO4)	mg/L	250	250	-	-	-	9.9	-	20.5	-	4.3	-	5.3	61.3	21.4	46.5	57.2	6.1
	Sodium (Na)	mg/L	200	200	-	-	-	72.2	-	13.5	-	30.4	-	18.6	53.1	42.5	22.2	19.7	21.2

In terms of irrigation water quality standards (see Figure 6-47) for March 2022 program, WaterWell-5, WaterWell-3, C-03, SK-01, and C-01 proved to be C2S1, Medium Salinity - Low Sodium whereas the remaining surface water points, namely WaterWell-2, C-02, and WaterWell-04, proved to be C3S1, High Salinity – Low Sodium.

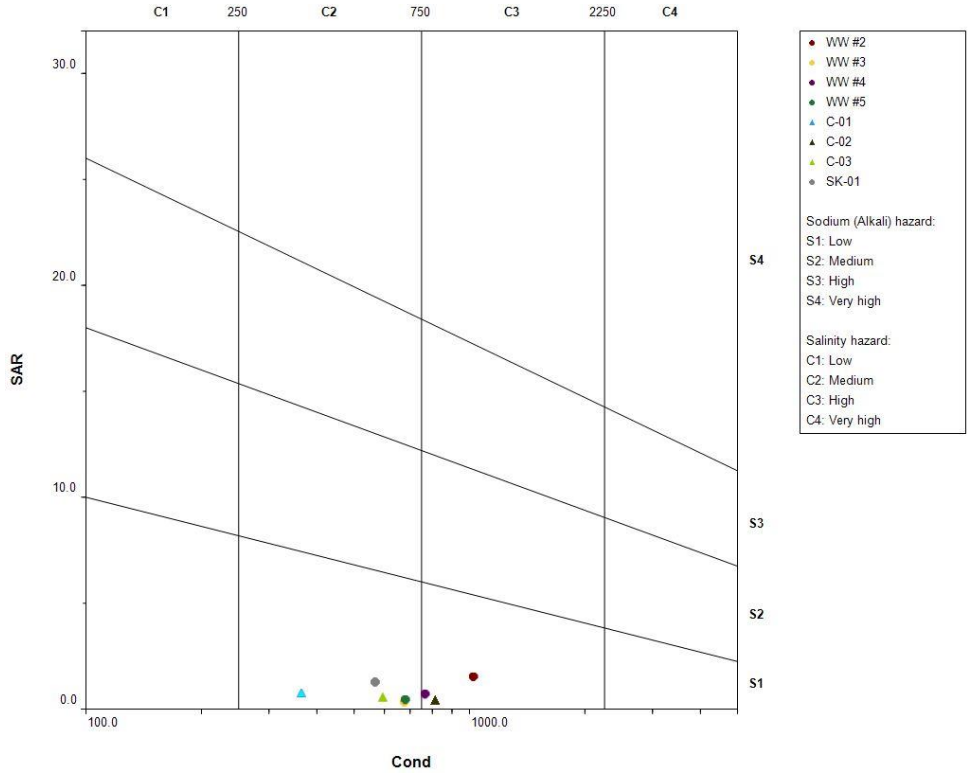


Figure 6-47: Wilcox Diagram for Groundwater Locations

Sensitivity Assessment

Sensitivity features	Supported by	Sensitivity value
Presence of shallow aquifer in AoI. Presence of exploited aquifer. Presence of groundwater exploitation in AoI. Presence of high rock permeability in AoI. Presence of aquifer vulnerability in AoI.	Primary data and secondary data	High

6.2.2 Biological

6.2.2.1 Flora

Table 6-40: General overview of Flora

Description	The plant species composing the terrestrial habitats of the region and study area.
Study Area	**RSA:** The Western Euxine region within the "PA0422. Euxine-Colchic broadleaf forests"[8]. **Rationale:** Based on literature review, this is the regional broad area containing the geographically distinct plant species and habitats potentially occurring within and in the vicinity of the Project.
	AoI: 200 m buffer around the Project Area and along the ETL **Rationale:** Flora species are expected to be influenced by Project activities only in the immediate vicinity of the Project site.
Data sources	**Primary sources**: 3 field work campaigns: ■ conducted in April and May 2021 by Armada. ■ conducted in February and May 2022 by a local flora expert Prof. Hayri Duman on behalf of Golder.
	Secondary sources: Secondary sources came from scientific articles and grey literature.

Methodological approach

Data to describe the regional context (i.e., RSA) were collected through literature review (references reported in Chapter 13.0), whereas the local context (i.e., AoI) was assessed by both literature review and the gathering of field data.

A general assessment of the RSA was obtained from the literature to identify sensible flora species within its boundaries and provide the ecological and climatic context for flora distribution and its conservation status in the region.

An initial bibliographical search was carried out by the local flora expert Prof. Hayri Duman to identify sensitive flora species potentially found within the Project's AoI according to national and international published literature (see also Appendix F or additional details). The bibliographic data were then implemented with a field investigation campaign carried out by Prof. Duman under Golder coordination, which consisted in four sampling events (November 2021, December 2021, April 2022, and May 2022) to cover the Autumn-Winter and Spring-Summer periods. The field surveys were conducted in 14 sampling points of 400 m^2 each, scattered across the Project site to represent the different habitats identified within the AoI.

[8] According to Terrestrial ecoregions identified by WWF (http://www.worldwildlife.org/biomes)

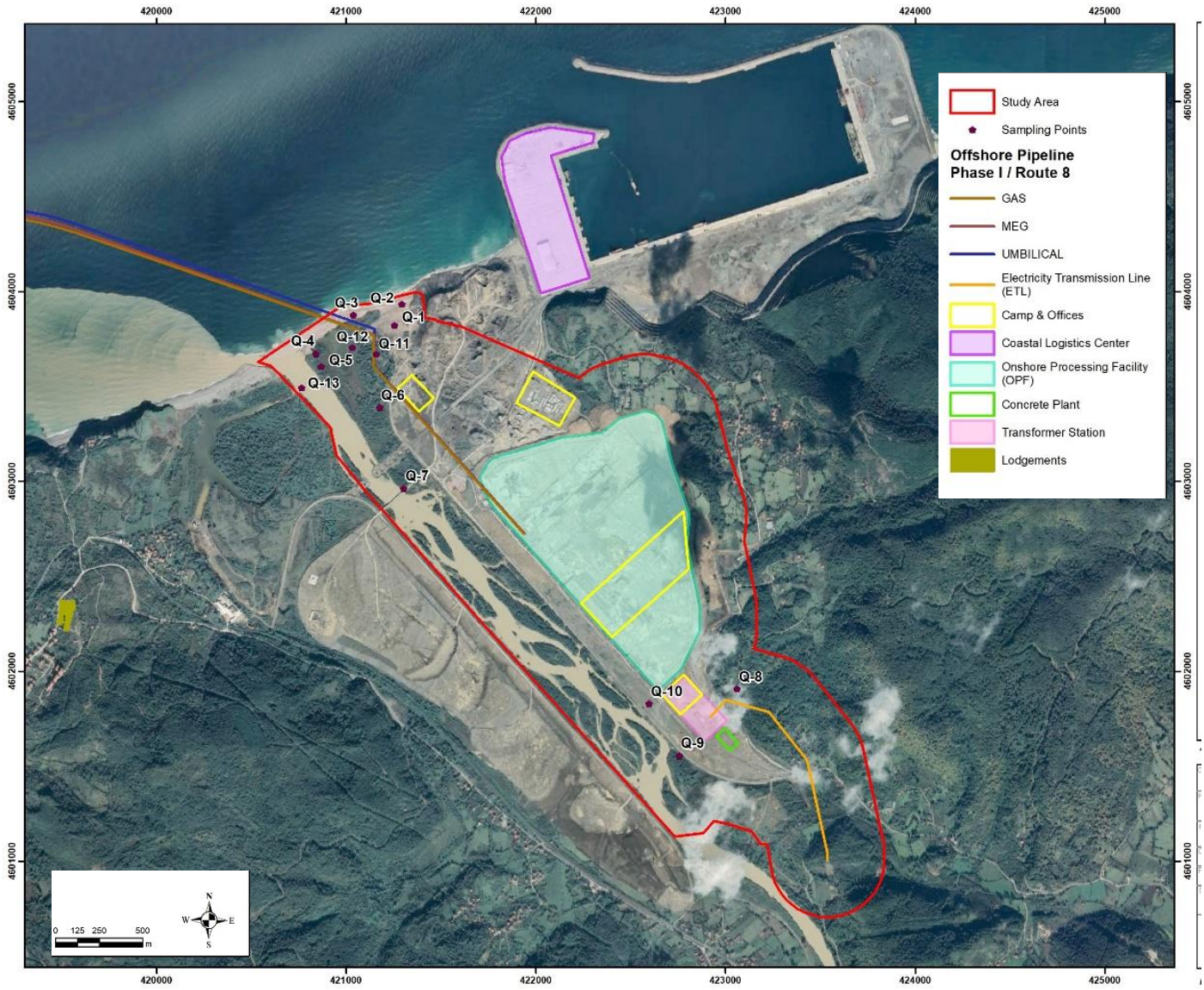


Figure 6-48: Flora AoI with sampling locations

The findings from field observations were used to produce a habitat-based species list which was then screened against national and international conservation datasets (e.g., “Red Data Book of Turkish Plants”, Bern Convention and CITES) to identify endemic, endangered and critically endangered species. The floristic composition at each sampling point was also used to identify the different habitats included in the AoI and to categorize them according to international habitat classification (EUNIS, 2022). The sensitivity of the observed flora was then evaluated considering the conservation status of each species and the impact factors these may be subjected to during construction, operation and decommissioning phases.

Regional context (RSA)

The Project terrestrial RSA corresponds to the terrestrial ecoregion “PA0422. Euxine-Colchic broadleaf forests”, which is considered part of the broader category “Temperate Broadleaf and Mixed Forests” (Figure 6-49). The ecoregion can be divided into two parts based on climate: a more humid Eastern Colchic region a relatively less humid Western Euxine region where the Project is located.

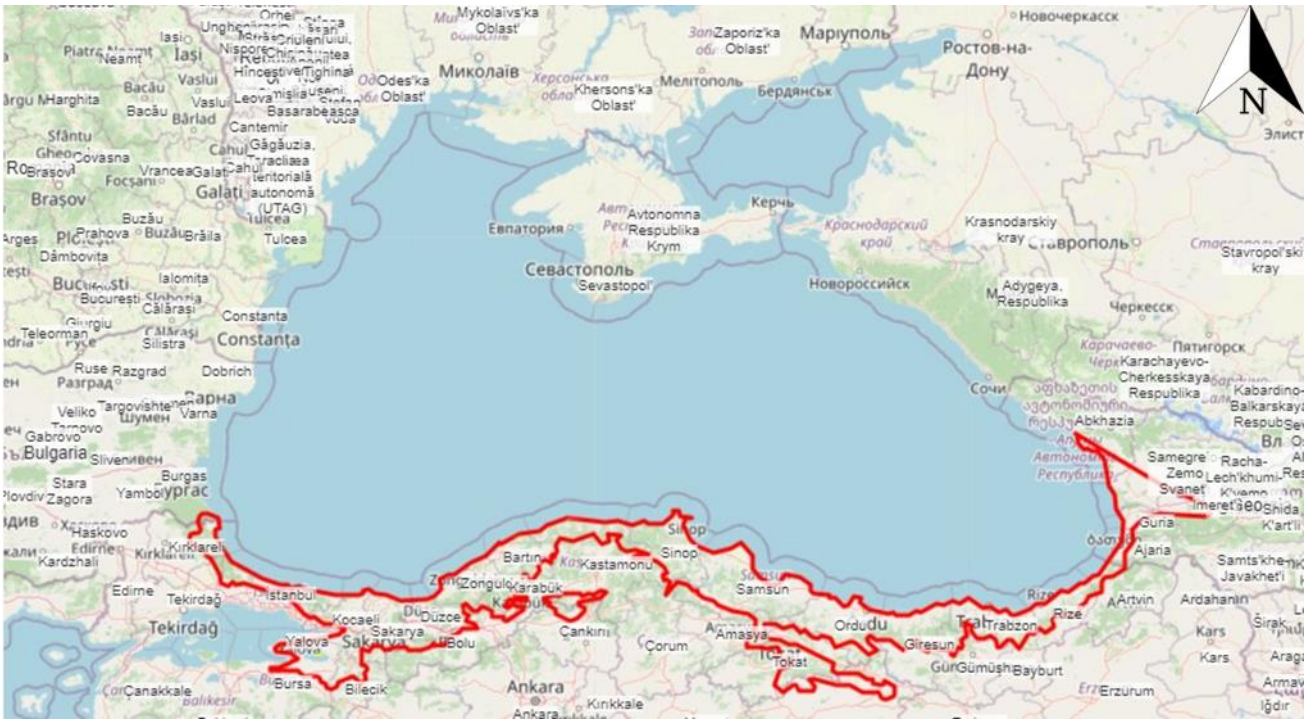


Figure 6-49: RSA – PA0422-Euxine-Colchic broadleaf forests

The Black Sea Region of Turkey (corresponding to the RSA) counts at least 277 endemic plant species with several more distributed across different regions (GDEIAPI, 2016).

As about 53% of the Turkish territory consists in farmland, the RSA also includes important semi-natural habitats and large areas of low intensity agriculture, defined as High Nature Value (HNV) farmland, which provide key habitats for wildlife and supports Turkey's rich biodiversity (EEA, 2010). These HNV farmlands consist in extensive crop and livestock production areas and extensive forest farming present mostly in mountain regions of Turkey, including the RSA (Figure 6-50)

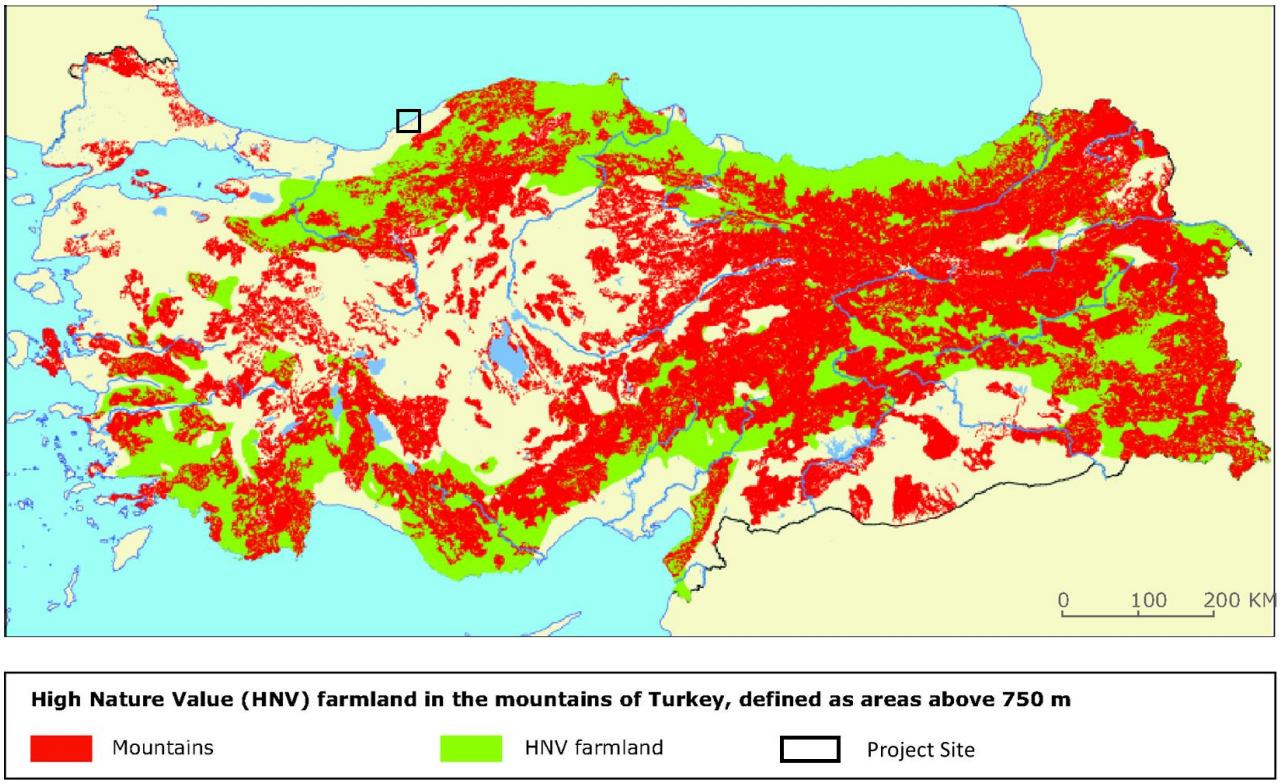


Figure 6-50: HVN farmland

Local context (AoI)

The field investigations identified 199 plant species within the Project's AoI (Appendix F), only six of these were considered as sensitive or potentially sensitive under national and/or international conservation classifications (Table 6-41).

Table 6-41: Sensitive plant species

Species	Local conservation status (Ekim *et al*., 2000)	IUCN Classification	Endemism	Status of population within the AoI
Centaurea kilaea	EN	Not Evaluated	X	4000
Heracleum platytaenium	LC	Not Evaluated	X	3
Peucedanum obtusifolium	VU	Not Evaluated	-	5
Pancratium maritimum	VU	LC	-	5000
Leucojum aestivum	VU	LC	-	1000
Cyclamen coum var. coum	CITES Appendix 2	Not Evaluated	-	100

The first four species reported in Table 6-41 were all found in the area identified as "Coastal stable dune grassland (grey dunes)" which is included in EUNIS Red List of Habitats (B1.4).

According to the literature (Ekim, 2000) the endemic *C. kilaea* (Figure 6-51) is strictly linked to the disappearing grey dune habitat and its numbers are constantly declining within Turkish territory. Similarly, *P. maritimum* (Figure 6-52) population has also seen a constant reduction, due to the loss of suitable habitat, putting this species in a vulnerable position nationally, despite the "LC" classification at a global level (IUCN).

Leucojum aestivum (Figure 6-53) is widespread in Europe from Ireland to northern Mediterranean (south France, Corsica, and Sardinia), and across east Europe to Iran. This species is considered rare in Turkey (Ekim, 2000) with a diminishing population, which determined the vulnerability of the species at a national level.

Figure 6-51: *Centaurea kilaea*

Figure 6-52: *Pancratium maritimum*

Figure 6-53: Leucojum aestivum

Heracleum platytaenium (Figure 6-54)is widespread andemic species with no indications of a diminishing population. Conversely, *Peucedanum obtusifolium* (**Figure 6-55**)shares similar reductions in numbers as per *C. kilaea* and *P. maritimum*, as well as the same habitat although it is only classified as vulnerable at a national level and, as per *H. platytaenium*, it is not the characterizing species of the area.

Figure 6-54: *Heracleum platytaenium*

Figure 6-55: *Peucedanum obtusifolium*

Cyclamen coum var. coum (Figure 6-56) appears to have stable populations in Turkey, although, the collection of wild specimens for the ornamental plant market required a regulation of the species' trade with its inclusion in Appendix II of CITES.

Figure 6-56: *Cyclamen coum var. coum*

Given the sensitivity of the grey dune habitat all specimens from its two most abundant species within the Project AoI (*C. kilaea*, and *P. maritimum*) were transplanted to a suitable and protected location in a preliminary mitigation measure, prior to site preparation operations. A specific Biodiversity Action Plan was prepared (Golder, 2022) which included all relevant baseline information and the methodological approach for the transplanting process. *H. platytaenium* and *P. obtusifolium* were not included in the transplanting as the few specimens present within the AoI were only identified in May 2022 and are positioned immediately outside the footprint of planned works.

Sensitivity Assessment

Sensitivity features	Supported by	Sensitivity value
Limited Presence (1) of threatened species of flora. Limited presence (1) of protected species Limited presence of endemic or restricted range species of flora.	Primary data and secondary data	**Medium**

6.2.2.2 Invertebrates

Table 6-42: General overview of Invertebrates

Description	Any animal, aquatic and/or terrestrial, lacking a vertebral column, in all of its life stages. These comprise 30 different phyla, and nearly 95% of all animal species.
Study Area	**RSA:** The Western Euxine region within the "PA0422. Euxine-Colchic broadleaf forests and the freshwater ecoregion "430 Northern Anatolia"[9], which comprises temperate coastal rivers and estuaries of north-central and western Anatolian Turkey. **Rationale:** Based on literature review, these are the regional broad areas containing the geographically distinct terrestrial and freshwater habitats potentially occurring within and in the vicinity of the Project.

[9] According to Freshwater Ecoregions Of The World (FEOW) (https://www.feow.org/)

	AoI: 1000 m buffer around the Project Area and ETL **Rationale:** This taxonomic group includes a variety of species with different distribution ranges and that can be found in a number of different habitats. The AoI was selected, in a conservative manner, considering all species (terrestrial and aquatic) that could be impacted by the different Project actions.
Data sources	**Primary sources**: field work campaigns: ■ conducted in January, February, March, and May 2022 by local expert Dr. Şafak Bulut. ■ conducted in March and May 2022 by local freshwater expert prof. Aydin Akbulut.
	Secondary sources: Secondary sources came from scientific articles and grey literature.

Methodological approach

Data to describe the regional context (i.e., RSA) were collected through literature review (references reported in Chapter 13.0), whereas the local context (i.e., AoI) was assessed by both literature review and the gathering of field data.

Terrestrial invertebrates were surveyed through visual inspections and identification at different fauna survey locations (Figure 6-57) within the Project AoI in four occasions, from January (Winter) to May (Spring) 2022.

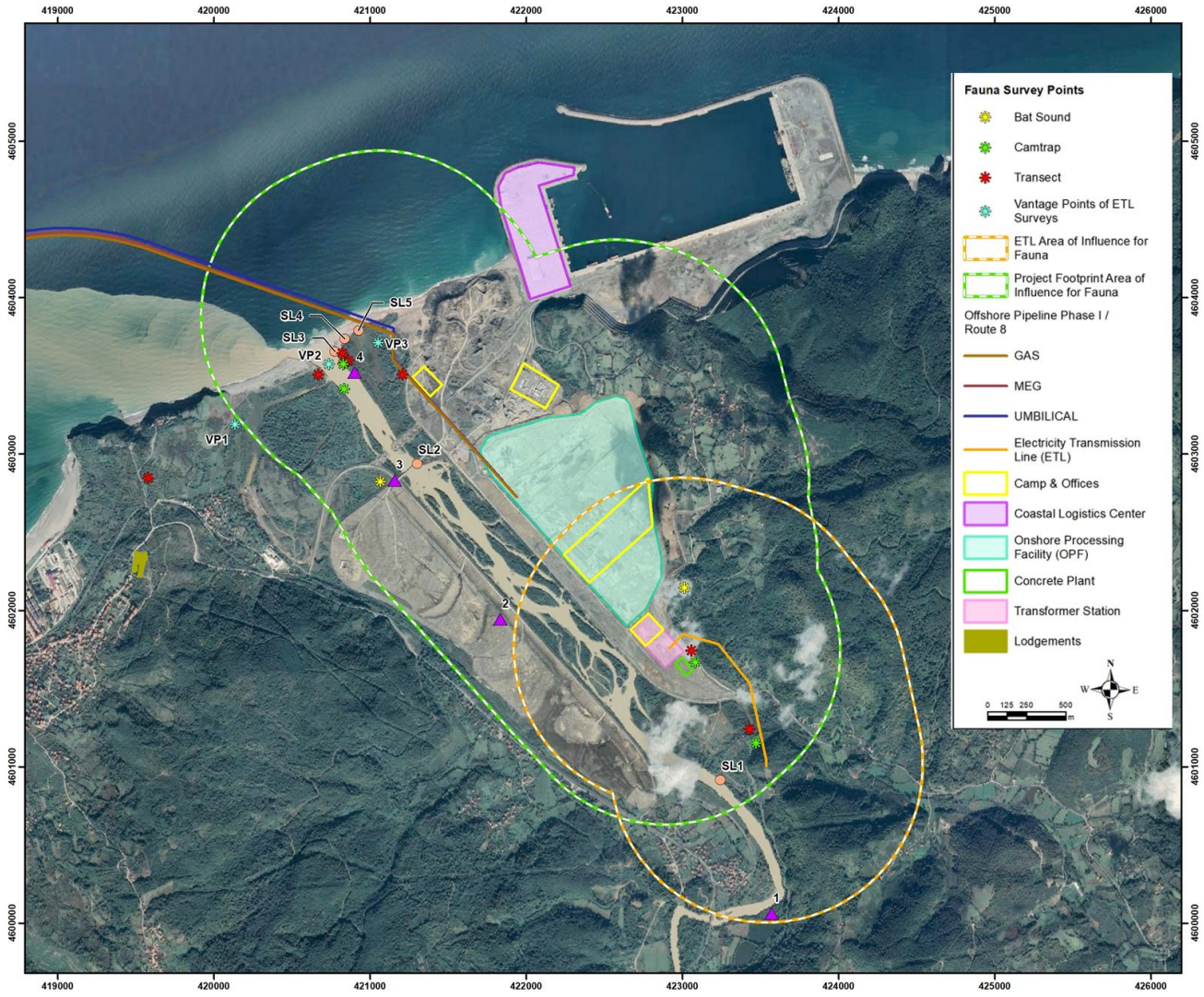


Figure 6-57: Fauna sampling stations

Aquatic invertebrates, including those having only an aquatic life stage, were sampled from four stations along Yenice River and the coastal pond on the Project area (Figure 6-58) in two sampling periods, March and May 2022 (respectively, late winter and spring). The report prepared by the local expert is available in Appendix G.

Figure 6-58: Freshwater Sampling Stations

Invertebrate specimens were collected using a scoop net (Figure 6-59) in the three river stations and a Peterson Grap (Figure 6-60) for the pond station (Station 4), sampling was replicated three times at each station and sampled material was sieved (mesh size 0.5mm) and sorted for subsequent identification in the laboratory.

Figure 6-59: Scoop net sampling in Yenice River

Figure 6-60: Peterson Grap sampling in the coastal pond

The collected data on abundance, diversity, and distribution of aquatic invertebrate taxonomic groups and species was then used to calculate four different biotic indices (Shannon-Wiener Index (H´), BWMP (Biological Monitoring Working Party), ASPT (Average Score Per Taxon), and FBI (Family Biotic Index)) which gave an indication of the biological water quality of Yenice River and the coastal pond. The values obtained concluded that Yenice River is in a moderate ecology state while the pond ecological status has been evaluated as poor. Further details about the evaluation of biotic indices can be found in Appendix G.

Regional context (RSA)

There are an identified 30.000 invertebrate species present in Turkey although the real number is thought to potentially reach the 80.000 species (GDEIAPI, 2016). This uncertainty makes it difficult to assess the number of species present within the RSA from bibliographical data as this is represented as the combination of both terrestrial and freshwater RSAs (Figure 6-61). Despite the uncertainty on the actual number of species, invertebrates remain a main contributor to Turkey's rich biodiversity in the different regions, supported by a high rate of endemism. Amongst them, only 59 endemic Lepidoptera (Butterflies) species have been reported as both endemic and either rare or endangered (GDEIAPI, 2016). This group is also fundamental to the food chain in a wide range of terrestrial and aquatic habitats.

Figure 6-61: RSA for invertebrate species

Local context (AoI)

The terrestrial invertebrates that have been observed within the Project AoI both through the specific surveys and recorded historically from literature sources are reported in Appendix H. Field survey focused on two main groups, namely Lepidoptera (Butterflies) and Odonata (Dragonflies) as these represent a widely used indicator of environmental health. No endangered and/or endemic species were identified locally, only one lepidoptera species, *Lycaena dispar* (Large Copper, Figure 6-62), was reported as Near Threatened according to IUCN and the Red Book of Butterflies in Turkey (Karaçetin and Welch, 2011).

Figure 6-62: *Lycaena dispar* (Large Copper)

The 589 freshwater aquatic invertebrates sampled in Yenice River and the coastal pond belonged to 22 species from four systematic groups, in order of abundance Arthropoda-Insecta (14), Arthropoda-Crustacea (4), Mollusca (3) and Anellida (2). A comprehensive list of collected and expected (from literature) species is reported in Appendix G.

Taxa of Annelida phylum and members of the Chrinomidae family of class Diptera were predominantly found at the pond station (4th station), these groups are generally associated to stagnant water, low in oxygen, with muddy bottoms and are often found in polluted environments. Conversely, members of orders such as Trichoptera, Odonato and Ephemeroptera live in gravelly and oxygen-rich environments ad have been found in river stations. This highlights the differences of the two habitats and suggests a more degraded state of the pond compared to the river, which is confirmed by the results from the biotic indices calculations (see Chapter 6.2.2.8).

Sensitivity Assessment

Sensitivity features	Supported by	Sensitivity value
■ Limited number (1) of threatened species of freshwater aquatic invertebrates. ■ Absence of endemic or restricted range species of freshwater aquatic invertebrates.	Primary data and secondary data	**Medium-low**

6.2.2.3 Freshwater fish

Description	Fish are aquatic animals which have gills. They are found in almost all aquatic environments and have a great diversity. Freshwater fish include species that evolved to survive exclusively in freshwater as well as those species that can tolerate different levels of salinity and also spend part of their life in salt water. It includes lampreys, hagfish, bony fish and cartilaginous fish.
Study Area	**RSA:** The freshwater ecoregion "430 Northern Anatolia"[10], which comprises temperate coastal rivers and estuaries of north-central and western Anatolian Turkey. **Rationale:** This freshwater ecoregion provides the general species and habitats potentially occurring within and in the vicinity of the Project Site.
	AoI: The terminal 4 km of Yenice River, including ponds and estuary ramifications. **Rationale:** None of the Project's activities have been considered to influence the abundance and distribution of freshwater fish species further upstream than 4 km from the reiver mouth.
Data sources	**Primary sources**: Specific field work campaigns: ■ eDNA analysis from water samples collected by Golder in February 2022 ■ conducted in February, March and May 2022 by local freshwater expert prof. Aydin Akbulut.
	Secondary sources: Secondary sources came from scientific articles and grey literature.

Methodological approach

Data to describe the regional context (i.e., RSA) were collected through literature review (references reported in Chapter 13.0, whereas the local context (i.e., AoI) was assessed by both literature review and the gathering of field data.

Preliminary approach

Fish species presence in both the RSA and AoI was first assessed through a literature review and a preliminary sampling event in February 2022 with the use of electrofishing technique in two locations in Yenice River. In this occasion samples were also collected for eDNA analysis, water was gathered from five locations (3 in the river and 2 in the coastal pond, Figure 6-63), and processed in-situ according to the instructions provided by the lab (Figure 6-64 and Figure 6-65). The obtained filters with genetic material form the water were then preserved and delivered to the laboratories of the Agrigenomics Hub (AgriGx) at Ankara University. The samples were then analysed and compared to genetic databases to identify the presence of genetic material from endemic and endangered fish species reported in the area from specific literature (Table 6-43).

[10] According to Freshwater Ecoregions Of The World (FEOW) (https://www.feow.org/)

Table 6-43: Target fish species for eDNA analysis

Species	IUCN Red List Classification	Endemic	Migrant
LEUCISCIDAE			
Alburnoides turani	NE	Endemic	--
CYPRINIDAE			
Capoeta tinca	LC	Endemic	--
GOBIONIDAE			
Gobio kizilirmakensis	NE	Endemic	--
NEMACHEILIDAE			
Oxynoemachelius banarescui	NT	Endemic	--
GOBIIDAE			
Ponticola turani	VU	Endemic	--
ACIPENSERIDAE			
Huso huso	CR	--	Migrant
Accipenser gueldenstaedtii	CR	--	Migrant

Figure 6-63: eDNA sampling points and fish sampling locations

Figure 6-64: Water collection for eDNA samples

Figure 6-65: In-situ preparation of samples with genetic material.

Fish Survey Campaign

Fish surveys were conducted in three stations in Yenice River, and one in the coastal pond (Figure 6-58), and were repeated in two periods, March (late winter) and May (spring) 2022. River surveys consisted in a 30 min long electrofishing sampling using a portable electro-shocker, a device that generates a small electric field around the surveyor to stun the fish and allow its collection with a scoop net (**Figure 6-66**).

Electrofishing technique was not deemed suitable in the coastal pond due to its muddy bottom and deeper waters. Fish nets were used in this habitat, 150 m long nets were deployed in the water crossing the pond and left in place for 24 hours (Figure 6-67). The fish collected was then identified to the lowest taxonomic level, measured (length, weight, etc.) and released, only one individual per species was kept for laboratory confirmation of species and genetic samples. Further details can be found in the expert's report added in Appendix G.

Figure 6-66: Electrofishing survey of Yenice River

Figure 6-67: Net sampling in coastal pond

Regional context (RSA)

The Project freshwater RSA corresponds to the freshwater ecoregion “430 Northern Anatolia”[11] characterized by temperate coastal rivers which drainages flowing into the Black Sea. It comprises the drainages of north-central and western Anatolian Turkey, from the Sakarya basin in the west to the Kizil and Kelkit basins in the east (Figure 6-68).

Figure 6-68: Northern Anatolia Freshwater Ecoregion

Turkey can count a total of 409 freshwater fish species, with about 194 endemic species, mostly due to speciation in isolated mountain lakes and water basins (Çiçek *et al*., 2018).

There is a very limited number of studies on the fish species from the streams of the Western Black Sea region, within the RSA there is only one species classified as CR (“Critically Endangered”) by IUCN, *Cobitis splendens,* which has been described in only one stream about 16 km east of Akçakoca (west of Zonguldak area). No endangered species were reported within the RSA (IUCN), although, between 10% and 20% of the species in the area are endemic (Çiçek *et al*., 2018). According to Çiçek *et al*. (2018) the number of endangered and critically endangered species under the IUCN classification parameters could be up to 30% of the total endemic fish. In addition, 29 exotic fish species have been also introduced to freshwater systems across Turkey.

Local context (AoI)

The results from the field investigation campaign confirmed the absence of endangered and critically endangered fish species among the 16 encountered within the AoI. Only two endemic species were recorded during fish surveys, *Capoeta tinca* (Figure 6-69) and *Cobitis simplicispina* (Figure 6-70), both collected with the

[11] According to Freshwater Ecoregions Of The World (FEOW) (https://www.feow.org/)

electrofishing technique in Yenice River stations, while a third endemic species, *Alburnoides turani* (Figure 6-71) was detected with the eDNA analysis of water samples from the river.

Figure 6-69: *Capoeta tinca*

Figure 6-70: *Cobitis simplicispina*

Figure 6-71: *Alburnoides turani* [12]

Despite the absence of endangered species, the presence of endemic species should be considered as an indication of the ecological importance of freshwater habitat around the Project site. In particular, *Alburnoides turani,* has been discovered and described in Yenice Basin only in 2020.

Finally, two introduced species were also found, *Carassius gibelio* (Prussian carp) in the coastal pond, and *Pseudorasbora parva* (Topmouth gudgeon) in the estuary area (station 3).

Sensitivity Assessment

Sensitivity features	Supported by	Sensitivity value
Absence threatened fish species Presence (3) of endemic fish species Presence (2) of introduced species	Primary data and secondary data	**Medium**

6.2.2.4 Amphibians

Description	Cold-blooded vertebrate animals that have, at least, an aquatic gill-breathing larval stage. This class comprises frogs, toads, newts, salamanders, and caecilians and inhabit a wide variety of habitats, with most species living within terrestrial, fossorial, arboreal or freshwater aquatic ecosystems. Although, there is a need for freshwater habitats across nearly all species.
Study Area	**RSA:** The freshwater ecoregion “430 Northern Anatolia”, which comprises temperate coastal rivers and estuaries of north-central and western Anatolian Turkey. **Rationale:** This freshwater ecoregion provides the general species and habitats potentially occurring within and in the vicinity of the Project Site.

[12] Kaya, Cüneyt, (2020). Spirlins of the southern Black Sea basin, with the description of a new species (Teleostei: Leuciscidae), Zootaxa. https://doi.org/10.11646/zootaxa.4763.3.6

	AoI: The terminal 4 km of Yenice River, including the coastal pond and estuary. **Rationale:** None of the Project's activities have been determined to influence the abundance and distribution of amphibian species inhabiting freshwater bodies further upstream than 4 km from the reiver mouth.
Data sources	**Primary sources**: field work campaigns: ■ conducted in April and May 2021 by Armada. ■ conducted in January, February, March, and May 2022 by local expert Dr. Şafak Bulut ■ eDNA analysis from water samples collected by Golder in February 2022.
	Secondary sources: Secondary sources came from scientific articles and grey literature.

Methodological approach

Data to describe the regional context (i.e., RSA) were collected through literature review (references reported in Chapter 13.0, whereas the local context (i.e., AoI) was assessed by both literature review and the gathering of field data.

Amphibians field surveys were conducted in all suitable habitats (e.g., puddles, irrigation channels, arcs, humid areas, etc.) within the appropriate AoI for this group (Figure 6-72). Observation efforts were concentrated especially at temporary riparian zones and at sites where the water flow was very low and/or stagnant. The bottoms of plants and stones were checked, the detected individuals were identified via direct observation, where a clear identification was not possible the individuals were captured, photographed, and released. Photo identification was carried out at a later date. The full fauna report is available in Appendix H.

Figure 6-72: Examples of suitable habitats for amphibians (small slow-flowing creek and paddle)

To further asses the presence of critical species within the freshwater habitats of the Project area, water samples were collected ad tested for the presence of genetic material (eDNA analysis, as described in the previous section) belonging to a NT endemic amphibian species known, from literature, to be present in the region (*Triturus anatolicus*, Anatolian crested newt).

Regional context (RSA)

No CR or EN amphibian species were reported in the official IUCN lists within the RSA (IUCN; Kaya *et al*., 2012). A total of 35 amphibian species, including 12 endemic, are present in Turkey with about ten species, of which one endemic (*Triturus anatolicus*), possibly occurring in the RSA.

Local context (AoI)

The data collection, both from the field and literature, within the Project's AoI confirmed the presence of 8 amphibian species in the area (Table 6-44). Only one endemic species (*Triturus anatolicus*, Figure 6-73) was found and its presence in Yenice River was also confirmed by the genetic material detected through eDNA analysis (Appendix I).

Table 6-44: Amphibian species within the Project's AoI

SCIENTIFIC NAME	ENGLISH NAME	IUCN Classification	Endemism
Rana dalmatina	Agile Frog	LC	-
Hyla orientalis	European Tree Fog	LC	-
Pseudepidalea variabilis	Green Toad	DD	-
Pelophylax ridibundus	Eurasian Marsh frog	LC	-
Bufo bufo	Common Toad	LC	-
Ommatotriton nesterovi	North-western Banded Newt	LC	-
Lissotriton vulgaris	Smooth newt	LC	-
Triturus anatolicus	Anatolian Crested Newt	LC	Endemic

Figure 6-73: *Triturus anatolicus* (image from Wielstra and Arntzen, 2016)

A complete list of the species can be found in the report from Dr. Şafak Bulut (Appendix H), where is also reported the threat/protection state of each species according to national and international classifications (i.e., Bern Convention, CITES, IUCN, and the Turkish Central Hunting Commission (MAK) Decision). According to the the international conventions and or national regulations a total of 8 species inhabiting the AoI resulted under protection according to.

The field investigations also identified the presence of areas, within the Project's AoI, deemed suitable for the spawning of the detected species. These areas should be carefully managed during spring seasons at the different Project phases.

Sensitivity Assessment

Sensitivity features	Supported by	Sensitivity value
Absence of threatened amphibian species Presence of protected species (8) Limited presence (1) of endemic amphibian Presence of areas, within the Project's AoI, deemed suitable for the spawning of the amphibian	Primary data and secondary data	**Medium**

6.2.2.5 Reptiles

Description	Cold-blooded vertebrate animals
Study Area	**RSA** The Western Euxine region within the "PA0422. Euxine-Colchic broadleaf forests and the freshwater ecoregion "430 Northern Anatolia", which comprises temperate coastal rivers and estuaries of north-central and western Anatolian Turkey. **Rationale** Based on literature review, these are the regional broad areas containing the geographically distinct terrestrial and freshwater habitats potentially occurring within and in the vicinity of the Project.
	AoI: 1000 m buffer around the Project Area and along the ETL **Rationale:** As per other taxonomic groups, reptiles include species with different distribution ranges and inhabiting different habitats. The AoI was selected, in a conservative manner, considering all species that could be negatively impacted by the different Project actions.
Data sources	**Primary sources**: field work campaigns: ■ conducted in April and May 2021 by Armada. ■ conducted in April and May 2022 by local expert Dr. Şafak Bulut ■ conducted in May 2022 by local freshwater expert prof. Aydin Akbulut.
	Secondary sources: Secondary sources came from scientific articles and grey literature.

Methodological approach

Data to describe the regional context (i.e., RSA) were collected through literature review (references reported in Chapter 13.0), whereas the local context (i.e., AoI) was assessed by both literature review and the gathering of field data.

Field surveys for reptiles were carried on between 28 April and 2 May 2022.

Surveys were conducted mostly at areas with rocky-stony habitats and tree hollows to detect reptile species (turtles, lizards and snakes) at the study site. In accordance with the specific reptile study methodology bottoms of plants and stones were also checked, the detected individuals were collected by hand and catcher rod, when possible, and identified in the field to the lowest taxonomic level, before being photographed and released.

Regional context (RSA)

The extent of the RSA for reptile species is reported in Figure 6-61. Of the 145 reptilian species that can be found in Turkey, 22 are endemic, seven are EN, and 4 CR (Kurnaz, 2020). No EN or CR species were reported occurring within the RSA, according to the literature and IUCN lists, most of these species, in fact, were distributed in eastern Anatolia. Nevertheless, three endemic species could be present in the RSA (*Darevskia rudis, Darevskia bithynica,* and *Vipera (Pelias) barani*).

Local context (AoI)

Survey data and literature sources identified 17 species of reptiles within the Project's AoI, amongst these two endemic species, *Darevskia bithynica* and *Vipera (Pelias) barani*, were present while no identified species had a CR or EN conservation status (IUCN).

Figure 6-74: *Darevskia bithynica*

Figure 6-75: *Vipera barani*, male individual from kozluk, Zonguldak (Kumlutaş *et al*., 2013)

In addition to the results from the reptile specific field surveys, an individual of the European pond turtle *Emys orbicularis,* probably subspecies *hellenica*, has also been encountered in the costal pond during the freshwater fish survey campaign (Figure 6-76).

A complete list of the species can be found in the interim report from Dr. Şafak Bulut, together with the threat/protection state of each species according to national and international classifications (i.e., Bern Convention, CITES, IUCN, and the Turkish Central Hunting Commission (MAK) Decision). Totally 17 species inhabiting the AoI result under protection according to the international conventions and or national regulations.

Figure 6-76: *Emys orbicularis* (subspecies *hellenica*), dorsal and ventral view.

During the interviews with the personnel working in the field, Dr. Bulut determined that there was Tortoise activity in the field, from a species classified on IUCN's Red List as "VU" (*Testudo graeca*, Figure 6-77).

Figure 6-77: Spur-thighed Tortoise (Testudo graeca)

Sensitivity Assessment

Sensitivity features	Supported by	Sensitivity value
Absence of threatened species Presence of protected species (17) Limited presence (2) of endemic species	Primary data and secondary data	**Medium**

6.2.2.6 Birds

General Overview	Birds, including sea birds (or Marine birds) are any warm-blooded vertebrate of the class Aves, having a body covered with feathers, forelimbs modified into wings, scaly legs, a beak, and no teeth, and bearing young in a hard-shelled egg. Many birds are colonial, and some migrate after the breeding season.
Study area	**RSA:** The Anatolian peninsula and the Black Sea coastal area

	Rationale: As many birds migrate, the migration routes need to be taken into consideration when assessing the RSA area. The Project site is located along one of Turkey's migratory routes and therefore, it has the potential of influencing the migration of birds across the country and the surrounding areas. In addition, seabirds can also spend most of their time feeding with similar species, and different groups of the same species, in open sea and then rest and breed along the whole Black Sea coast.
	AoI: The Turkish Black Sea coastal area from Filyos Port to Adapazarı **Rationale:** The Project site is located on a migratory route that runs east-to-west along the north coast of Turkey, therefore any impact from a Project activity has the potential to influence the whole length of the route until it converges with the other routes from the south-east.
Data sources	**Primary sources**: field work campaigns: ■ conducted in April and May 2021 by Armada. ■ conducted in January, February, March, and May 2022 by local expert Dr. Şafak Bulut ■ eDNA analysis from water samples collected by Golder in February 2022
	Secondary sources: Secondary sources came from scientific articles, grey literature, and databases.

Methodological approach

Data to describe the regional context (i.e., RSA) were collected through literature review (references reported in Chapter 13.0), whereas the local context (i.e., AoI) was assessed by both literature review and the gathering of field data.

Field studies were conducted on January 28-30, February 11-13, and March 30-31, and 28 April-2 May at suitable habitats at the Project site and alternative areas to detect the bird species within the Study Area. The nests, eggs, youngster and adult birds in these areas were all recorded. The biological activities of the birds (breeding, feeding, on the move, etc.) at these areas were also recorded. Photographs of individuals of observed bird species were taken, when possible.

Bird surveys were based on observations from a fixed location from where the whole project area can be seen and all the birds flying can be detected, surveyors used a vantage point (VP) (on high ground) methodology for both migratory and breeding/resident species as described in the Onshore Wind Farm Guidance published by Scottish Natural Heritage (SNH). The VP methodology required a minimum of 36 hours of observations (SNH 2010).

Samples for eDNA analysis were collected as per Freshwater fish in Chapter 6.2.2.3.

Regional context (RSA)

A representation of the migration routes across the Anatolian peninsula is reported in Figure 6-78.

According to IUCN lists, there are about 8 CR, and 15 EN bird species in the areas around the Black Sea that are included in the RSA, among these three CR and five EN can be found within the Turkish national territory.

Figure 6-78: Main bird migration routes across Anatolian peninsula, with Project site (red dot), as reported in Dr. Bulut's report (Appendix H).

Local context (AoI)

A total of 263 bird species were identified within the Project's AoI according to field observations and literature data. A complete list of the species can be found in the interim report from Dr. Şafak Bulut, together with the threat/protection state of each species according to national and international classifications (i.e., Bern Convention, CITES, IUCN, and the Turkish Central Game Commission (MAK), and Bird Directive (2009/147/EC)).

Of these species, IUCN reports *Aquila nipalensis* (Steppe Eagle, Figure 6-79) as "CR", *Grus virgo* (Demoiselle Crane, Figure 6-80) as "EN" and *Oxyura leucocephala* (White-headed Duck, Figure 6-81) as Global-EN. The majority of bird species (175) resulted listed in Annex II of Bern Convention, and 56 were declared illegal to hunt within Turkish national territory (MAK, Annex I).

There are no endemic species identified within the AoI.

The eDNA analysis results also confirmed the presence of genetic material from *Grus virgo* in the samples from the coastal pond, and from *Oxyura leucocephala* in three out of the four sampling locations (i.e., Up-stream, Mid-Stream, and Pond). Despite their occasional presence in the AoI, the area has been deemed not suitable for breeding and overwintering of these critical species.

The Project's AoI is also included within the west boundary of an Important Bird Area (Amasra Kilyary KBA and IBA) the operation area and its vicinity appear to be used as staging post by the migratory birds.

Figure 6-79: *Aquila nipalensis* (image from IUCN)

Figure 6-80: *Grus virgo* (image from IUCN)

Figure 6-81: *Oxyura leucoc*ephala (image from birdsoftheworld.org)

Sensitivity Assessment

Sensitivity features	Supported by	Sensitivity value
Presence of threatened bird species (2 confirmed, 1 potential). Presence of protected species (175) Absence of endemic species.	Primary data and secondary data	**Medium-high**

6.2.2.7 Mammals

Description	Warm-blooded vertebrate animals of the class Mammalia, whose young feed on milk produced by the mother's mammary glands. Mammals have a diaphragm that separates the heart and lungs from the other internal organs, red blood cells that lack a nucleus, and usually hair or fur. All mammals but the monotremes bear live young. Mammals include rodents, cats, dogs, ungulates, cetaceans, and apes.
Study Area	**RSA:** The Western Euxine region within the "PA0422. Euxine-Colchic broadleaf forests". **Rationale:** Based on literature review, this is the regional broad area containing the geographically distinct plant species and habitats potentially occurring within and in the vicinity of the Project and therefore, including the mammal species adapted to live in these habitats.
	AoI: 1000 m buffer around the Project Area and along the ETL **Rationale:** This taxonomic group includes a variety of species with different distribution ranges and that can be found in a number of different habitats. The AoI

	was selected, in a conservative manner, considering all species that could be impacted by the different Project actions.
Data sources	**Primary sources**: field work campaigns: ■ conducted in April and May 2021 by Armada. ■ conducted in January, February, March, and May 2022 by local expert Dr. Şafak Bulut.
	Secondary sources: Secondary sources came from scientific articles and grey literature.

Methodological approach

Data to describe the regional context (i.e., RSA) were collected through literature review (references reported in Chapter 13.0), whereas the local context (i.e., AoI) was assessed by both literature review and the gathering of field data.

Field studies were carried out in and around the project site for mammalian species using camera traps (Figure 6-82), these were positioned in points where mammals were determined be more active (Figure 6-84). The devices remained operative from January 28 to 30, February 11 to 13, March 30 to 31, and the May 28 to 2 of 2022.

Additional Bat Voice Recorders (Figure 6-83) were also used to detect the presence of these animals. The devices were specially designed for bat sound frequencies and the sounds recorded were analysed with BatSound 4.2 and BatExplorer programs to isolate bat sounds. Species identification was made by comparing the BatExplorer program with the species suggestion and the literature data. Temporary roost scanning was also carried out in the old buildings around the area.

Figure 6-82: Camera Trap

Figure 6-83: Bat voice recorder

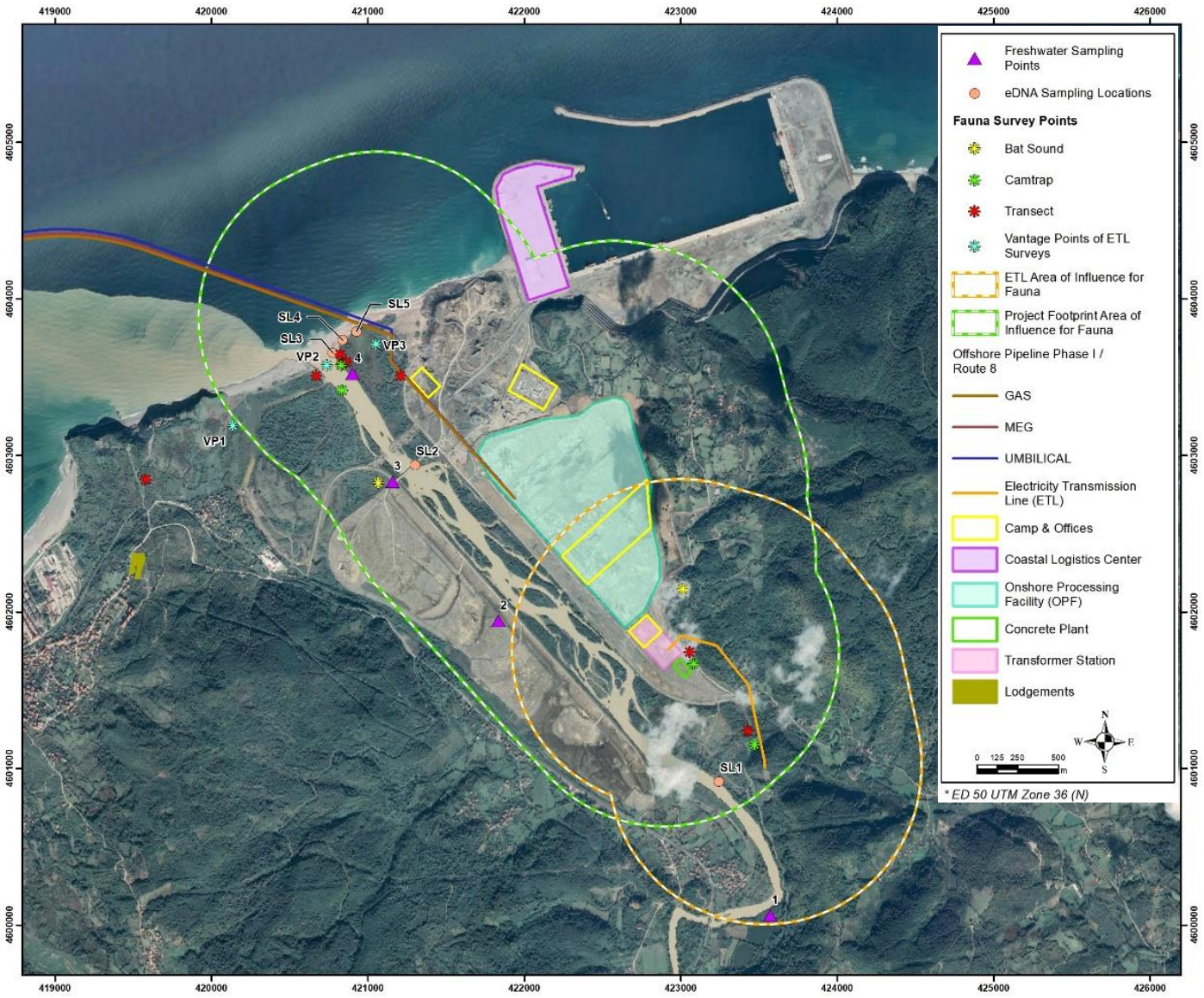


Figure 6-84: Position of Camera Traps (red dots) around the Project Site (yellow area)

Regional context (RSA)

Only one mammal species of the over 100 that can be found within the RSA is listed as EN, *Myomimus roachi* (Mouse-tailed Dormouse). The RSA includes only about five “Vulnerable” species.

Local context (AoI)

Of the 41 species of mammals identified in the Project’s AoI no endangered species were included. Only two “VU” bat species (i.e., *Myotis capaccinii* and *Miniopterus schreibersii*) were reported in the area. *Miniopterus schreibersii* was also identified through the Bat voice recorder (Figure 6-85). Although, the flying and feeding activities of bats have been determined to be more frequent around the Project site and not within it.

In addition to the IUCN classification, 24 species resulted protected under Bern Convention’s (14 under Annex II), and one, the European Otter (*Lutra lutra*) is included in Annex I of CITES as well as being recently assessed as ”Largely Depleted” (IUCN, The Green Status Assessment). Finally, the Least Weasel (*Mustela nivalis*) and

the Eurasian Badger (*Meles meles*) fall under the national protection from hunting (MAK, Annex I), while the European Hare (*Lepus europaeus*), the Golden Jackal (*Canis aureus*), the Red Fox (*Vulpes vulpes*), the Stone Marten (*Martes foina*), and the Wild Boar (*Sus scrofa*) are only allowed to be hunted in certain periods (MAK, Annex II).

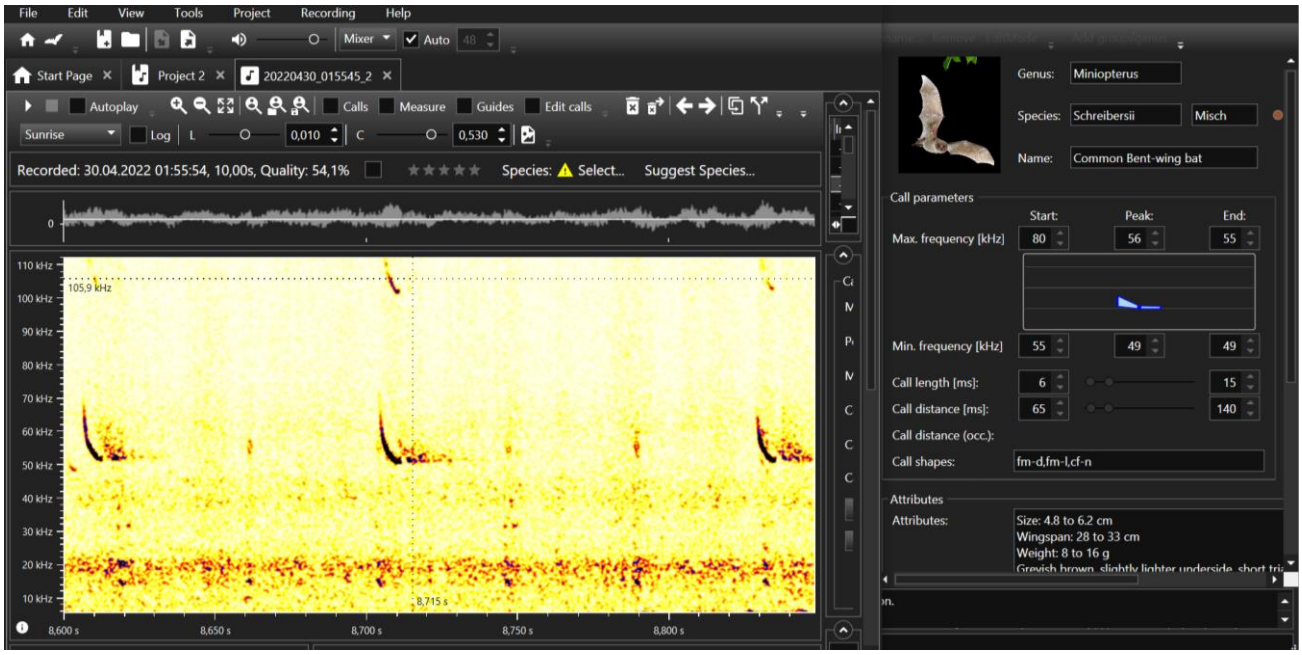


Figure 6-85: The identification of *Miniopterus schreibersii* with the bat voice identification software (BatExplorer)

The photo traps also suggested that the area is frequented by different species of wild mammals, in particular predators, some examples are given in Figure 6-86, Figure 6-87, and Figure 6-88.

Figure 6-86: *Golden Jackal (Canis aureus*)

Figure 6-87: Red Fox (*Vulpes vulpes*)

Figure 6-88: Stone Marten (*Martes foina*)

A complete list of the species can be found in the interim report from Dr. Şafak Bulut, together with the threat/protection state of each species according to national and international classifications (i.e., Bern Convention, CITES, IUCN, and the Turkish Central Hunting Commission (MAK) Decision).

Sensitivity Assessment

Sensitivity features	Supported by	Sensitivity value
Absence of threatened species Presence of protected species (24) including bat species, predators and scavengers, and European otter. Absence of endemic species.	Primary data and secondary data	**Medium**

6.2.2.8 Habitats

Description	Habitat is defined as a terrestrial, freshwater, or marine geographical unit or airway that supports assemblages of living organisms and their interactions with the non-living environment (IFC GN6).
Study Area	**RSA:** The Western Euxine region within the "PA0422. Euxine-Colchic broadleaf forests". The freshwater ecoregion "430 Northern Anatolia", which comprises temperate coastal rivers and estuaries of north-central and western Anatolian Turkey. **Rationale:** Based on literature review, this is the regional broad area containing the geographically distinct species and habitats potentially occurring within and in the vicinity of the Project. This freshwater ecoregion provides the general freshwater species and habitats potentially occurring within and in the vicinity of the Project Site.
	AoI: 1000 m buffer around the Project Area and along the ETL **Rationale:** Flora and fauna species characterizing the different habitats are expected to be influenced by Project activities only in the immediate vicinity of the Project site.
Data sources	**Primary sources**: field work campaigns: ■ conducted in April and May 2021 by Armada; ■ conducted in February and May 2022 by a local flora expert Prof. Hayri Duman on behalf of Golder. ■ conducted in January, February, March, and May 2022 by local expert Dr. Şafak Bulut; ■ Freshwater fish surveys conducted in March and May 2022 by local expert prof. Aydin Akbulut.
	Secondary sources: Secondary sources came from scientific articles and grey literature.

Methodological approach

Data to describe the regional context (i.e., RSA) were collected through literature review (references reported in Chapter 13.0), whereas the local context (i.e., AoI) was assessed by both literature review and the gathering of field data.

Alongside the general classification of the habitats obtained through the bibliography the field surveys carried out from the local experts provided an accurate description of the flora and fauna that was used to better characterize the habitats according to the international guidelines (EUNIS).

Two flora field surveys were carried out in November 2021, December 2021, April 2022, and May 2022 in order to identify the main flora species that characterize the different habitat types in Sakarya Gas Site Development area (see Chapter 6.2.2.1).

Sampling studies for aquatic organisms and habitats were carried out in March and May 2022 at four different stations, three in Yenice River and one in the coastal pond, located along the Project side. In addition, the freshwater invertebrate communities were here used to assess the ecological state of the freshwater habitats (Chapter 6.2.2.2).

Additional data on habitats and fauna were also collected during the specific field studies conducted in January, February, March, and May 2022 by the local fauna expert (Chapter 6.2.2.4, 6.2.2.5, 6.2.2.6, and 6.2.2.7)

Regional context (RSA)

The Euxine-Colchic broadleaf forests (PA0422) is temperate broadleaf and mixed forests ecoregion located along the southern shore of the Black Sea. The ecoregion extends along the thin coastal strip from the south-eastern corner of Bulgaria in the west, across the northern coast of Turkey, to Georgia in the east, where it wraps around the eastern end of the Black Sea (Ayyildiz *et al.*, 2011).

The unique ecosystems of the plains around the Black Sea (Colchian forests), are one of the most valuable biosphere genetic resources in the world and shelter many relict species such as *Parrotia persica*, *Gleditsia caspica*, *Zelkova carpinifolia*, and *Pterocarya fraxinifolia* (Naqinezhad *et al.*, 2018). The Colchic region has high rainfall, averaging 150–250 centimetres annually, with a maximum of more than 400 cm, and is home to some of Europe's temperate rainforests. The Euxine forests receive a little less rainfall with an average of 100 to 150 cm precipitation annually.

The Northern Anatolia (430) ecoregion comprises the drainages of north-central and western Anatolian Turkey, from the Sakarya basin in the west to the Kizil and Kelkit basins in the east. The ecoregion is bounded by the Black Sea to the north, the Western Transcaucasia ecoregion (433) to the east, the Upper Tigris-Euphrates (442), Southern Anatolia (432), and Central Anatolia (431) to the south, and Western Anatolia (429) and Thrace (423) to the west. The ecoregion lies on the Anatolian Plateau, incised by rivers along minor coastal plains. The coast is steep and rocky and rivers cascade through the coastal range of the Pontus, which forms an interrupted chain paralleling the coast, rising eastwards to more than 3500 m. Between the Sakarya and Kizil rivers lie four main ridges of the western Pontic Mountains: Küre, Bolu, Ilgaz, and Koroglu mountains. The Kizil and Yesil Irmak rivers have built up deltas in the sea from their heavy silt load (Akbulut *et al.*, 2022).

Local context (AoI)

The flora surveys conducted within the Project's AoI have identified 10 different EUNIS habitat classes:

- B1.4c Black Sea coastal stable dune grassland (grey dunes)

This habitat consists of *Centaurea kilaea* Boiss, a regional endemic species and non-endemic but rarely-occurring *Pancratium maritimum* and *Peucedanum obtusifolium*. The dominant species of the habitat are *Otanthus maritimus, Teucrium polium* and *Medicago marina*.

- C1.2 Permanent mesotrophic lakes, ponds and pools

This habitat was formed as a result of blockage of the branches of Filyos Creek. The habitat which resembles ponds consists of occasional *Phragmites australis, Thypha domingensis* and *Schoenoplectus lacustris* species.

- C2.2 Permanent non-tidal, fast, turbulent watercourses

This habitat type represents Filyos creek. The creek which flows fast at some locations and slows down at others consists of trees and herbaceous species with high water demand.

- C3.2 Water-fringing reedbeds and tall helophytes other than canes

This habitat represents tall herbaceous species developing by the banks of Filyos Creek and the ponds. The dominant species of the habitat are Phragmites australis and Thypha domingensis.

- D5.2 Beds of large sedges normally without free-standing

This habitat occurs in the flood zones of Filyos Creek. It represents marshland habitats which are under water in winter months and devoid of water in summer months (Photo 12). The dominant species of the habitat are Phragmites australis, Juncus littoralis, Juncus maritimus and Cyperus longus. In addition, Iris pseudacorus was found in this habitat.

- G1.1 Riparian and gallery woodland, with dominant Alnus, Betula, Populus or Salix

This habitat represents the riparian gallery forestry occurring on the river bank of Filyos Creek (Photo 14). The dominant species of the habitat are *Alnus glutinosa, Salix alba* and *Platanus orientalis*. *Heracleum platytaenium* which is widespread endemic is spread in the opening of this forests.

- G1.A Meso-and eutrophic Quercus, Fraxinus, Acer, Tilia, Ulmus and related woodland

This habitat represents the deciduous forestry occurring in the periphery of the project area. The dominant species of the habitat are *Carpinus betulus, Quercus hartwissiana* and *Quercus frainetto*. The habitat consists of *Cyclamen coum* which is included in CITES App. 2 list.

- G1.C Highly artificial broadleaved deciduous forestry

This modified habitat consists of *Fraxinus angustifolia* plantation.

- G2.8 Highly artificial broadleaved evergreen forestry

This modified habitat consists of *Eucalyptus camaldulensis* plantation.

The resulting map of the AoI according to the flora assessment and characterization is reported in Figure 6-89.

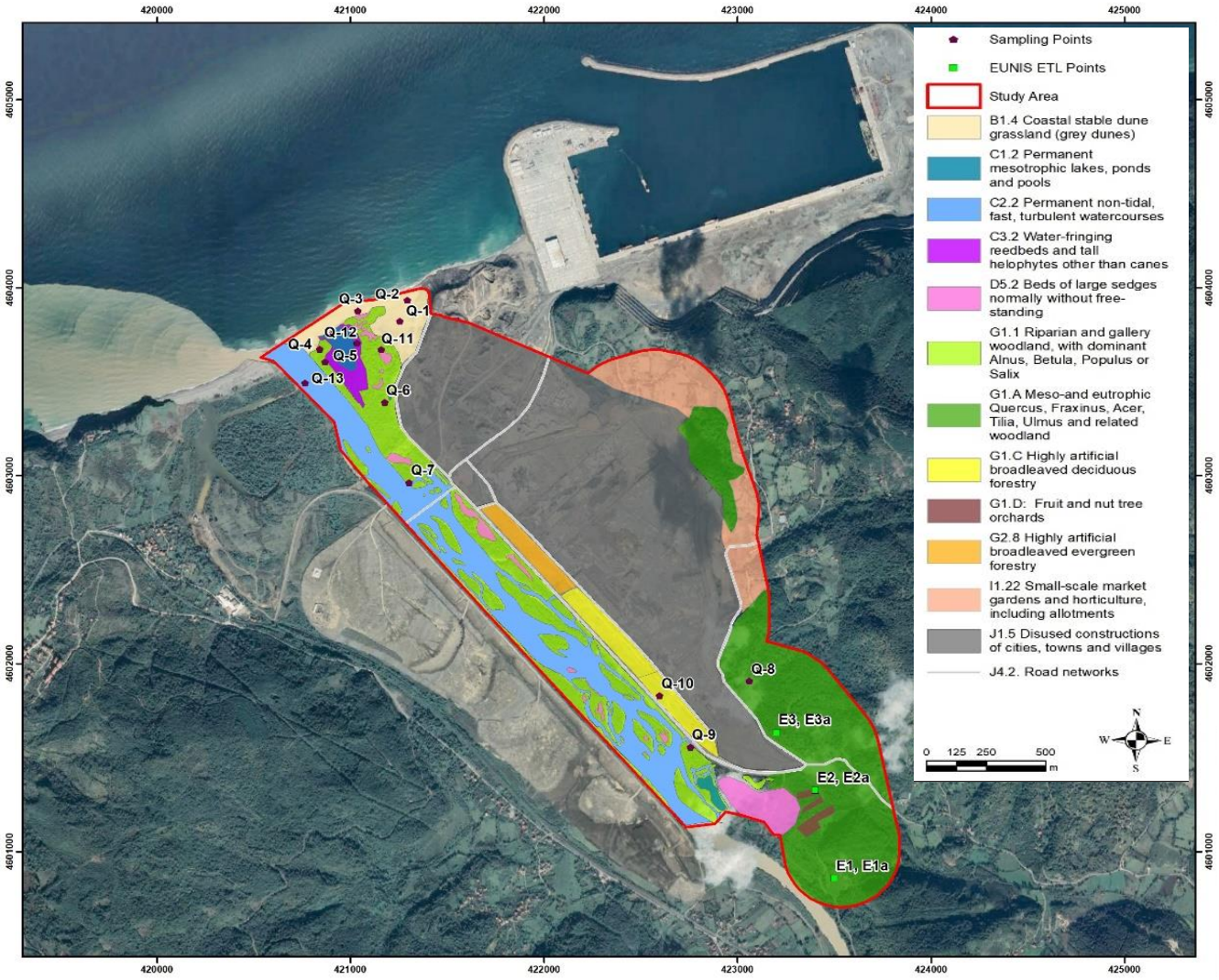


Figure 6-89: EUNIS habitat classification with sampling points

Only one the identified habitats is classified as critical, B1.4 Coastal stable dune grassland (grey dunes), as it consist of rare and critical species and is menaced by increasing development in coastal areas.

The additional classification of the freshwater habitats on the four sampling stations (Figure 6-58) is presented in the table below:

Table 6-45: Freshwater habitat classification.

Station	EUNIS habitat type	Description
Freshwater Station_1	C2.3 - Permanent non-tidal, smooth-flowing watercourses	It has turbulent, irregular, and large water volume. It is a wide riverbed and a fast-flowing river with laminar flow. The bottom structure consists of sand or mud.
Freshwater Station_2	C2.3 - Permanent non-tidal, smooth-flowing watercourses	It has turbulent, irregular, and large water volume. It is a wide riverbed and a fast-flowing river with laminar flow. The bottom

Station	EUNIS habitat type	Description
		structure consists of sand or mud. There are trees and bushes around the sampling point.
Freshwater Station_3	C2.3 - Permanent non-tidal, smooth-flowing watercourses	It has turbulent, irregular, and large water volume. It is a wide riverbed and a fast-flowing river with laminar flow. The bottom structure consists of sand or mud. There are trees and bushes around the sampling point.
Freshwater Station_4	C1.3 - Permanent eutrophic lakes, ponds and pools	It has a stagnant lake ecosystem. It is a lagoon lake that is filled with water during the flood periods of the river waters. It is surrounded by dense reeds.

The differences of classification between the two assessments were further analysed using the flora and freshwater fauna species reported in each report (Appendix F and Appendix G), concluding that the classification of the coastal pond area appeared to be more consistent with the C1.3 than the C1.2, this habitat appears to be rich in nutrients, as suggested by the invertebrate analysis, and consisting mainly of freshwater although, some seawater could occasionally reach the pond. Regarding the river habitat classification, the Yenice river appears to fall within the official description of EUNIS C2.3- Permanent non-tidal, smooth-flowing watercourses.

The excessive ecological impoverishment of the coastal pond habitat could have adverse effects especially on the birds living in the area as well as those migrating across the north coast of Turkey and using Yenice estuary as an occasional stop for feeding during their migration.

According to the habitat classification more than the 50% of the AoI consists of “Modified habitats” (J1.5; I1.22; G1.D; G1.C; G2.8 of Figure 6-89).

Sensitivity Assessment

Sensitivity features	Supported by	Sensitivity value
Presence of threatened and/or protected habitats (Habitats: B1.4, G1.A and C1.2)	Primary data and secondary data	**Medium-high**

6.2.2.9 Legally Protected Areas and Internationally Recognized Areas

Description	Legally Protected Areas and Internationally Protected Areas are “clearly defined geographical spaces, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values” (IUCN Definition 2008).

Study Area	**RSA:** Turkey national territory. **Rationale:** Based on literature review, this is the regional broad area containing the geographically distinct species and habitats potentially occurring within and in the vicinity of the Project. This freshwater ecoregion provides the general freshwater species and habitats potentially occurring within and in the vicinity of the Project Site.
	AoI: 10 km buffer around the Project Area and along the ETL **Rationale:** Turkey does not have regulations on distances from the boundaries of a protected area where a project can be implemented. Therefore, using a precautionary approach, a 10-km buffer is considered as appropriate.
Data sources	**Primary sources:** no primary sources were required
	Secondary sources: Secondary sources came from scientific articles and grey literature.

Methodological approach

Data to describe the regional context (i.e., RSA) and the AoI were collected through literature review (references reported in Chapter 13.0). Local expert communications were also considered.

Regional context (RSA)

Turkey has the 8.9% of its territory under protection through a system of 15 different categories of Protected Areas (Birben, 2019). These categories include “National Parks”, “Nature Parks”, “Natural Monuments” and “Nature Protection Areas”, “Wildlife Protection Areas”, “Wildlife Development Areas”, and “Wildlife Settlement Areas”, under the national legislation.

Local context (AoI)

There are no Protected Areas, as per those categories mentioned above, within the Project’s AoI. The closest PA is Göldağı Nature Park at approximately 18 km south-west from the Project Site, with four more at distances of 24 to 70 km.

Two Key Biodiversity Areas (Important Birds and Biodiversity Areas, respectively IBA and KBA) are present within 50 km from the Project’s AoI. These areas are the Sofular Tepeleri KBA (OBK008) which is located outside the Project Area and is listed as “Partially Protected KBA”, and the Amasra Kilyary KBA and IBA (OBK009) which partially includes the Project Area but is defined as an “Unprotected KBA” (Eken *et al*., 2016).

A Filyos Bird Snctuary (personal communication Dr. Bulut) – local bird expert) is reported within the IBA immediately north-west of the Project Area (Figure 6-90).

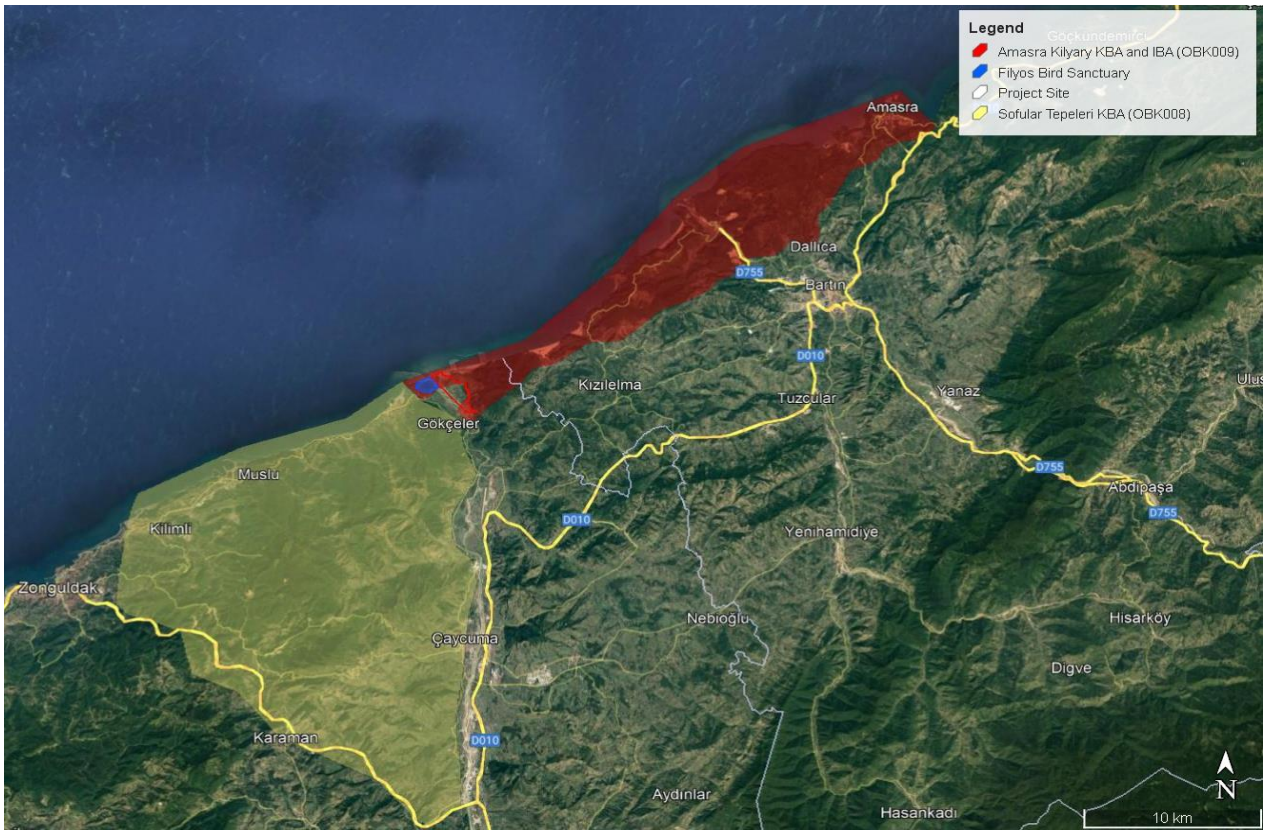


Figure 6-90: Key Biodiversity Areas and Important Bird Areas (the Project Site is defined by the red line)

Sensitivity Assessment

Sensitivity features	Supported by	Sensitivity value
Absence of protected areas within the Project's AoI Presence of two Key Biodiversity Areas and one relevant area for biodiversity (according to national/local regulation)	Secondary data	**Medium**

6.2.2.10 Critical Habitats

Based on the information reported in the sections above, 13 species and one habitat are considered eligible to potentially trigger Critical Habitat (CH) according to the definitions, criteria and thresholds provided by IFC Performance Standard 6 (PS6, 2019). The identified species are reported in Table 6-46.

Table 6-46: Shortlist of species potentially eligible for the Critical Habitat determination under IFC PS6 Criteria

Species	National conservation status	IUCN Classification (Criterion I)	Endemism and/or Restricted-range (Criterion II)	Migratory or Congregator (Criterion III)	Habitat (Criterion IV)
Flora					
Centaurea kilaea	EN	NE	Endemic	-	-
Peucedanum obtusifolium	VU	NE	-	-	-
Pancratium maritimum	VU	LC	-	-	-
Freshwater Fish					
Alburnoides turani	-	NE	Endemic	-	-
Capoeta tinca	-	LC	Endemic	-	-
Cobitis simplicispina	-	LC	Endemic	-	-
Amphibians					
Triturus anatolicus	-	LC	Endemic	-	-
Reptiles					
Darevskia bithynica	-	LC	Endemic	-	-
Vipera barani	-	NT	Endemic	-	-
Birds					
Aquila nipalensis	-	CR	-	Migrant	-
Grus virgo	-	EN	-	Migrant	-
Oxyura leucocephala	-	EN	-	Migrant	-
Mammals					
Miniopterus schreibersii	-	VU	-	Migrant	-
Habitats					
B1.4c Coastal stable dune grassland (grey dunes)	-	-	-	-	EN

Criterion 1: Habitats of significant importance to Critically Endangered and/or Endangered species

To evaluate those species potentially triggering this criterion the following guidelines from IFC GN6 applied:

i) Habitats of significant importance to endangered or critically endangered species

The presence of species having Endangered (EN) or Critically Endangered (CR) conservation status according to Global IUCN criteria shall be considered. In the absence of a Global IUCN assessment (i.e.

Not Evaluated NE or Data Deficient DD), local assessments (i.e. RF Red Data Book and YNAO Red Data Book) shall be considered.

In order to assess the importance of the LSA for these species, the following thresholds shall be applied (Guidance Note 6, GN72, IFC 2019):

a) areas that support globally important concentrations of an IUCN Red-listed EN or CR species (≥ 0.5% of the global population AND ≥5 reproductive units of a CR or EN species);
b) areas that support globally important concentrations of an IUCN Red-listed VU species, the loss of which would result in the change of the IUCN Red List status to EN or CR and meet the thresholds in GN72(a).
c) as appropriate, areas containing important concentrations of a nationally or regionally listed EN or CR species.

According to the definitions above, from Table 6-46 three species of flora (*Centaurea kilaea, Peucedanum obtusifolium*, and *Pancratium maritimum*), three species of birds (*Aquila nipalensis, Grus virgo*, and *Oxyura leucocephala*), and one mammalian species (*Miniopterus schreibersii*) were evaluated for this criterion. In particular, while not critically endangered or endangered, *Peucedanum obtusifolium* and *Pancratium maritimum* were also included as these species are found to be locally vulnerable with diminishing populations due to the loss of habitat which is identified as B1.4 in EUNIS classification and reported as an endangered habitat. Similarly, *Miniopterus schreibersii* is a vulnerable bat species with declining and highly fragmented populations, the loss of which could result in the change of the IUCN Red List status to EN and meet the thresholds in GN72(a), it was therefore included in the Criterion I evaluation.

Since for most eligible species an exact numerical estimation of the local populations does not exist, it was adopted the use of an Ecologically Appropriate Area of Analysis (EAAA), which was identified for each species and used to determine the presence of CHs.

Once the EAAA was selected it was then compared with the Extent of Occurrence (EOO) of each species, which represents the global population distribution, in order to identify if that area could potentially meet Criterion I threshold: if the EAAA is ≥ 0.5% of the EOO, the area is defined as triggering Critical Habitat (CH).

The only exception is represented by the three plant species mentioned above, as these were assessed against Criterion I threshold from the local expert Prof. Duman. He compiled the required information and local knowledge to estimate a correct population size and obtain the concentration value to compare to the 0.5% threshold.

Prof. Duman data (local expert) indicated that *Centaurea kilaea* was the only plant species that was found to have an estimated impacted population of up to 1% of the global Turkish population, with 4000 reproductive individuals present within the AoI. This triggered the Critical Habitat for the relative area of influence for this species, identified as the grey dune area within the Project's boundaries (B1.4 of Figure 6-89). The results for *C. kilaea,* and the other two plan species analysed, are reported in Table 6-47

Table 6-47: Critical Habitat assessment data for endangered plant species

Species	National conservation status	IUCN Classification	Status of population within the AoI	Ratio to Turkish population
Centaurea kilaea	EN	NE	4000	0,5-1%
Peucedanum obtusifolium	VU	NE	5	0,01-0,2%

Species	National conservation status	IUCN Classification	Status of population within the AoI	Ratio to Turkish population
Pancratium maritimum	VU	LC	5000	0,1-0,2%

The EAAA identification for each of the remaining species is reported below:

- *Aquila nipalensis* has been reported as a possible occasional sighting on the AoI defined for bird species. It has also been classified as critically Endangered on a global scale by IUCN. he analysis of biological and ecological data available on this wide-spread species identified the Project Site as sitting in a minor route for migratory birds across the Anatolian peninsula, which is even omitted in some studies (Hacioğlu *et al.*, 2017; Birben, 2019). According to the data provided by the local expert Dr. Bulut, this minor route connects two other located in the region around Belyaka on the east and Düzce on the west (see also Figure 6-78). It was then assumed that the individuals potentially occurring within the Project Site and its AoI would correspond to those selecting this particular route, the EAAA was then identified as the coastal area between these two locations (Figure 6-91).
- *Grus virgo* and *Oxyura leucocephala* were both directly observed, and detected through eDNA analysis, within the Project's AoI. Both species are classified as Endangered at a global level by IUCN. Being both migratory species with an extended distribution range a similar approach as per *Aquila nipalensis* was adopted, defining the EAAA as the same as per the previous species.

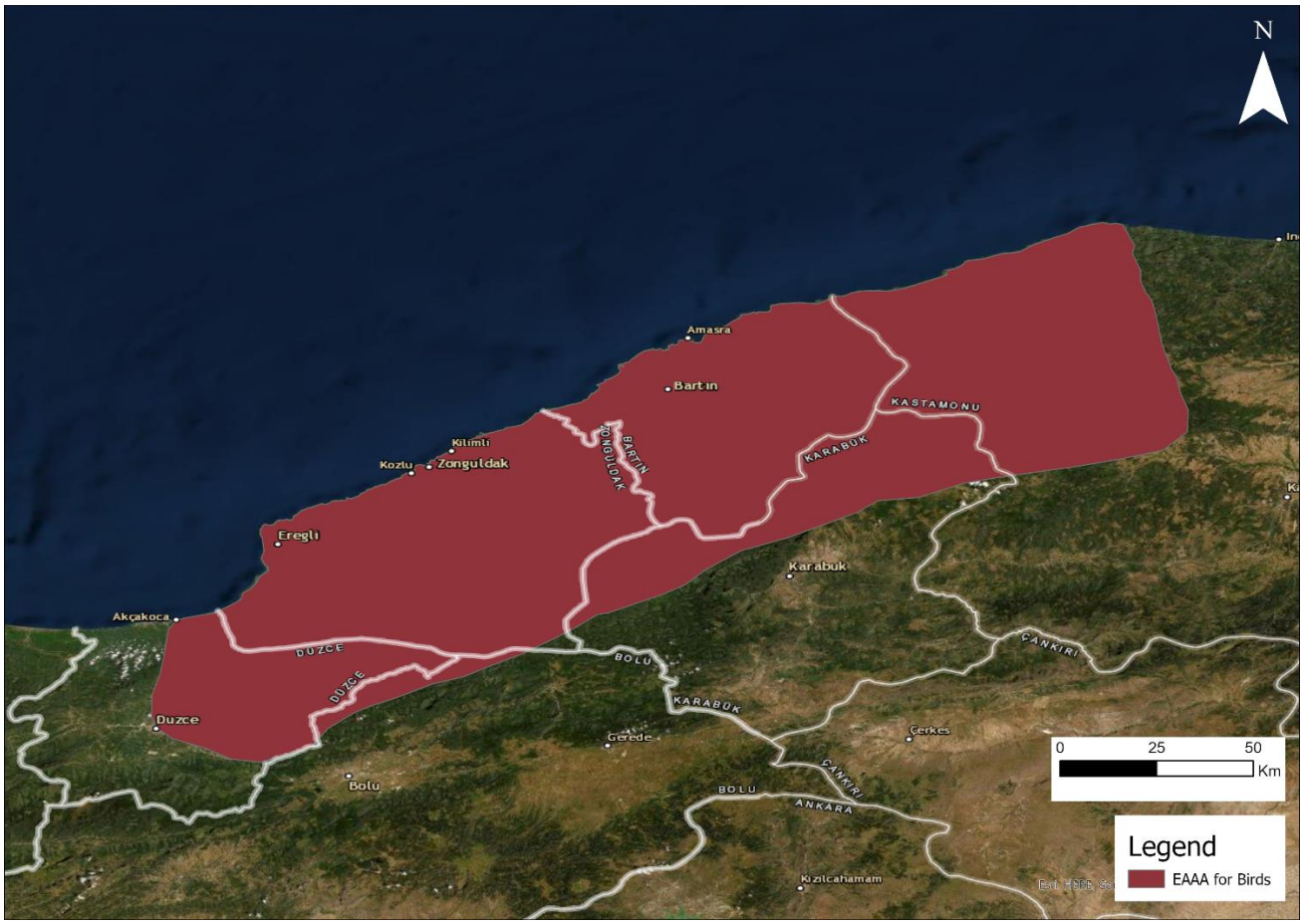


Figure 6-91: EAAA for bird species

The results obtained from the comparison of the EAAA defined for the three species and their EOO, showed that none of these triggers the Critical Habitat for endangered bird species under the Criterion I of the IFC PS6.

The data with the relative EAAA, EOO and the proportion of EAAA over EOO, for each species are reported in Table 6-48.

Table 6-48: Critical Habitat assessment data for endangered bird species

Species	Common name	IUCN Global Red List Status	Potentially Present/ Observed [P/O]	EOO (km²)	EAAA (km²)	% of EOO	EAAA is ≥ 0.5% of EOO [Y/N]	Trigger Critical Habitat [Y/N]
Aquila nipalensis	Steppe Eagle	CR	P	8506511,916	11011,06	0,13	N	N
Grus virgo	Demoiselle Crane	EN	O	20922727,4	11011,06	0,05	N	N

Species	Common name	IUCN Global Red List Status	Potentially Present/ Observed [P/O]	EOO (km²)	EAAA (km²)	% of EOO	EAAA is ≥ 0.5% of EOO [Y/N]	Trigger Critical Habitat [Y/N]
Oxyura leucocephala	White-Headed Duck	EN	O	10927989,59	11011,06	0,1	N	N

- *Miniopterus schreibersii* was the only mammalian included in Criterion I analysis, the estimated EAAA for this species was obtained by using the available ecological and biological information (IUCN, 2020). Given that the foraging area of maternity colonies was estimated around 200,000 ha (2000 km²) this provided an EAAA of about 1.070 km² to be compared to an EOO of nearly 198.000 km². The calculated percentage of potentially impacted area was 0,054% of the EOO resulting below the 0,5% threshold for Criterion I, and therefore, not triggering the CH.

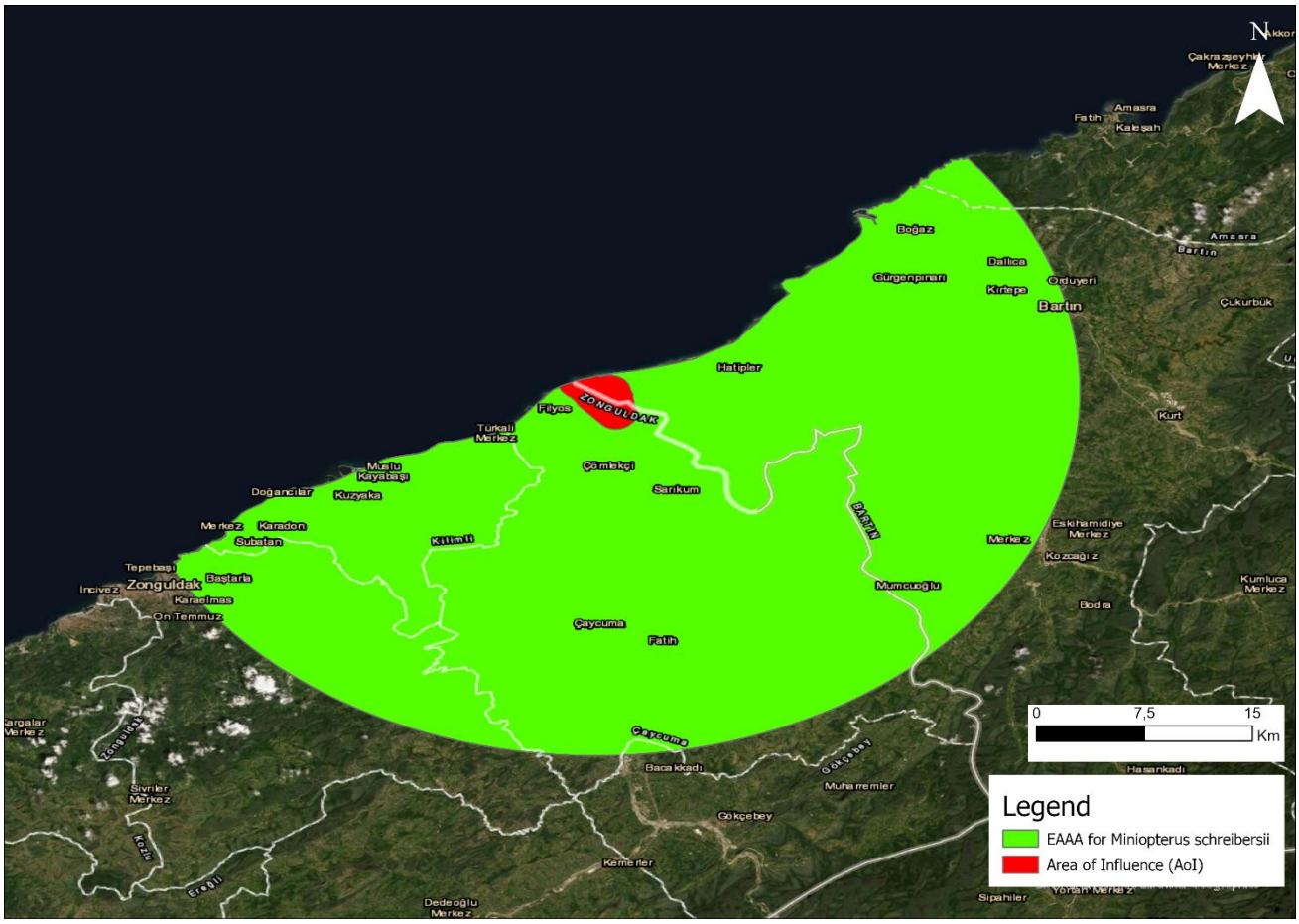


Figure 6-92: EAAA and AoI for *Miniopterus schreibersii*.

Criterion 2: Habitats of significant importance to Endemic and/or Restricted-range species

According to IFC PS6 GN74, the term endemic is defined as Restricted-range. Restricted-range refers to a limited extent of occurrence (EOO).

- For terrestrial vertebrates and plants, restricted-range species are defined as those species that have an EOO less than 50,000 square kilometres (km2).
- For marine systems, restricted-range species are provisionally being considered those with an EOO of less than 100,000 km2.
- For coastal, riverine, and other aquatic species in habitats that do not exceed 200 km width at any point (for example, rivers), restricted range is defined as having a global range of less than or equal to 500 km linear geographic span (i.e., the distance between occupied locations furthest apart).

The threshold for Criterion 2 (as reported in GN75) is the following:

a) Areas that regularly hold ≥10% of the global population size AND ≥10 reproductive units of a species.

Seven species were reported as endemic from local experts although, some of these species were not meeting the definition of restricted range as per the guidelines in GN74. Those that met the EOO requirements were evaluated according to the parameters for the CH evaluation of Criterion 2 (GN74, IFC 2019).

A description of the rationale behind the calculation of EAAA and EOO for the different species is given below.

Of the three freshwater fish species reported in Table 6-49 only *Alburnoides turani* qualified as proper endemic according to IFC definitions (GN74). This species has been only recently described (Kaya, 2020), therefore, limited ecological data is available. The detection of its presence using the eDNA analysis from river water samples provided a range of 12 km, which is the approximate maximum detection limit for this method, it was therefore assumed that individuals from this species were present within 12 linear km from the Project Area and as a conservative measure an additional 15 km was added to this distance. The 27 km of Yenice River's final section including its ramifications were then adopted as the species' EAAA. Furthermore, *A. turani* has been only described from Yenice Basin and therefore this was considered as its EOO (Figure 6-93).

In the case of the endemic amphibian *Triturus anatolicus*, a similar approach was used, as this to was detected through the eDNA analysis. However, while its EAAA was described as per *A. turani*, this species mobility and ability to inhabit smaller and temporary water bodies (e.g., puddles, seasonal streams, artificial ponds, etc.) required the inclusion of all general suitable habitats around the last 24 km of Yenice River and its tributaries (Figure 6-94). The decision was also made to evaluate this species as a terrestrial vertebrate. In addition, the EOO of *T. anatolicus* was not limited to Yenice Basin but resulted being still below the 50.000 km^2 threshold from GN74.

The lizard *Darevskia bithynica* is a Turkish endemic species reported as potentially occurring in the Project's AoI, an EAAA corresponding to all suitable habitats within a 5 km radius was established according to the general home range of lizard species of similar body size (Figure 6-95). The EOO for this species was obtained from a recent study by Kurnaz and Hosseinian (2020).

Vipera barani is endemic of the Black Sea coastal area but given the limited ecological information available its presence is limited to specific areas resulting in an EOO below the GN74 threshold. The EAAA for this species was selected as per *D. bithynica* with a 5km radius around the Project Area (Figure 6-96).

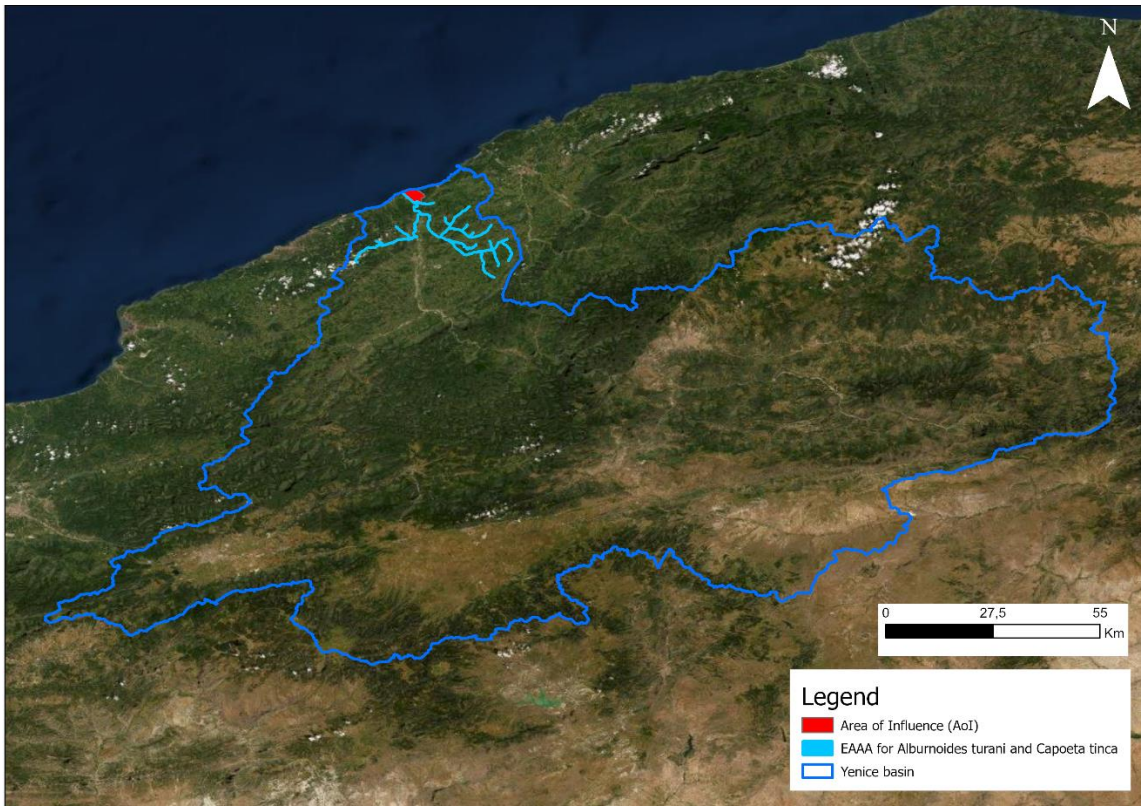


Figure 6-93: EAAA and EOO for *Alburnoides turani*

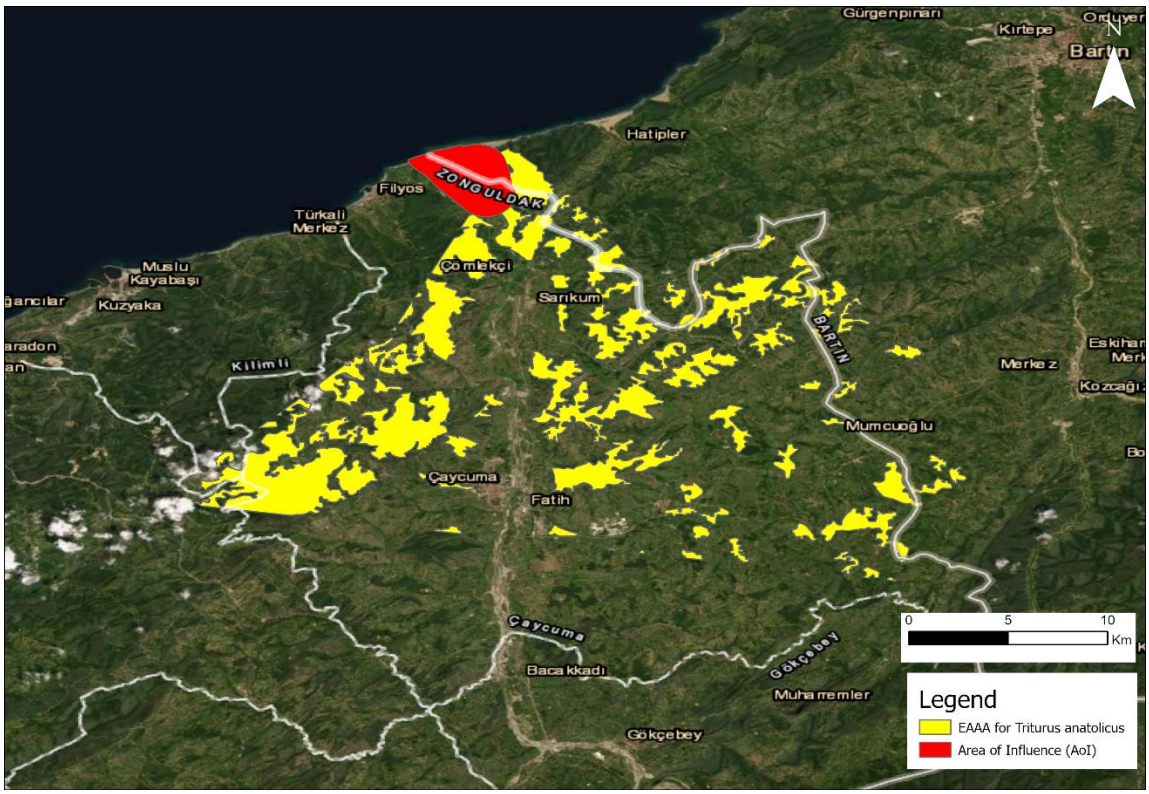


Figure 6-94: EAAA for *Triturus anatolicus*

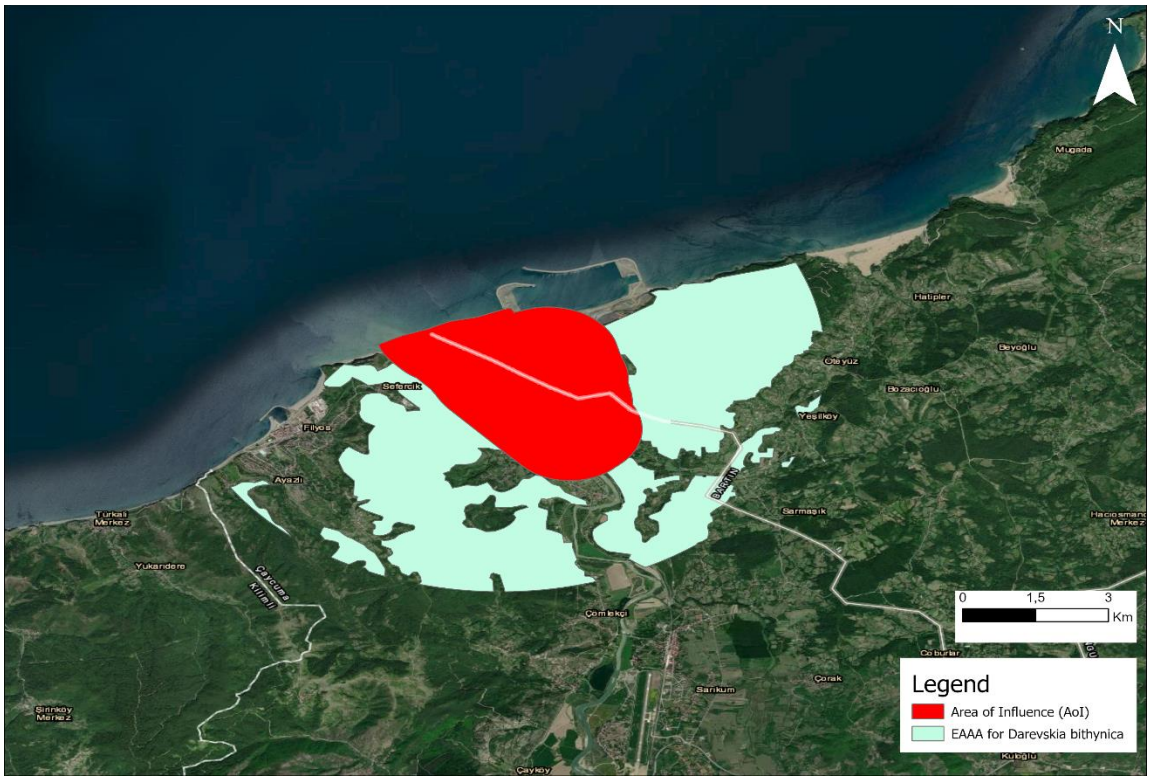


Figure 6-95: EAAA for *Darevskia bithynica*

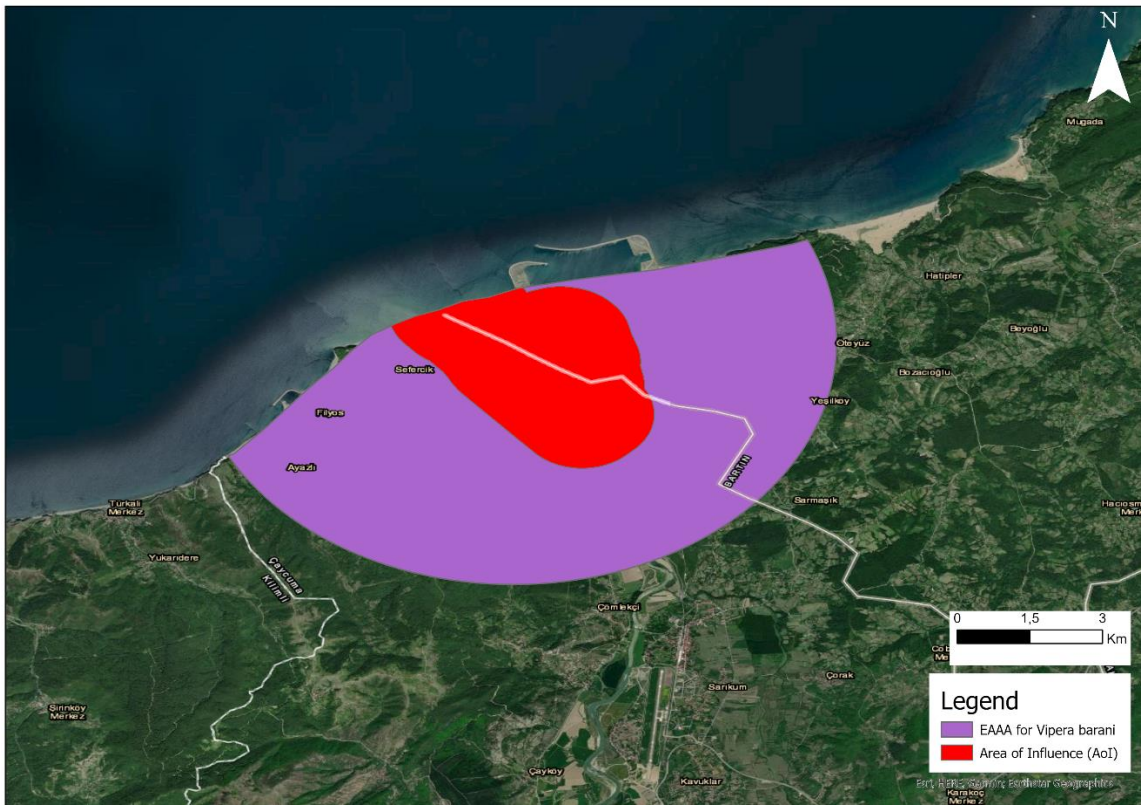


Figure 6-96: EAAA for *Vipera barani*

No endemic specie here identified and assessed met the requirement to trigger a Critical Habitat status under Criterion 2.

A summary of the data on endemic species obtained for the evaluation of Criterion 2 is provided in the table below.

Table 6-49: Critical Habitat Assessment data for Endemic Species

Species	Common name	IUCN Global Red List Status or National Conservation Status	Potentially Present/ Observed [P/O]	EOO (km^2)	EAAA (km^2)	% of EOO	EAAA is ≥ 10% of EOO [Y/N]	Trigger Critical Habitat [Y/N]
Terrestrial Plants and Vertebrates								
Centaurea kilaea	-	EN	O	>50.000	-	-	N	N
Darevskia bithynica	-	LC	P	27.875	24,2	0,1	N	N
Vipera barani	-	NT	P	39.322	44,8	0,1	N	N
Triturus anatolicus	Anatolian crested newt	LC	O	38.811	89,54	0,23	N	N
Riverine and Aquatic species								
Alburnoides turani	-	NE	O	17,3 km^2 <500 (linear km)	0,5	3	N	N
Capoeta tinca	Western Fourbarbel Scraper	LC	O	>500 (linear km)	-	-	N	N
Cobitis simplicispina	Galatian Spined Loach	LC	O	>500 (linear km)	-	-	N	N

Criterion 3: Habitats supporting globally significant concentrations of Migratory and/or Congregatory species

GN76 of IFC P6 defines Migratory species as “any species of which a significant proportion of its members cyclically and predictably move from one geographical area to another (including within the same ecosystem)”.

GN77 also indicates as Congregatory species those “whose individuals gather in large groups on a cyclical or otherwise regular and/or predictable basis”, giving the following examples:

- Species that form colonies.
- Species that form colonies for breeding purposes and/or where large numbers of individuals of a species gather at the same time for non-breeding purposes (for example, foraging and roosting).

- Species that utilize a bottleneck site where significant numbers of individuals of a species occur in a concentrated period of time (for example, for migration).
- Species with large but clumped distributions where a large number of individuals may be concentrated in a single or a few sites while the rest of the species is largely dispersed (for example, wildebeest distributions).
- Source populations where certain sites hold populations of species that make an inordinate contribution to recruitment of the species elsewhere (especially important for marine species).

The thresholds for Criterion 3 provided in GN78 are the following:

(a) Areas known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent of the global population of a migratory or congregatory species at any point of the species' lifecycle.

(b) Areas that predictably support ≥10 percent of the global population of a species during periods of environmental stress.

The data collected in the field and literature suggested that of 263 bird species observed or potentially occurring around the Project Area, the majority is migratory. Among these the two endangered and one critically endangered bird species listed in the section concerning Criterion 1 (i.e., *Grus virgo*, *Oxyura leucocephala*, and *Aquila nipalensis*) are also identified as migratory species.

Only one species of mammal, the Schreiber's Bent-winged Bat (*Miniopterus schreibersii*), was identified as a migratory species.

For migratory birds, in particular, the area adopted as EAAA, according to the rationale used above for Criterion 1, was assumed to be the same for all species (Figure 6-91). This was because it includes the migration route crossing the Project Area and covers a wider area than the two KBAs including a IBA (see Chapter 6.2.2.8). It was also assumed that migratory birds generally have an extended EOO crossing different countries and according to the local expert only a few species (34) use the EAAA for nesting and feeding.

No Critical Habitat was identified for migratory or congregatory species (Criterion 3), based on the approach used for Criterion 1, and the percentage values of EAAA over the EOO obtained for these species in the previous sections (Table 6-48 and page 40).

Criterion 4: Highly Threatened and/or Unique Ecosystems

In GN80 of IFC PS6 the thresholds for Criterion 4 are defined as the following:

a) Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN.

b) Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.

The Criterion 4 application (GN79, IFC 2019) foresees the use of the "Red List of Ecosystems (RLE)" where formal IUCN assessments have been conducted, however no evaluation were performed within the Anatolian Peninsula area as shown in the IUCN RLE Database[13]. The "European Red List of Habitats – Part 2" was used

[13] http://assessments.iucnrle.org/

to assess the conservation level of the habitats identified within the Project's AoI, resulting in the area identified as "B1.4c Black Sea coastal dune grassland (grey dune)" resulting as EN.

The area used for the CH assessment was identified as per the AoI in Chapter 6.2.2.8 resulting in an area of 0,11 km^2 that, when compared to the EOO of 64,21 km^2 for this habitat, resulted being 0.2% of the global extent.

This resulted in no Critical Habitat identified under Criterion 4.

Criterion 5: Areas associated with Key Evolutionary Processes

The AoI is not known to contain landscape features that may influence evolutionary processes, as described in IFC PS6 GN81, giving rise to regional configurations of species and ecological properties. In fact, no species and/or subpopulations of species is characterized by a particular level of isolation, spatial heterogeneity, and wealth of environmental gradients or edaphic interfaces. Moreover, the areas are not considered to be of demonstrated importance as to climate change adaptation or as biological corridor. These considerations suggest that the AoI does not support any key evolutionary processes. Thus, no Critical Habitat is triggered under Criterion 5.