ENVIRONMENTAL IMPACT ASSESSEMENT

PROJECT:

NEPTUN DEEP

PROJECT TITLEHOLDERS:

OMV Petrom S.A

Romgaz Black Sea Limited

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

CHAPTER 4 - DESCRIPTION OF RELEVANT ENVIRONMENTAL FACTORS LIKELY TO BE AFFECTED BY THE PROJECT

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4.1 DESCRIPTION OF EXISTING LAND USES AND VICINITY AREAS OF THE PROJECT SITE AND IDENTIFICATION OF THE POPULATION LIVING OR UTILIZING THE LAND

4.1.1 Description of the land in the project site area

The onshore site designated for the implementation of the analysed project is located south of the administrative territory of Tuzla commune and at the northern boundary of the administrative territory of Costinești commune.

OMV Petrom S.A. owns three land plots in the urban and rural areas of Tuzla commune:

- Urban land S1 with a total area of 85,000 m^2;
- Rural land S3 with a total area of 70,880 m^2;
- Rural land S4 with a total area of 67,304 m^2.

Figure 4.1 Owned Land Plots

The gas production pipeline will be laid underground the land plots S3 and S4, owned by the project proponent.
Currently, the land plots comprising the onshore project site are used for agricultural purposes, and no industrial activities have been identified on the site or in the immediate vicinity.
A land use presentation conducted using the Corine Land Cover 2012-2018 program for the onshore project site is shown below (Figure 4.2). Field reconnaissance carried out to identify aspects related to the initial state of the environment confirmed the current agricultural use of the land and the surrounding areas of the project site.

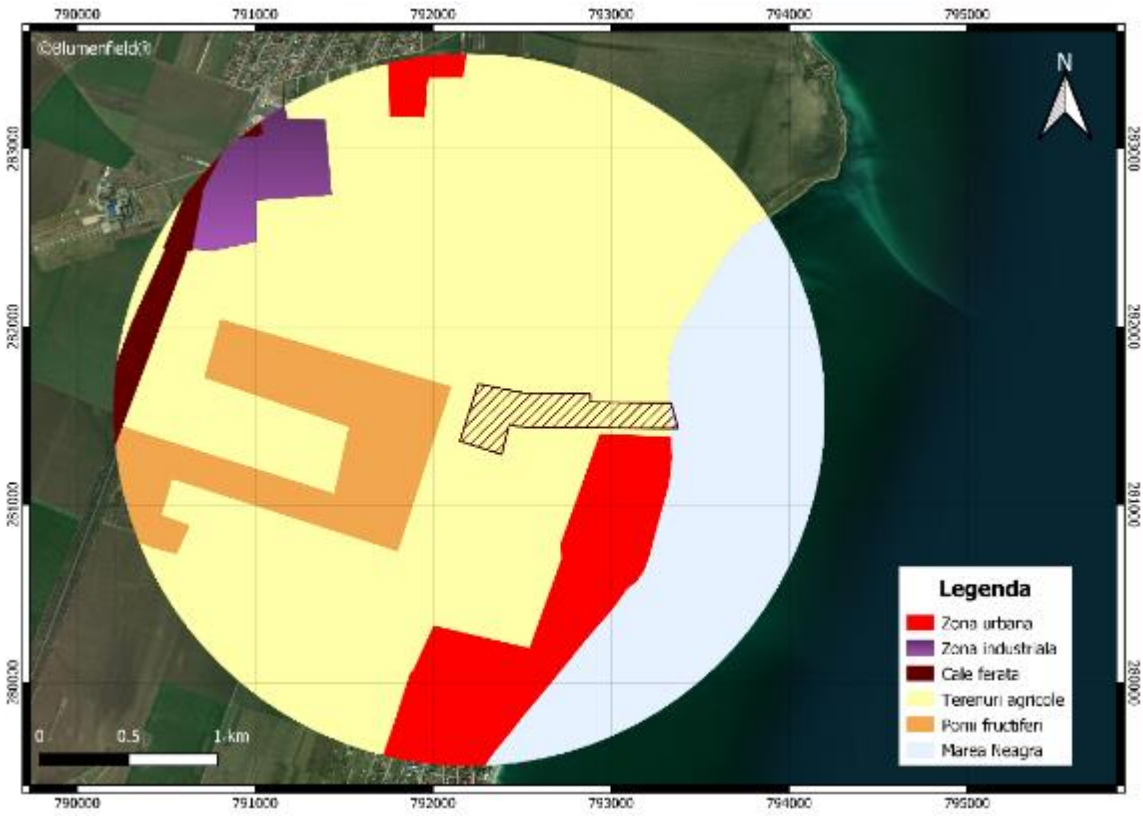


Figure 4.2 Land Use of the Onshore Project Site

The onshore project site is traversed, from west to east, by the following transportation routes:

- DC 4 Communal Road located east of the S1 land plot.
- Constanta - Mangalia Railway situated between DC 4 Communal Road and DE 277 access road.
- DE 277-access road located between Constanta - Mangalia Railway and the S3 land plot.
- DE 259/4 access road situated between the S3 and S4 land plots.

Currently, the buildings within the administrative boundaries of Tuzla and Costinești communes are predominantly used for residential purposes. Tourist guesthouses are mainly occupied by tourists during the summer season (June to August).
The nearest residential buildings are located approximately 100 meters south of the proposed pipeline installation and onshore microtunnel entry point, and approximately 350 meters southeast of the proposed installation site of the metering station.
Private residences and tourist guesthouses have been identified south and southeast of the project's onshore site within the administrative territory of Costinești commune. According to the provisions of the General Urban Plan of Costinești commune, a tourist development zone (''urban area'') is proposed for construction adjacent to the southern boundary of the project site.
The beach area near the project site is used by both locals and tourists for sport fishing and recreation, except for the sections of the beach allocated to the *Costinești - Shipwreck* landing point (190 meters from the beach) and *Tuzla - Lighthouse* landing point (100 meters from the beach), located approximately 1.3 kilometres south and north of the project's onshore site, respectively.

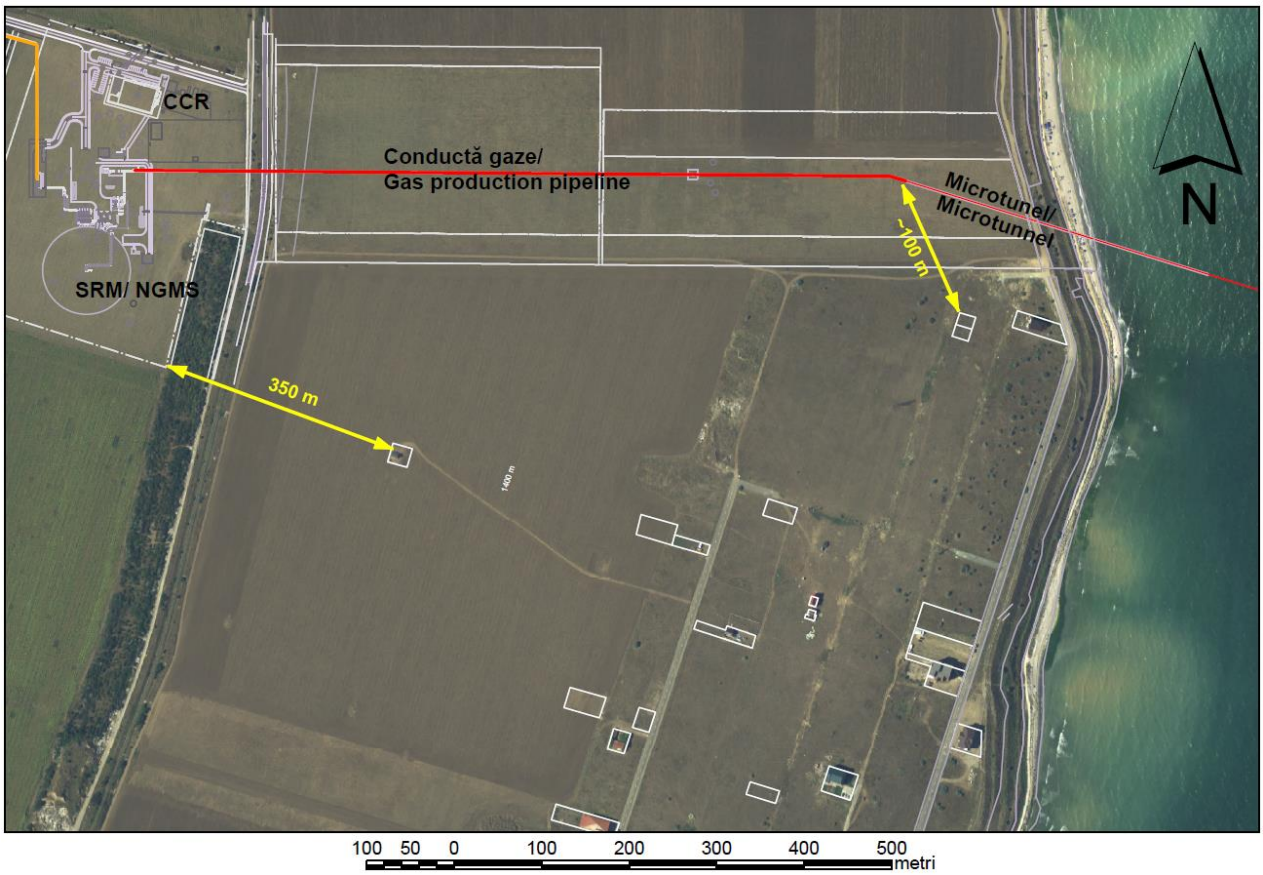


Figure 4.3 Onshore facilities distances towards closest housings

4.1.2 Data collection and method for investigation methods

The method of reviewing data and information of a scientific and technical nature within the documents, reports, and field studies conducted for the Neptun Deep project during the period 2018-2022 has been applied.

The identification of current land uses and neighbouring lands allocated for the onshore facilities of the Neptun Deep project was carried out in two stages: the documentation stage, using satellite maps, documentation, and studies previously prepared for the proposed project.

The data sources were as follows:

- The Corine Land Cover Program 2012-2018 for identifying land uses;
- The Environmental Impact Assessment Report prepared by Ramboll in 2019 for the *"Zonal Urban Plan - Establishment of a natural gas measuring station and control centre, construction of roads and underground natural gas pipelines"*
- Data collected from the field - land use identification, topographic surveys, and project site demarcation
- Preparation of maps and positioning of the project site in relation to neighbouring lands and land uses.

4.2 DESCRIPTION OF TOPOGRAPHIC, GEOLOGICAL, PEDOLOGICAL, AND SOIL QUALITY CONDITIONS AND SEDIMENTS IN THE PROJECT AREA.

4.2.1 Onshore Site

4.2.1.1 Local Topography

The topography of Tuzla commune is generally flat, with slopes towards the sea (East) and North (towards Lake Techirghiol), with a maximum altitude of 60 meters above sea level (Băldăran Hill). In the eastern part, the boundary is represented by the cliff, which has the highest elevation at Cape Tuzla, with lower heights to the north (Eforie) and south (Costinești).

Geomorphology

From a geomorphological perspective, the onshore project site is located in the Southern Dobrogea Plateau, specifically in the subunit known as the Mangalia Plateau. Similarly, in Tuzla commune, the project site has predominantly flat topography, with the highest altitude recorded in the western part of the site, gradually sloping towards the east.

4.2.1.2 Geology

The onshore site of the Neptun Deep project is situated in the Southern Dobrogea sector of the Moesian Platform. The Southern Dobrogea sector has two major structural units developed in the onshore project site area, represented by sedimentary deposits covering the crystalline rock formation.

The local geology is mainly represented by topsoil (up to 1.00 meter thick), followed by Pleistocene loess deposits with thicknesses of up to 15.00 meters, interspersed with reddish layers indicating paleo soil layers from interglacial periods. Clay deposits are developed on the Sarmatian limestones and associated with the formation of loess; the transition has developed gradually, making it difficult to distinguish. The rock formation is represented by bio clastic limestone with karstification of Sarmatian age, starting below 20.00 meters depth (as encountered in the boreholes during the geotechnical investigation campaign conducted on the site in 2019).

A geotechnical study was conducted in 2019 by Geoservices & Technic Consulting S.R.L to determine the lithology in the studied area, which involved the execution of 9 geotechnical boreholes. The study also included the delimitation of potential karst features in the limestone of NGMS and along the onshore pipeline route.

The coordinates and depth of the geotechnical boreholes are presented in Table 4.1. The location of these geotechnical boreholes is shown in Figure 4.4.

Table 4.1 Borehole Coordinates and Depth

No.	Borehole location	ID foraj	Coordinates STEREO 70			Depth (m)
			North (x)	East (y)	Elevation (z)	
1	Gas production pipeline route	BP1	281507,38	792429,43	30,90	15
2		BP2	281506,36	792599,54	29,64	15
3		BP3	281504,63	792799,68	27,15	15
4		BP4	281502,78	792999,78	23,82	15
5		BP5	281501,08	793199,53	19,63	20
6	NGMS & CCR Area	BN1	281439,35	792279,93	32,00	50
7		BN2	281476,48	792312,14	31,91	50

No.	Borehole location	ID foraj	Coordinates STEREO 70			Depth (m)
			North (x)	East (y)	Elevation (z)	
8		BN3	281531,34	792329,80	31,94	50
9		BN4	281591,35	792429,43	31,77	50

The lithological sequence identified in the two drilling areas is summarized below:

● **Superficial layer** - dark brown, brown-yellowish black, friable, with frequent plant roots and variable thickness between 0.6 - 1.0 m.
● **Loess formation** - yellowish-brown/brown clay and sandy clays, with two subdivisions: upper microporous loess and lower loess. Pleistocene deposits with intercalations of paleo brown, reddish-brown soil, with a relatively consistent thickness across the entire site between 8.30 m and 9.35 m.
● **Paleo soil formation** - primarily represented by clay and sandy clay as part of the cohesive layers of the loess formation.
● **Red clay** - encountered at the transition to the Sarmatian limestone formation.
● **Limestone formation (organogenetic)** - Sarmatian deposits with bioaccumulation of marl limestone and oolitic limestone. The thickness of the formation varies across the entire onshore project site due to the presence of green clay intercalations and cavities. The organ genic limestone formation has a thickness of 28.45 m to 30.0 m.
● **Green clay formation (greenish-gray clay)** - observed as an intercalation in the Sarmatian limestone formation with a reduced thickness of layers across the entire site between 1.0 - 2.45 m. This cohesive formation was encountered only in deep wells in the NGMS area, at depths below 30.0m below ground level.

Figure 4.4 Geotechnical Borehole Locations

Cross-section of the onshore project location underground, from north to south in the NGMS area is presented in figure 4.5 and from the west to east along the gas pipeline corridor installed on the onshore section is presented in figure 4.6 below.

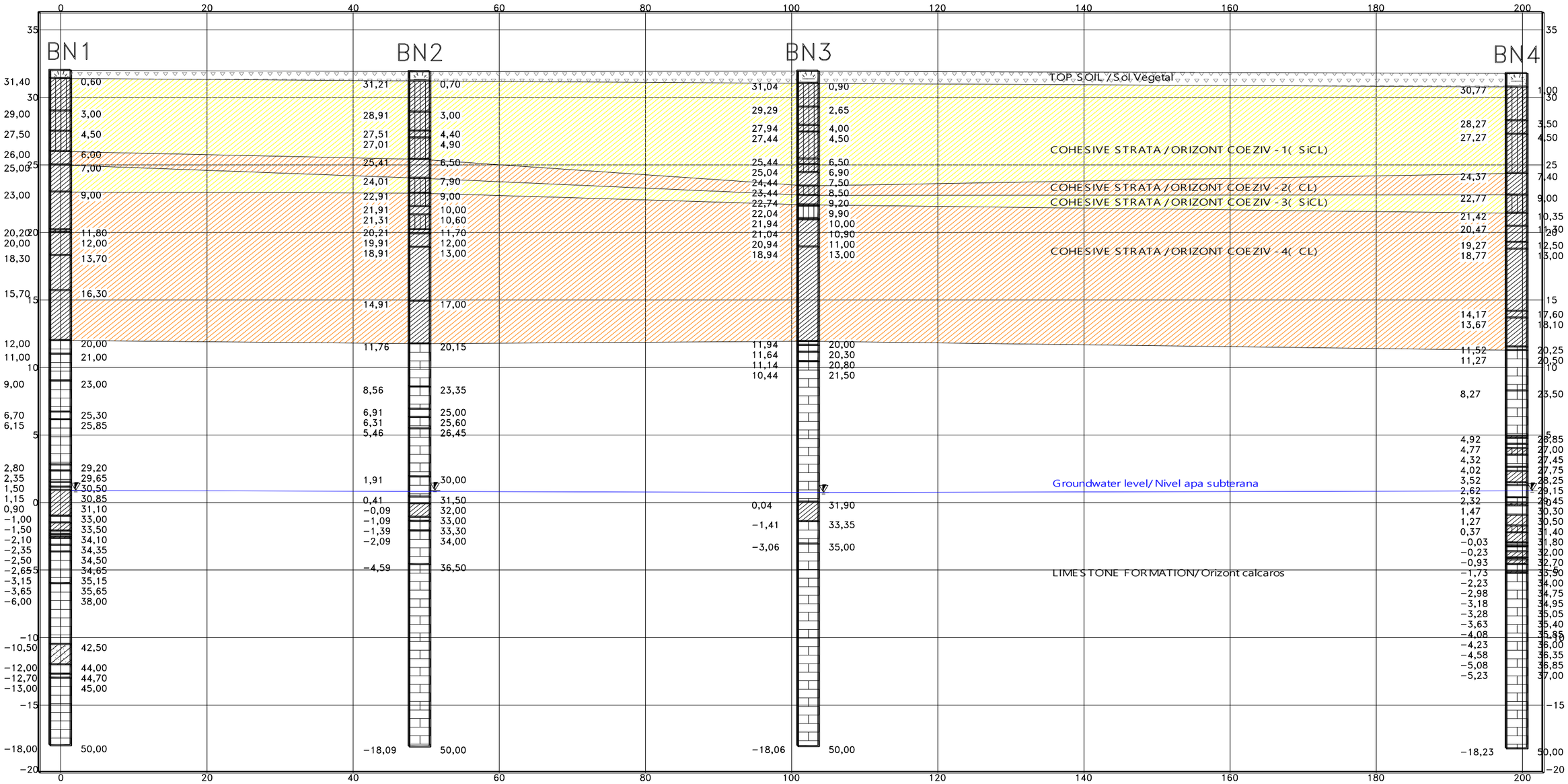


Figure 4.5 Soil cross section in NGMS area

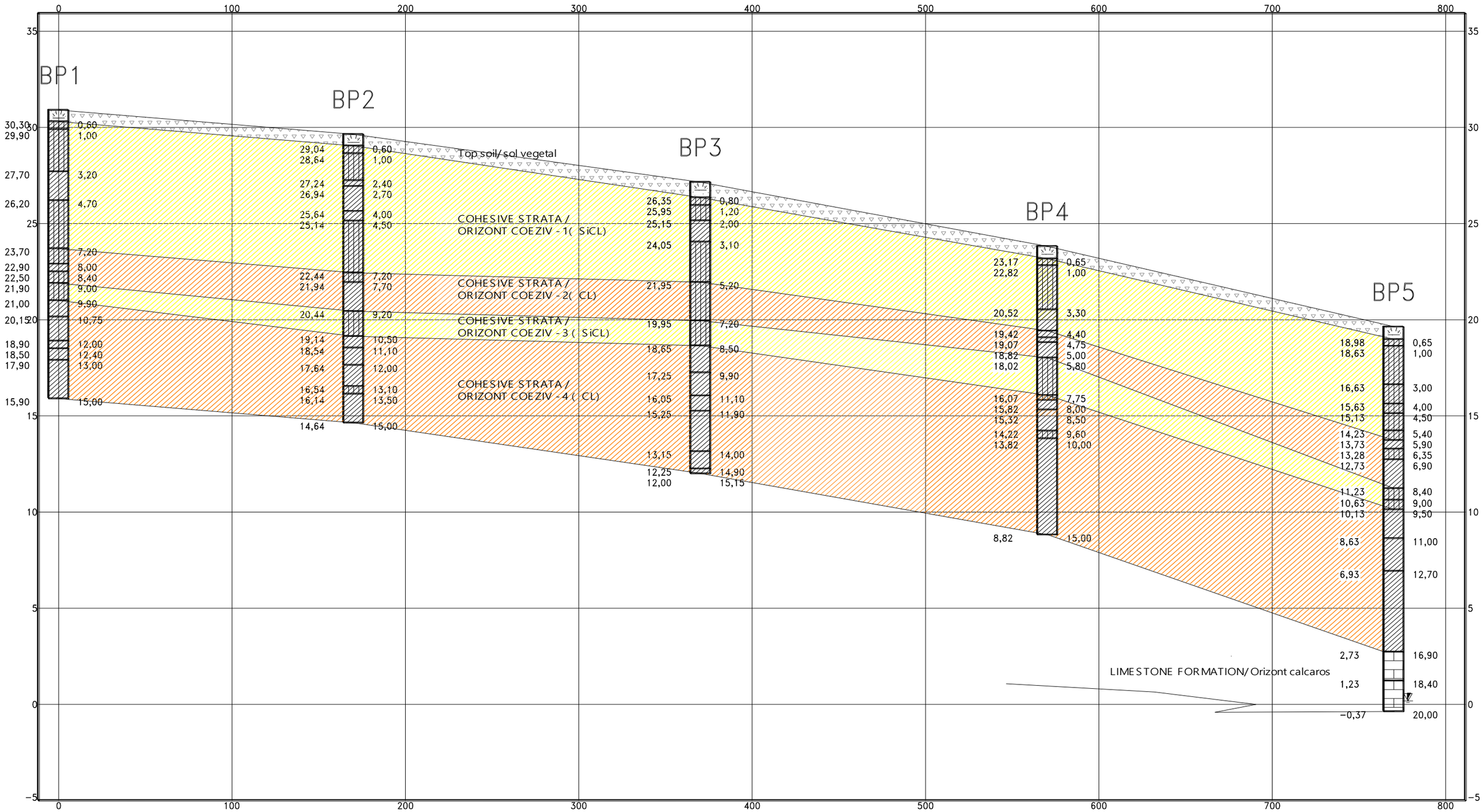


Figure 4.6 Soil cross section in the GPP instalment area

4.2.2 The offshore site

Regarding the geology of the offshore site, it should be noted that the proposed drilling wells for the Domino and Pelican Sud drill centres will penetrate into the Miocene layer of the Black Sea stratigraphy (Figure 4.7).

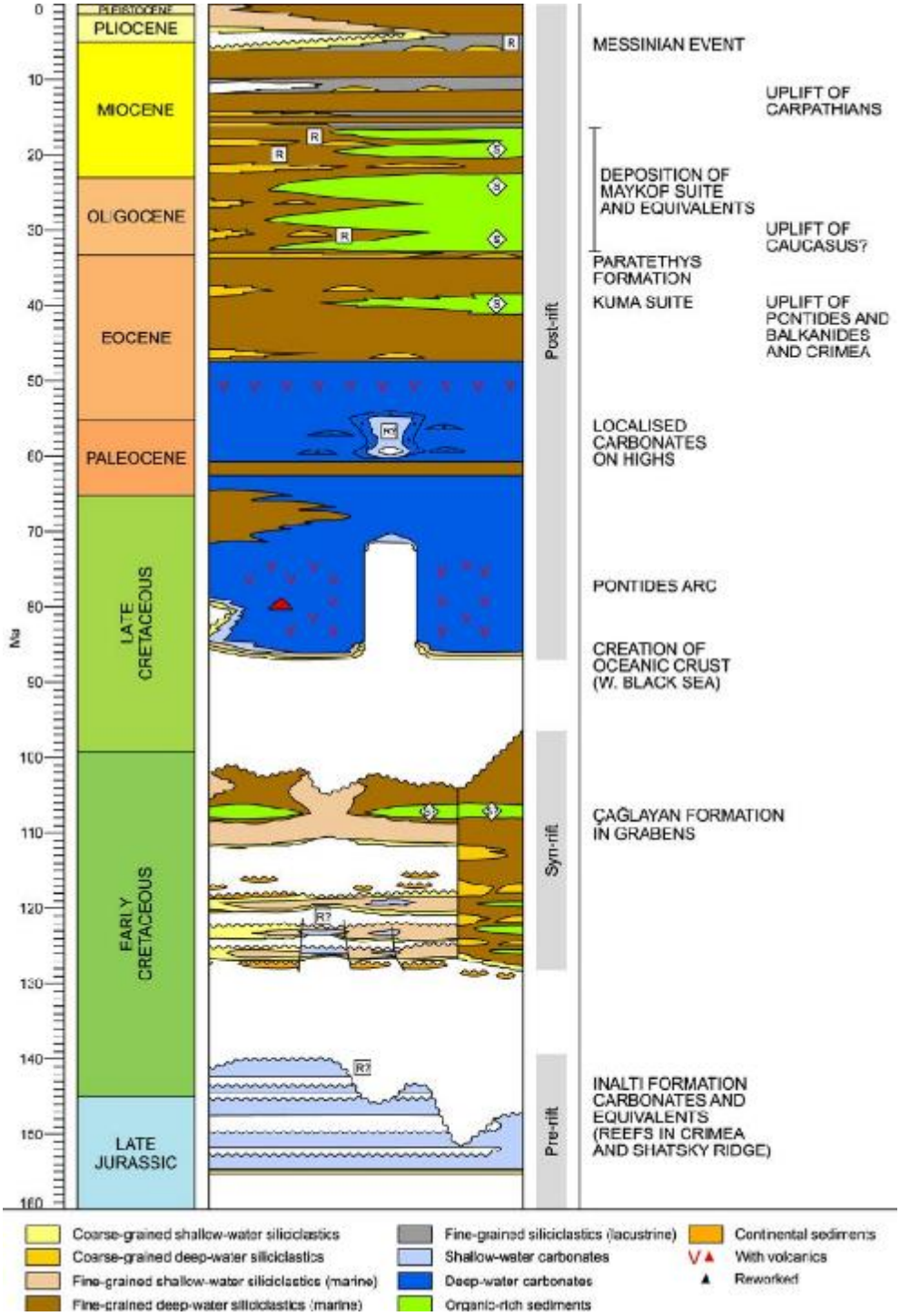


Figure 4.7 Stratigraphy of the Black Sea

4.2.2.1 Geological Considerations - Seafloor

- Faults on the seafloor and adjacent fault zones are generally limited to crest and graben areas. The production pipeline will traverse at least three seafloor faults. Evaluation of the faults indicates that they are not seismically active but rather growth faults that move at approximately 0.1 to 1.7 mm/year.
- Mass transport deposits occur along the entire continental slope and on the piedmont. These deposits are generally buried by at least 3 m of normal sediment deposition, suggesting that slope faults are relics and an increase in shear strength occurs 3 m below the mudline.
- Gas-bearing sediments are present at depths below 700 m.

4.2.2.2 Geotechnical Parameters

During the geotechnical investigations conducted in 2014 and 2017, shallow geotechnical samples were collected in the offshore project site area, and in situ tests were performed to determine the soil properties for the continental shelf, slope, and piedmont.

The geophysical and geotechnical data were integrated to develop anticipated soil profiles for the slope and piedmont, in order to define soil properties for pipeline foundation and design, including:

- The types of soil encountered in the slope and piedmont areas are generally consistent and grouped into geotechnical units.
- Soil properties - shear strength, water content, specific weight, plasticity limit, liquid limit, particle density, coefficient of consolidation.

At the shoreline and near-shore area, there is a high cliff of approximately 15 m near a 30 m wide beach. The cliff is eroding at a rate of approximately 0.3 m/year. Near the shoreline, there are limestone outcrops. In some areas, the rock is covered by 0-5 m (locally 10 m) of gravel and sand or clay. Water depths range from 0 to 15 m.

4.2.3 Data collection and methods for investigations.

The method of data and information review of scientific and technical nature from documents, reports, and field studies conducted for the Neptun Deep project during the period 2018-2022 was applied.

The data regarding the initial state of the soil in the terrestrial area and the sediments in the marine area of the Neptun Deep project site were sourced from both specialized literature and field study results conducted by the project proponent between 2017 and 2023, as follows:

- Geotectonics of Romania - Sandulescu M., 1984;
- Geology of platform units and of the North Dobrogean Orogeny - Ionesi L., 1994;
- Stratigraphic and tectonic synthesis of the Romanian Black Sea shelf and correlation with major land structure - C. Dinu, H.K. Wong, D. Tambrea, 2002;

Field Studies:

- Geotechnical Study for the Neptun Deep project - Geoservices & Tehnic consulting S.R.L, 2021;

- Pedological Study no. 341/16.06.2021 – Office of Pedology and Agrochemical Studies (OSPA);
- Pedological Study no. 784/17.07.2018 – Office of Pedology and Agrochemical Studies (OSPA);
- Report on geophysical interpretation, diagnostic archaeological investigations for the Neptun Deep project – National Institute for Research and Development of Marine Geology and Geo-ecology (GeoEcoMar), 2020;
- Geotechnical and marine environmental study - GeoQuip Marine, 2017;
- Report on the initial state of the marine environment (Environmental Baseline Survey Report) - GeoQuip Marine, 2018;
- Study on initial soil and water investigations – Jacobs (Halcrow Romania), 2019;
- Report on sediment quality indicators, coastal area of the Neptun Deep Project – Blumenfield, 2023

The field investigation methods involved the sampling of soil and sediment samples and analysis in specialized laboratory for environmental technical analyses.

Sediment samples were collected using a sediment grab (van Veen grab) from the ships' decks during marine expeditions, appropriately preserved, and transported to shore. Upon arrival at the laboratory, these samples were coded, and their condition was checked to ensure compliance with conservation requirements.

Chemical analyses were conducted according to standard methods to determine the required chemical parameters. Where applicable, the obtained results were compared with legal references for the maximum values of soil and marine sediment quality indicators.

4.2.3.1 Soils

The onshore project site area has undergone an assessment of pedological conditions and soil quality classes as part of Pedological Study no. 341/ 16.06.2021 conducted by the Office for Pedological and Agrochemical Studies (OSPA) Constanța. According to the conclusions of this study, the onshore project site is characterized by Calcaric Chernozem soils, which belong to the brown-blackish Cernosols class. These soils have a coarse, angular, and loose structure, reaching a thickness of 55-60 cm, with an organic matter content of up to 3.5 - 4%, and they have been classified in quality class III (three).

For the onshore project site, potential historical sources of contamination could be related to the common practice of pesticide and fertilizer use to modify soil quality for agricultural purposes.

Soil samples were taken in 2022 to assess the soil quality in the NGMS and CCR areas, as well as along the gas production pipeline route. The coordinates of the soil sampling points are presented in Table 4.2, and the location of the points within the area can be found in Figure 4.8.

Figure 4.8 Positioning of soil sampling locations, 2022.

The soil samples were analysed in an accredited laboratory, Bálint Analitika Kft, and the results obtained were analysed and compared to the maximum permissible limits for sensitive soils specified in Order 756/1997 on the approval of the Regulation regarding the assessment of environmental pollution. The trial results are presented in tables 4.3 - 4.16.

Table 4.2 Sampling points for soil sample

Sampling point	Sampling date	Coordinates of sampling points				ID Sample	Depth (m)	Description of the sample	Weather conditions
		Stereo 70 X (m) North	Stereo 70 Y (m) East	Geographic WGS 84 Lat (N)	Geographic WGS 84 Long (E)				
P6	27.04.2022	281645.93	792275.17	43°58'31.9''	28°38'29.1"	P6	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P7	27.04.2022	281572.18	792285.18	43°58'29.5''	28°38'29.4"	P7	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
						QAQC1	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P8	27.04.2022	281516.73	792220.70	43°58'27.8''	28°38'26.4"	P8	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P9	27.04.2022	281430.05	792217.90	43°58'25.0''	28°38'26.1"	P9	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P10	27.04.2022	281369.13	792169.29	43°58'23.1''	28°38'23.8"	P10	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P11	27.04.2022	281584.75	792358.28	43°58'29.8''	28°38'32.7"	P11	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P12	27.04.2022	281483.84	792382.92	43°58'26.5''	28°38'33.6"	P12	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P13	27.04.2022	281504.51	792292.69	43°58'27.3''	28°38'29.6"	P13	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P14	27.04.2022	281437.24	792309.11	43°58'25.1''	28°38'30.2"	P14	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
						QAQC2	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P15	27.04.2022	281364.98	792283.34	43°58'22.8''	28°38'28.9"	P15	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P16	27.04.2022	281589.26	792458.54	43°58'29.8''	28°38'37.2"	P16	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P17	27.04.2022	281531.82	792418.71	43°58'28.0''	28°38'35.3"	P17	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
						QAQC3	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P18	27.04.2022	281468.24	792448.36	43°58'25.9''	28°38'36.5"	P18	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P19	27.04.2022	281390.39	792367.03	43°58'23.5''	28°38'32.7"	P19	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C

Sampling point	Sampling date	Coordinates of sampling points				ID Sample	Depth (m)	Description of the sample	Weather conditions
		Stereo 70 X (m) North	Stereo 70 Y (m) East	Geographic WGS 84 Lat (N)	Geographic WGS 84 Long (E)				
P20	27.04.2022	281301.02	792373.28	43°58'20.6''	28°38'32.8"	P20	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P21	27.04.2022	281506.08	792533.72	43°58'27.0''	28°38'40.4"	P21	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
						QAQC5	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P22	27.04.2022	281506.06	792739.11	43°58'26.7''	28°38'49.6"	P22	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P23	27.04.2022	281501.07	792971.51	43°58'26.2''	28°39'00.0"	P23	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P24	27.04.2022	281499.25	793136.79	43°58'25.9''	28°39'07.4"	P24	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
P25	27.04.2022	281494.32	793233.01	43°58'25.6''	28°39'11.7"	P25	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C
						QAQC4	0.05-0.30	Composite sample, vegetal soil, brown, odourless, mixed with plant residues.	Sun, approximately 18^{0}C

Heavy Metals

The results regarding the concentration level of heavy metals contained in the soil samples collected from the project site area are presented in Table 4.3 below.

Table 4.3 Concentrations of Heavy Metals in Soil Samples expressed in mg/kg dry matter

Parameter	Sb	Ag	As	Ba	Be	Soluble boron (B)	Cd	Co	Chrom	Cr VI	Cu	Fe	Mn	Hg	Mo	Ni	Pb	Se	Sn	Tl	V	Zn
P6	0,59	0,16	9,79	363	1,20	1,75	0,20	11,1	62,3	<0,4	32,9	25400	623	0,11	0,52	35,3	15,8	0,53	2,17	0,38	66,7	81,3
P7	0,63	0,09	8,69	310	0,96	1,68	0,25	11,9	62,8	<0,4	26,8	26200	690	0,05	0,52	35,7	16,5	0,35	2,16	0,43	73,6	59,8
P8	0,62	0,13	9,48	386	1,11	1,57	0,21	10,5	58,0	<0,4	29,1	24800	591	0,11	0,50	32,7	16,3	0,46	2,28	0,40	65,0	77,4
P9	0,48	0,14	9,89	348	0,98	1,37	0,22	11,2	62,7	<0,4	29,5	25800	620	0,11	0,46	36,2	16,0	0,47	2,19	0,39	68,0	80,5
P10	0,56	0,18	9,63	383	0,97	1,37	0,24	11,1	61,3	<0,4	30,7	25800	613	0,12	0,45	34,5	16,2	0,51	2,31	0,39	67,2	78,7
P11	0,58	0,19	9,55	363	1,01	1,25	0,21	11,2	61,7	<0,4	27,9	26400	624	0,11	0,48	35,4	16,6	0,47	2,42	0,39	66,4	76,0

Parameter	Sb	Ag	As	Ba	Be	Soluble boron (B)	Cd	Co	Chrom	Cr VI	Cu	Fe	Mn	Hg	Mo	Ni	Pb	Se	Sn	Tl	V	Zn
P12	0,53	0,14	9,76	366	1,01	0,84	0,21	11,0	60,0	<0,4	28,1	26400	591	0,10	0,44	35,2	16,6	0,45	2,38	0,42	65,7	76,2
P13	0,66	1,63	10,6	418	1,14	1,26	0,25	12,6	73,8	<0,4	31,8	28100	673	0,12	0,56	39,1	17,4	0,31	2,64	0,45	83,7	68,7
P14	0,72	0,08	9,01	319	0,95	1,12	0,24	11,4	62,9	<0,4	26,0	25800	654	0,07	0,61	33,4	16,5	0,34	2,19	0,42	73,6	57,9
P15	0,62	0,39	10,6	398	1,16	1,15	0,25	12,8	72,3	<0,4	29,5	28000	684	0,09	0,55	38,9	18,0	0,37	2,45	0,46	82,6	68,4
P16	0,68	0,43	10,2	381	1,15	1,17	0,24	12,4	69,0	<0,4	27,9	28800	666	0,33	0,55	38,0	17,3	0,31	2,47	0,45	80,3	68,3
P17	0,67	0,15	10,3	392	1,12	1,11	0,24	12,4	68,7	<0,4	29,0	27500	660	0,16	0,57	37,9	17,5	0,31	2,38	0,48	80,9	66,9
P18	0,60	0,16	10,7	396	1,13	1,01	0,27	12,0	68,4	<0,4	22,9	28000	627	0,100	0,54	37,8	17,0	0,26	2,24	0,45	76,7	67,0
P19	0,64	0,75	10,7	398	1,06	1,08	0,26	12,8	72,2	<0,4	30,4	29200	669	0,13	0,53	39,0	17,5	0,28	2,48	0,46	82,8	68,0
P20	0,68	0,13	10,6	392	1,20	0,99	0,25	12,7	73,4	<0,4	31,3	29700	669	0,10	0,54	39,5	17,8	0,27	2,58	0,48	83,6	67,8
P21	0,66	0,08	9,38	302	0,98	1,11	0,21	12,5	68,7	<0,4	20,1	27400	729	0,04	0,43	39,4	16,3	0,34	2,36	0,41	77,5	62,5
P22	0,70	0,17	10,7	393	1,21	1,07	0,24	13,1	75,6	<0,4	22,8	29200	693	0,06	0,52	40,4	18,1	0,29	2,46	0,46	84,7	69,1
P23	0,66	0,60	10,5	375	1,09	1,14	0,22	12,4	69,9	<0,4	21,5	28100	656	0,11	0,49	37,9	16,9	0,26	2,50	0,45	81,2	66,2
P24	0,63	0,65	10,8	399	1,03	1,10	0,20	12,5	71,6	<0,4	21,2	28900	656	0,09	0,54	38,9	16,8	0,27	2,37	0,45	81,1	66,6
P25	0,66	0,10	9,07	337	0,95	1,00	0,23	11,8	66,9	<0,4	19,6	27300	665	0,08	0,50	35,2	16,3	0,30	2,28	0,42	76,6	60,5

According to Order MAPPM no.756/1997 approving the Regulation on the assessment of environmental pollution, the reference values for heavy metals in the case of sensitive land uses are presented in Table 4.4.

Table 4.4 Reference Values for Metal Concentrations in Soil

Parameter	M.U	Normal value	Alert limits	Intervention limits
Antimonium (Sb)	mg/kg su	5	12,5	20
Silver (Ag)	mg/kg su	2	10	20
Arsene (As)	mg/kg su	5	15	25
Barium (Ba)	mg/kg su	200	400	625
Berillium (Be)	mg/kg su	1	2	5
Soluble boron (B)	mg/kg su	1	2	3
Cadmium	mg/kg su	1	3	5
Cobalt (Co)	mg/kg su	15	30	50
Chrom	mg/kg su	30	100	300
Hexavalent Chron (Cr VI)	mg/kg su	1	4	10
Copper (Cu)	mg/kg su	20	100	200
Iron (Fe)	mg/kg su	-	-	-
Mangane (Mn)	mg/kg su	900	1500	2500
Mercury (Hg)	mg/kg su	0,1	1	2
Molybdenum (Mo)	mg/kg su	2	5	10
Nickel (Ni)	mg/kg su	20	75	150
Lead (Pb)	mg/kg su	20	50	100
Selenium (Se)	mg/kg su	1	3	5
Stanium (Sn)	mg/kg su	20	35	50
Talium (Tl)	mg/kg su	0,1	0,5	2
Vanadium (V)	mg/kg su	50	100	200
Zinc (Zn)	mg/kg su	100	300	600

Analysing the obtained data (Table 4.3) and comparing it with the limits in Order MAPPM No. 756/1997 (Table 4.4), the following observations can be made:

- The concentrations of antimony (Sb), silver (Ag), cadmium (Cd), cobalt (Co), hexavalent chromium (Cr VI), manganese (Mn), molybdenum (Mo), lead (Pb), selenium (Se), tin (Sn), and zinc (Zn) are below the normal value limits.
- The concentration of Arsenic in the samples is around 10 mg/kg dry substance, which is above the normal value but below the alert limit indicated by the legislation (15 mg/kg dry substance).
- For Barium, most of the measured concentrations exceed the normal value but do not exceed the alert limit. The exception is the result obtained at sampling point P13, which is 418 mg/kg dry substance, exceeding the alert limit but below the intervention limit of 625 mg/kg dry substance.
- The concentration of Beryllium at sampling points P7, P9, P10, P14, P21, and P25 is around 0.95-0.98 mg/kg dry substance, falling below the normal value of 1 mg/kg dry substance. For other sampling points, the values obtained exceed the normal value but do not exceed the alert limit.
- The obtained values for soluble boron in sampling points P12, P20, and P25 fall below the normal values. For other sampling points, the measured concentration is above the normal

value but below the alert limit of 2 mg/kg dry substance, with values ranging from 1.07 mg/kg to 1.75 mg/kg dry substance, with an average value of 1.27 mg/kg dry substance.

- Chromium is recorded below the alert limit of 100 mg/kg dry substance, with the average value being 66.67 mg/kg dry substance. The lowest determined value is 58 mg/kg dry substance, and the highest value is 78 mg/kg dry substance.
- Copper shows only one value below the normal value, which is recorded at sampling point P25 with 19.6 mg/kg dry substance. For all other sampling points, the values are below the alert limit (100 mg/kg dry substance), ranging from 20.1 mg/kg to 32.9 mg/kg dry substance.
- For iron, Order 756/1997 does not specify normal value limits, alert limits, or intervention limits. The results are around the average value of 27,340 mg/kg dry substance, with values ranging from 24,800 mg/kg to 29,700 mg/kg dry substance.
- The concentration of mercury in sampling points P7, P12, P14, P15, P18, P20, P21, P22, P24, and P25 is below the normal values (0.05 mg/kg to 0.1 mg/kg dry substance). For other sampling points, the values are below the alert limit (1 mg/kg dry substance), with the highest value obtained at sampling point P16 being 0.33 mg/kg dry substance.
- Nickel concentration exceeds the normal values in all analysed samples but remains below the alert limit of 50 mg/kg dry substance. The highest value was obtained at sampling point P8 with 40.4 mg/kg dry substance, and the lowest value was obtained at sampling point P8 with 32.7 mg/kg dry substance.
- The range of values obtained for thallium is from 0.38 mg/kg dry substance (sampling point P6) to 0.48 mg/kg dry substance (sampling point P17), with an average value of 0.43 mg/kg dry substance, falling below the alert limit of 0.5 mg/kg dry substance.
- Vanadium exhibits the same trend as thallium, with the obtained values below the alert limit of 50 mg/kg dry substance. The minimum value of 65 mg/kg dry substance was obtained at sampling point P8, and the highest value was 84.7 mg/kg dry substance at sampling point P22.

Other Elements

Table 4.5 presents the results for a series of anions categorized as "other elements" according to Order No. 756/1997. This category includes free and complex cyanides, sulphocyanides, bromine, elemental sulphur, and sulphates. Analysing the obtained results, the following observations can be made:

- The concentrations of free and complex cyanides, sulphocyanides, bromine, sulphur, and sulphates measured in all soil samples are below the normal values indicated in Order No. 756/1997.
- Order No. 756/1997 does not specify a normal value reference for elemental sulphur. From the analysis of the results for this parameter, it can be observed that for most samples, the concentrations are below the alert limit of 400 mg/kg dry substance, except for sampling points P6, P8, P9, and P10 where the obtained values were 465 mg/kg dry substance, 428 mg/kg dry substance, 401 mg/kg dry substance, and 402 mg/kg dry substance, respectively.

Table 4.5 Concentrations of Anions in Soil Samples expressed in mg/kg dry substance

Parameter	Cyanides (free)	Cyanides (complex)	Sulphocyanates	Bromine (Br)	Sulphur (elementary)	Sulphides	Sulphates
Normal value	<1	<5	<0,1	-	-	-	-
Alert limits	5	100	10	50	400	200	2000
Intervention thresholds	10	250	20	100	1000	1000	10000
P6	<0,1	<0,1	<0,5	8,57	465	23	210
P7	<0,1	<0,1	<0,5	10,6	253	16,1	290
P8	<0,1	<0,1	<0,5	6,88	427	15,1	195
P9	<0,1	<0,1	<0,5	8,78	401	2,5	<100
P10	<0,1	<0,1	<0,5	7,97	402	10,3	135
P11	<0,1	<0,1	<0,5	8,57	398	15,7	245
P12	<0,1	<0,1	<0,5	12,4	379	14	<100
P13	<0,1	<0,1	<0,5	9,9	291	16,7	155
P14	<0,1	<0,1	<0,5	10,5	248	14,6	183
P15	<0,1	<0,1	<0,5	11,7	270	18,8	170
P16	<0,1	<0,1	<0,5	12,6	289	9,9	120
P17	<0,1	<0,1	<0,5	11,3	281	8,6	120
P18	<0,1	<0,1	<0,5	12,6	284	14,6	135
P19	<0,1	<0,1	<0,5	12,1	257	11,7	120
P20	<0,1	<0,1	<0,5	12,3	271	11,3	<100
P21	<0,1	<0,1	<0,5	18,5	310	40	<100
P22	<0,1	<0,1	<0,5	11,1	290	23	175
P23	<0,1	<0,1	<0,5	9,75	289	16,5	<100
P24	<0,1	<0,1	<0,5	10,3	276	28	230
P25	<0,1	<0,1	<0,5	12	263	21	<100

Mononuclear aromatic hydrocarbons (BTEX compounds)

Table 4.6 presents the results for mononuclear aromatic hydrocarbons such as benzene, toluene, ethylbenzene, and xylenes, and as can be observed, they were not detected in the analysed samples.

Table 4.6 Concentrations of anions and petroleum hydrocarbons in the soil samples expressed in mg/kg dry substance.

Parameter	Benzene	Ethylbenzene	Toluene	Xylene	Total BTEX	Hydrocarbons from petroleum
Normal value	<0,01	<0,05	<0,05	<0,05		<100
Alert limits	0,25	5	15	7,5		200
Intervention thresholds	0,5	10	30	15		500
P6	ND	ND	ND	ND	ND	39,5
P7	ND	ND	ND	ND	ND	32,4
P8	ND	ND	ND	ND	ND	31,9
P9	ND	ND	ND	ND	ND	27,2
P10	ND	ND	ND	ND	ND	42,7
P11	ND	ND	ND	ND	ND	47,7
P12	ND	ND	ND	ND	ND	32,7
P13	ND	ND	ND	ND	ND	42,5
P14	ND	ND	ND	ND	ND	65,7
P15	ND	ND	ND	ND	ND	41,3
P16	ND	ND	ND	ND	ND	38,6
P17	ND	ND	ND	ND	ND	40,7
P18	ND	ND	ND	ND	ND	53,0
P19	ND	ND	ND	ND	ND	53,6

Parameter	Benzene	Ethylbenzene	Toluene	Xylene	Total BTEX	Hydrocarbons from petroleum
P20	ND	ND	ND	ND	ND	39,3
P21	ND	ND	ND	ND	ND	19,9
P22	ND	ND	ND	ND	ND	57,9
P23	ND	ND	ND	ND	ND	33,9
P24	ND	ND	ND	ND	ND	68,4
P25	ND	ND	ND	ND	ND	45,8

Petroleum Hydrocarbons

The concentration of petroleum hydrocarbons in the analysed samples is below the normal value of 100 mg/kg ds (Table 4.6), with the obtained results ranging from 27.2 for point P9 to a maximum of 68.4 for point P24.

Hydroxybenzenes

Table 4.7 presents the results obtained for hydroxybenzenes (phenols in the analysed results). All the results were below the limits of normal values. Phenol was identified in all samples, with the obtained results ranging from 0.001 mg/kg ds[1] to 0.002 mg/kg ds. Only in sample P11, hydroquinone was identified at a value of 0.001 mg/kg ds, and the normal value for this parameter is <0.05 mg/kg ds.

Table 4.7 Concentrations of hydroxybenzenes in soil samples expressed in mg/kg dry substance

Parameter	Phenol	Catechol	Resorcinol	Hydroquinone	Cresol	Total Phenol
Normal value	<0,02	<0,05	<0,05	<0,05	<0,05	<0,5
Alert limits	5	5	2,5	2,5	2,5	25
Intervention thresholds	10	10	5	5	5	50
P6	0,002	ND	ND	ND	ND	0,002
P7	0,002	ND	ND	ND	ND	0,002
P8	0,002	ND	ND	ND	ND	0,002
P9	0,002	ND	ND	ND	ND	0,002
P10	0,002	ND	ND	ND	ND	0,002
P11	0,002	ND	ND	ND	0,001	0,003
P12	0,002	ND	ND	ND	ND	0,002
P13	0,002	ND	ND	ND	ND	0,002
P14	0,002	ND	ND	ND	ND	0,002
P15	0,002	ND	ND	ND	ND	0,002
P16	0,001	ND	ND	ND	ND	0,001
P17	0,002	ND	ND	ND	ND	0,002
P18	0,002	ND	ND	ND	ND	0,002
P19	0,002	ND	ND	ND	ND	0,002
P20	0,001	ND	ND	ND	ND	0,001
P21	0,002	ND	ND	ND	ND	0,002
P22	0,002	ND	ND	ND	ND	0,002
P23	0,001	ND	ND	ND	ND	0,001
P24	0,002	ND	ND	ND	ND	0,002
P25	0,001	ND	ND	ND	ND	0,001

[1] ds – dried substance

Polycyclic Aromatic Hydrocarbons (PAHs)

Table 4.8 presents the results obtained for polycyclic aromatic hydrocarbons. Among the monitored hydrocarbons, acenaphthylene, acenaphthene, fluorene, and anthracene were not detected in the analysed samples (non-detectable substances). In certain analysed samples, 1-methylnaphthalene was non-detectable (P8, P13, P15, P18, P20, P21, P22, P24, P25), while for the remaining samples, the determined concentrations were very low, on the order of 0.001 mg/kg dry substance. It is worth noting that for the identified PAHs, for which concentration values were obtained, these values were below the normal limits, with the total sum also being below the normal value of <0.1 mg/kg dry substance.

Table 4.8 Reference values PAH concentrations in soil

Parameter	UM	Normal value	Alert thresholds	Intervention limits
Naphthalene	mg/kg ds	<0,02	2	5
2-methyl-naphthalene	mg/kg ds	-	-	-
1-methyl-naphthalene	mg/kg ds	-	-	-
Acenaphthylene	mg/kg ds	-	-	-
Acenaphten	mg/kg ds	-	-	-
Fluorene	mg/kg ds	-	-	-
Fenantrene	mg/kg ds	<0,05	2	5
Anthracene	mg/kg ds	<0,05	5	10
Fluorantene	mg/kg ds	<0,02	5	10
Pyrene	mg/kg ds	<0,5	5	10
Benz (a)anthracene	mg/kg ds	<0,02	2	5
Chrysene	mg/kg ds	<0,02	2	5
Benzo (b)fluoranthene+ Benzo (k)fluoranthene	mg/kg ds	<0,02	2	5
Benzo (e) pyrene	mg/kg ds	<0,02	2	5
Benzo (a) pyrene	mg/kg ds	<0,02	2	5
Indeno (1,2,3-cd) pyrene	mg/kg ds	<0,02	2	5
Benzo (g,h,i) perylene	mg/kg ds	<0,02	5	10
Total HAP	mg/kg ds	<0,1	7,5	15

Table 4.9 Concentrations of Polycyclic Aromatic Hydrocarbons in soil samples expressed in mg/kg dry substance.

	Naphthalene	2-Methylnaphthalene	1-Methylnaphthalene	Acenaftylene	Acenaften	Fluorene	Phenanthrene	Anthracene	Fluoranten e	Pyrene	Benz (A)Anthracene	Chrysene	Benzo (B)Fluoranthene & Benzo (K)Fluoranthene	Benzo (E) Pyrene	Benzo (A) Pyrene	Indeno (1,2,3-Cd) Pyrene	Benzo (G,H,I) Perylene	***Total HAP***
P6	0,001	0,001	0,001	ND	ND	ND	0,001	ND	0,003	0,002	0,001	0,002	0,003	0,001	0,001	0,001	0,001	0,019
P7	0,001	0,001	0,001	ND	ND	ND	0,001	ND	0,003	0,002	0,001	0,001	0,004	0,001	0,001	0,001	0,001	0,019
P8	0,001	0,001	ND	ND	ND	ND	0,001	ND	0,002	0,001	0,001	0,001	0,002	0,001	0,001	0,001	0,001	0,014
P9	0,001	0,001	0,001	ND	ND	ND	0,001	ND	0,003	0,002	0,001	0,002	0,004	0,001	0,001	0,001	0,001	0,02
P10	0,001	0,001	0,001	ND	ND	ND	0,001	ND	0,002	0,002	0,001	0,001	0,003	0,001	0,001	0,001	0,001	0,017
P11	0,001	0,001	0,001	ND	ND	ND	0,001	ND	0,003	0,002	0,001	0,002	0,004	0,001	0,001	0,001	0,001	0,02
P12	0,001	0,001	0,001	ND	ND	ND	0,001	ND	0,002	0,002	0,001	0,001	0,003	0,001	0,001	0,001	0,001	0,017
P13	0,001	0,001	ND	ND	ND	ND	0,001	ND	0,003	0,002	0,001	0,002	0,004	0,001	0,001	0,001	0,001	0,019
P14	0,001	0,001	0,001	ND	ND	ND	0,001	ND	0,002	0,002	0,001	0,001	0,002	0,001	0,001	0,001	0,001	0,016
P15	0,001	0,001	ND	ND	ND	ND	0,001	ND	0,002	0,002	0,001	0,001	0,003	0,001	0,001	0,001	0,001	0,016
P16	0,001	0,001	0,001	ND	ND	ND	0,001	ND	0,003	0,002	0,001	0,001	0,003	0,001	0,001	0,001	0,002	0,019
P17	0,001	0,001	0,001	ND	ND	ND	0,001	ND	0,003	0,002	0,001	0,001	0,004	0,001	0,001	0,001	0,001	0,019
P18	0,001	0,001	ND	ND	ND	ND	0,002	ND	0,003	0,003	0,001	0,002	0,004	0,001	0,002	0,002	0,002	0,024
P19	0,001	0,001	0,001	ND	ND	ND	0,001	ND	0,003	0,002	0,001	0,001	0,004	0,001	0,001	0,001	0,001	0,019
P20	0,001	0,001	ND	ND	ND	ND	0,001	ND	0,002	0,002	0,001	0,001	0,004	0,001	0,001	0,001	0,002	0,016
P21	0,001	0,001	ND	ND	ND	ND	0,001	ND	0,001	0,001	ND	0,001	0,001	0,001	0,001	0,001	0,001	0,011
P22	0,001	0,001	ND	ND	ND	ND	0,001	ND	0,002	0,002	0,001	0,001	0,003	0,001	0,001	0,001	0,001	0,016
P23	0,001	0,001	0,001	ND	ND	ND	0,001	ND	0,002	0,001	0,001	0,001	0,002	0,001	0,001	0,001	0,001	0,015
P24	0,001	0,001	ND	ND	ND	ND	0,001	ND	0,002	0,002	0,001	0,001	0,003	0,001	0,001	0,001	0,001	0,016
P25	0,001	0,001	ND	ND	ND	ND	0,001	ND	0,001	0,001	ND	0,001	0,002	0,001	0,001	0,001	0,001	0,012

Polychlorinated Biphenyls (PCBs)

The results obtained regarding the concentration of polychlorinated biphenyls in the soil samples are presented in Table 4.10:

- PCB 28 (2,2,4'-trichlorobiphenyl) was detected only in sample P10 with a value of 0.0001 mg/kg dry substance, below the normal limit value and below the alert limit of 0.02 mg/kg.
- Compounds PCB 52 (2,2',5,5'-tetrachlorobiphenyl), PCB 101 (2,2',4,5,5'-pentachlorobiphenyl), and PCB 118 (2,2',4,4',5-pentachlorobiphenyl) were not detected in any of the analysed samples.
- The results for PCB 138 (2,2',3,4,4',5'-hexachlorobiphenyl), PCB 153 (2,2',4,4',5,5'-hexachlorobiphenyl), and PCB 180 (2,2',3,4,4',5,5'-heptachlorobiphenyl) were below the limit values of <0.0004 mg/kg dry substance, with the obtained values being 0.0001 mg/kg dry substance.

Table 4.10 Concentrations of Polychlorinated Biphenyls in soil samples expressed in mg/kg dry substance.

	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	Total Polychlorinated Biphenyls
Normal value	<0,0001	<0,0001	<0,0004	<0,0004	<0,0004	<0,0004	<0,0004	<0,01
Alert limits	0,002	0,002	0,01	0,01	0,01	0,01	0,01	0,25
Intervention limits	0,01	0,01	0,04	0,04	0,04	0,04	0,04	1
P6	ND	ND	ND	ND	0,0001	0,0001	0,0001	0,0003
P7	ND	ND	ND	ND	0,0001	ND	0,0001	0,0002
P8	ND	ND	ND	ND	0,0001	0,0001	0,0001	0,0003
P9	ND	ND	ND	ND	0,0001	0,0001	0,0001	0,0002
P10	0,0001	ND	ND	ND	0,0001	0,0001	0,0001	0,0004
P11	ND	ND	ND	ND	0,0001	0,0001	0,0001	0,0003
P12	ND	ND	ND	ND	0,0001	0,0001	0,0001	0,0003
P13	ND	ND	ND	ND	0,0001	ND	0,0001	0,0002
P14	ND	ND	ND	ND	0,0001	0,0001	0,0001	0,0003
P15	ND	ND	ND	ND	0,0001	ND	ND	0,0001
P16	ND	ND	ND	ND	0,0001	ND	ND	0,0001
P17	ND	ND	ND	ND	0,0001	ND	0,0001	0,0002
P18	ND	ND	ND	ND	0,0001	0,0001	0,0001	0,0003
P19	ND	ND	ND	ND	0,0001	0,0001	0,0001	0,0003
P20	ND	ND	ND	ND	0,0001	ND	ND	ND
P21	ND	ND	ND	ND	0,0001	0,0001	0,0001	0,0003
P22	ND	ND	ND	ND	0,0001	ND	ND	ND
P23	ND	ND	ND	ND	0,0001	0,0001	0,0001	0,0003
P24	ND	ND	ND	ND	0,0001	ND	ND	ND
P25	ND	ND	ND	ND	ND	ND	ND	ND

Chlorobenzenes

The identified chlorobenzenes were bromobenzene, chlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,2,4-trichlorobenzene, 1,2,3-trichlorobenzene, 1,3,5-trichlorobenzene, tetra chlorobenzene, penta chlorobenzene, hex chlorobenzene, and 2-chloronaphthalene. Following the tests, these substances were not detected. The normal value for total chlorobenzenes is <0.01 mg/kg dry substance, and the samples comply with the limits indicated by the legislation (Table 4.11).

Chlorophenols

The results obtained for chlorophenols are presented in Table 4.12. Among the monitored chlorophenols, only 2-monochlorophenol was identified in sample P23. 2,4,6-trichlorophenol was identified in samples P6 to P20. Apart from the mentioned cases, the analysis for the other chlorophenols yielded non-detectable results. It should be noted that the Order 756/1997 specifies normal values, alert limits, and intervention limits for total chlorophenols, and the values obtained for the identified cases are below the normal limit.

Polychlorinated Dibenzodioxins (PCDD) and Polychlorinated Dibenzofurans (PCDF)

The compounds belonging to the polychlorinated dibenzodioxins (dioxins) category are presented in Table 4.13. The normal value for the total of these compounds is <0.0001 mg/kg dry substance, the alert limit is 0.0001 mg/kg dry substance, and the intervention limit is 0.001 mg/kg dry substance. The highest value obtained was 0.0004164 mg/kg dry substance for sample P20.

The compounds belonging to the polychlorinated dibenzofurans category are presented in Table 4.14. The normal value for the total of these compounds is <0.0001 mg/kg dry substance, the alert limit is 0.0001 mg/kg dry substance, and the intervention limit is 0.001 mg/kg dry substance. Results above the normal values were obtained in samples P10 and P11, with values of 0.0001139 and 0.0001147 mg/kg dry substance, respectively. All other values are below the normal limits.

Table 4.11 Concentrations of Chlorobenzenes in Soil Samples Expressed in mg/kg Dry Substance

Parameter	brombenzen	clorbenzen	1,2 diclorbenzen	1,3 diclorbenzen	1,4 diclorbenzen	1,2,4 trilorbenzen	1,2,3 triclorbenzen	1,3,5 triclorbenzen	tetraclorobenzeni	pentaclorbenzeni	hexaclorbenzen	2-cloronaftalen	Total clorbenzeni
Normal value	-	-	-	-	-	-	-	-	-	-	-	-	<0,01
Alert limits	-	-	-	-	-	-	-	-	-	-	-	-	5
Intervention limits	-	-	-	-	-	-	-	-	-	-	-	-	10
P6 – P25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 4.12 Concentrations of Chlorophenols in Soil Samples Expressed in mg/kg Dry Substance

Parameter	3 Monochlorophenol	4 Monochlorophenol	2 Monochlorophenol	2,6 dichlorophenol	3,5 dichlorophenol	2,5 dichlorophenol	2,4 dichlorophenol	3,4 dichlorophenol	2,3 dichlorophenol	2,4,6 triclhlorophenol	2,3,6 triclhlorophenol	2,4,5 triclhlorophenol	2,3,5 triclhlorophenol	3,4,5 triclhlorophenol	2,3,4 triclhlorophenol	2,3,5,6 tetrachlorophenol	2,3,4,6 tetrachlorophenol	2,3,4,5 tetrachlorophenol	pentachlorophenol	Total chlorphenol
Normal value	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,02
Alert limits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,5
Intervention limits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
P6	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,001
P7	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,002	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,002
P8	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,001
P9	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,001
P10	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,002	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,002
P11	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,001
P12	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,001
P13	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,002	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,002
P14	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,002	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,002
P15	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,003	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,003
P16	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,005	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,005
P17	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,004	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,004
P18	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,003	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,003
P19	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,004	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,004
P20	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,001
P21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0
P22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0
P23	ND	ND	0,002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,002
P24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0
P25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0

Table 4.13 Concentrations of Polychlorinated Dibenzodioxins (PCDDs) in Soil Samples Expressed in mg/kg Dry Substance

Parameter	2,3,7,8-TeCDD (ng/kg ds)	1,2,3,7,8 -PeCDD (ng/kg ds)	1,2,3,4,7,8 -HxCDD (ng/kg ds)	1,2,3,6,7,8 -HxCDD (ng/kg ds)	1,2,3,7,8,9 -HxCDD (ng/kg ds)	1,2,3,4,6, 7,8 – HpCDD (ng/kg ds)	OCDD (ng/kg ds)	Total PCDD (mg/kg ds)
Normal value	-	-	-	-	-	-	-	<0,0001
Alert limit	-	-	-	-	-	-	-	0,0001
Intervention limit	-	-	-	-	-	-	-	0,001
P6	ND	ND	0,02049	ND	ND	0,02782	0,00268	0,056*10-6
P7	ND	ND	ND	ND	ND	0,02524	0,0022	$0,05637*10^{-6}$
P8	ND	ND	0,02003	ND	ND	0,02842	0,00268	$0,08782*10^{-6}$
P9	ND	ND	0,02011	ND	ND	0,02406	0,00237	$0,05204*10^{-6}$
P10	ND	ND	ND	ND	ND	0,02077	0,0022	$0,11392*10^{-6}$
P11	ND	ND	ND	ND	ND	0,02156	0,00229	$0,11447*10^{-6}$
P12	ND	ND	ND	ND	ND	0,02674	0,00257	$0,061507*10^{-6}$
P13	ND	ND	ND	ND	ND	0,0258	0,00251	$0,06169*10^{-6}$
P14	ND	ND	ND	ND	ND	0,0293	0,00272	$0,0506*10^{-6}$
P15	ND	ND	ND	ND	ND	0,02469	0,00236	$0,05486*10^{-6}$
P16	ND	ND	ND	ND	ND	0,0231	0,00228	$0,03553*10^{-6}$
P17	ND	ND	ND	ND	ND	0,02222	0,00231	$0,08517*10^{-6}$
P18	ND	ND	ND	ND	ND	0,02366	0,00232	$0,05826*10^{-6}$
P19	ND	ND	ND	ND	ND	0,02378	0,00242	$0,04972*10^{-6}$
P20	0,1046	0,2827	ND	ND	ND	0,0264	0,00279	$0,06695*10^{-6}$
P21	ND	ND	ND	ND	ND	0,017131	0,002	$0,08373*10^{-6}$
P22	ND	ND	ND	ND	ND	0,0131	0,00153	$0,07253*10^{-6}$
P23	ND	ND	ND	ND	ND	0,01372	0,00164	$0,05772*10^{-6}$
P24	ND	ND	ND	ND	ND	0,01452	0,00165	$0,05008*10^{-6}$
P25	ND	ND	ND	ND	ND	0,01362	0,0016	$0,00343*10^{-6}$

Table 4.14 Concentrations of Polychlorinated Dibenzofurans (PCDFs) in Soil Samples Expressed in mg/kg Dry Substance

Parameter	2,3,7,8-TeCDF (ng/kg su)	1,2,3,7,8 - PeCDF (ng/kg su)	2,3,4, 7,8 - PeCDF (ng/kg su)	1,2,3,4,7,8 - HxCDF (ng/kg su)	1,2,3,6,7,8 - HxCDF (ng/kg su)	2,3,4,6,7,8 - HxCDF (ng/kg su)	1,2,3,7,8,9 -HxCDF (ng/kg su)	1,2,3,4,6, 7,8 – HpCDF (ng/kg su)	1,2,3,4, 7,8,9 – HpCDF (ng/kg su)	OCD7 (ng/kg su)	Total PCDF (mg/kg su)
Normal value	-	--	-	-	--		-	--		-	<0,0001
Alert limits	-	--	-	-	--		-	--		-	0,0001
Intervention limits	-	--	-	-	--		-	--		-	0,001
P6	0,01354	0,00353	0,03318	ND	ND	ND	ND	0,00551	ND	0,00024	0,000056
P7	0,0147	0,00361	0,0327	ND	ND	ND	ND	0,0051	ND	0,00026	0,00005637
P8	0,01283	0,0338	0,03501	ND	ND	ND	ND	0,00594	ND	0,00024	0,00008782
P9	0,01188	0,00333	0,03129	ND	ND	ND	ND	0,00527	ND	0,00027	0,00005204
P10	0,012	0,00498	0,04452	ND	0,02353	0,02286	ND	0,00578	ND	0,00025	0,00011392
P11	0,01371	0,00497	0,04386	ND	0,02181	0,02393	ND	0,00593	ND	0,00026	0,00011447
P12	0,01357	0,00383	0,03825	ND	ND	ND	ND	0,005577	ND	0,00028	0,000061507
P13	0,01412	0,00356	0,03807	ND	ND	ND	ND	0,00568	ND	0,00026	0,00006169
P14	0,01148	0,00324	0,03087	ND	ND	ND	ND	0,00478	ND	0,00023	0,0000506
P15	0,01163	0,00374	0,03429	ND	ND	ND	ND	0,00496	ND	0,00024	0,00005486
P16	ND	ND	0,03069	ND	ND	ND	ND	0,00471	ND	0,00013	0,00003553
P17	0,01274	0,00351	0,04308	ND	0,02007	ND	ND	0,00561	ND	0,00016	0,00008517
P18	0,01119	0,003	0,03879	ND	ND	ND	ND	0,00513	ND	0,00015	0,00005826
P19	0,01114	0,00353	0,03003	ND	ND	ND	ND	0,00488	ND	0,00014	0,00004972
P20	0,01245	0,00434	0,04479	ND	ND	ND	ND	0,00521	ND	0,00016	0,00006695
P21	ND	0,0036	0,04992	0,02376	ND	ND	ND	0,00626	ND	0,00019	0,00008373
P22	0,0113	0,00329	0,03114	ND	0,02215	ND	ND	0,0045	ND	0,00015	0,00007253
P23	0,01211	0,00322	0,03729	ND	ND	ND	ND	0,00495	ND	0,00015	0,00005772
P24	0,01156	ND	0,03381	ND	ND	ND	ND	0,00456	ND	0,00015	0,00005008
P25	ND	ND	ND	ND	ND	ND	ND	0,00331	ND	0,00012	0,00000343

Table 4.15 Organochlorine Pesticide Concentrations in Soil Samples Expressed in mg/kg Dry Substance

Parameter	α,β,δ-HCH (BHC)	γ-HCH/Lindan (BHC)	Heptaclor	Heptaclor epoxid	0,p'-DDD	p,p'-DDD (4,4 DDD)	cis-clordan	Endosulfan - I (alfa)	trans-clordan	o,p'-DDE	p,p'-DDE (4,4 DDE)	Endrin	Endosulfan -I (beta)	o,p'-DDT	p,p'-DDT (4,4 DDT)	Endrin - aldehida	Aldrin	dieldrin	Endosulfan-sulfat	Toxafen	Total pesticide organoclorurate
Normal value	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0,2
Alert limits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Intervention limits	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
P6	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	0,05	ND	ND	0,002	0,006	ND	ND	ND	ND	ND	0,059
P7	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	0,016	ND	ND	0,001	0,001	ND	ND	ND	ND	ND	0,019
P8	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	0,015	ND	ND	0,001	0,001	ND	ND	ND	ND	ND	0,018
P9	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	0,017	ND	ND	0,001	0,002	ND	ND	ND	ND	ND	0,021

Parameter	α,β,δ-HCH (BHC)	γ-HCH/Lindan (BHC)	Heptaclor	Heptaclor epoxid	0,p'-DDD	p,p'-DDD (4,4 DDD)	cis-clordan	Endosulfan - I (alfa)	trans-clordan	o,p'-DDE	p,p'-DDE (4,4 DDE)	Endrin	Endosulfan -I (beta)	o,p'-DDT	p,p'-DDT (4,4 DDT)	Endrin - aldehida	Aldrin	dieldrin	Endosulfan-sulfat	Toxafen	Total pesticide organoclorurate
P10	ND	ND	ND	ND	ND	0,002	ND	ND	ND	ND	0,028	ND	ND	0,001	0,002	ND	ND	ND	ND	ND	0,033
P11	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	0,016	ND	ND	0,001	0,001	ND	ND	ND	ND	ND	0,019
P12	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	0,011	ND	ND	ND	0,001	ND	ND	ND	ND	ND	0,013
P13	ND	ND	ND	ND	0,001	0,002	ND	ND	ND	ND	0,047	ND	ND	0,002	0,002	ND	ND	ND	ND	ND	0,054
P14	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	0,016	ND	ND	0,001	0,001	ND	ND	ND	ND	ND	0,019
P15	ND	ND	ND	ND	0,001	0,002	ND	ND	ND	ND	0,044	ND	ND	0,016	0,062	ND	ND	ND	ND	ND	0,125
P16	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	0,016	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,017
P17	ND	ND	ND	ND	0,001	0,003	ND	ND	ND	ND	0,062	ND	ND	0,002	0,002	ND	ND	ND	ND	ND	0,07
P18	ND	ND	ND	ND	0,001	0,002	ND	ND	ND	ND	0,038	ND	ND	0,001	0,002	ND	ND	ND	ND	ND	0,044
P19	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	0,015	ND	ND	0,001	0,001	ND	ND	ND	ND	ND	0,018
P20	ND	ND	ND	ND	ND	0,001	ND	ND	ND	ND	0,005	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,006
P21	ND	ND	ND	ND	0,003	0,004	ND	ND	ND	0,001	0,125	ND	ND	0,001	0,002	ND	ND	ND	ND	ND	0,136
P22	ND	ND	ND	ND	0,001	0,003	ND	ND	ND	0,001	0,062	ND	ND	0,001	0,001	ND	ND	ND	ND	ND	0,069
P23	ND	ND	ND	ND	0,001	0,003	ND	ND	ND	0,001	0,065	ND	ND	0,001	0,001	ND	ND	ND	ND	ND	0,072
P24	ND	ND	ND	ND	0,001	0,002	ND	ND	ND	0,001	0,036	ND	ND	ND	ND	ND	ND	ND	ND	ND	0,04
P25	ND	ND	ND	ND	0,001	0,002	ND	ND	ND	ND	0,042	ND	ND	0,001	0,001	ND	ND	ND	ND	ND	ND

Table 4.16 Pesticide Triazine Concentrations in Soil Samples Expressed in mg/kg Dry Substance

Parameter	atrazine - diisopropyl	deethyl atrazine	Atraton	Prometone	Simazine	Atrazine	Propazine	Terbumeton	terbuthylazine	Secbumeton	Sebutilazina	Metribuzine	Simetrine	Ametrine	Prometrine	Terbutrin	Hexazionа	Total pesticide triazines
Normal range																		<0,2
Alert limits																		1
Intervention Limits																		2
P6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P10	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P11	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P12	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P13	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Parameter	atrazine - diisopropyl	deethyl atrazine	Atraton	Prometone	Simazine	Atrazine	Propazine	Terbumeton	terbuthylazine	Secbumeton	Sebutilazina	Metribuzine	Simetrine	Ametrine	Prometrine	Terbutrin	Hexazio na	Total pesticide triazines
P15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P16	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P18	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P19	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P21	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P22	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P23	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
P25	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Organochlorine and Triazine Pesticides

Table 4.15 above presents the measured concentrations of organochlorine pesticides in the soil samples. In the majority of cases, these pesticides were non-detectable. However, in some instances, 0,p'-DDD, p,p'-DDD (4,4 DDD), o,p'-DDE, p,p'-DDE (4,4 DDE), o,p'-DDT, and p,p'-DDT (4,4 DDT) were identified. The total concentration of organochlorine pesticides was below the normal values of 0.2 mg/kg dry substance, with the highest value being 0.136 mg/kg dry substance for sample P21.

Table 4.16 above presents the triazine pesticides in the soil samples. None of these pesticides were identified in any of the analysed samples.

4.2.3.2 Sediments

In 2017, the project owner conducted a research program to assess the physicochemical and biological properties of marine sediments and the water column in the area of the offshore components of the Neptun Deep project and along the gas production pipeline route.

The sampling and in site tests were carried out by Geoquip Marine Operations AG (Geoquip) through TDI Brooks International (TDI). A report on the environmental baseline study was prepared by Benthic Solutions Ltd.

The coordinates and depth of the sediment sampling points are presented in Table 4.17[2]:

Table 4.17 Sediment Sampling Stations Coordinates

No.	Sampling station ID	STEREO 70 coordinates		WGS 84/ TM 30NE coordinates		Depth (m)
		East	North	East	North	
1	EBS- BX-03A	803273,759	281107,053	401969	4868838	-40,01
2	EBS- BX-05A	811846,506	282512,971	410604	4869714	-48,56
3	EBS- BX- 10	873760,288	291946,697	472912	4875314	-67,98
4	EBS- BX-11	889763,535	294155,266	489000	4876530	-70,33
5	EBS- BX- 15	926050,446	299780,376	525513	4879899	-111,93
6	EBS- BX-17	938521,983	299219,246	537907	4878570	-119,82
7	EBS- BX-18	938545,222	299216,672	537930	4878566	-125,87
8	EBS-BX-19	946678,842	299002,141	546022	4877850	-134,98
9	EBS-BX-20	946762,047	298971,170	546103	4877814	-123,23
10	EBS-BX-21	947754,347	298536,925	547065	4877320	-126,72
11	EBS-BX-22	947437,339	298195,148	546728	4876999	-126,44
12	EBS-BX-23	947742,956	298736,924	547066	4877520	-125,83
13	EBS-BX-24	947767,737	298337,050	547066	4877120	-126,29
14	EBS-BX-29	948685,755	299457,683	548050	4878180	-129,08
15	EBS-BX-32	947450,470	298096,613	546735	4876900	-122,99
16	EBS-BX-33	951438,647	295519,805	550550	4874086	-135,01
17	EBS-BX-34 (nou)	964409,897	280037,057	562519	4857858	-948,86
18	EBS-BX-35 (nou)	959448,278	278767,305	557497	4856899	-956,90
19	EBS-BX-39	961945,390	277388,375	559900	4855371	-1030,80
20	EBS-BX-40	954473,194	289449,608	553199	4867850	-347,36

[2] Report on the Environmental Baseline Study for the Neptun Deep Project, Benthic Solutions Ltd., 2018

No.	Sampling station ID	STEREO 70 coordinates		WGS 84/ TM 30NE coordinates		Depth (m)
		East	North	East	North	
21	EBS-BX-41	961182,666	278862,658	559231	4856887	-967,79

The positioning of the sediment sampling stations is depicted in the image Figure 4.9 below.

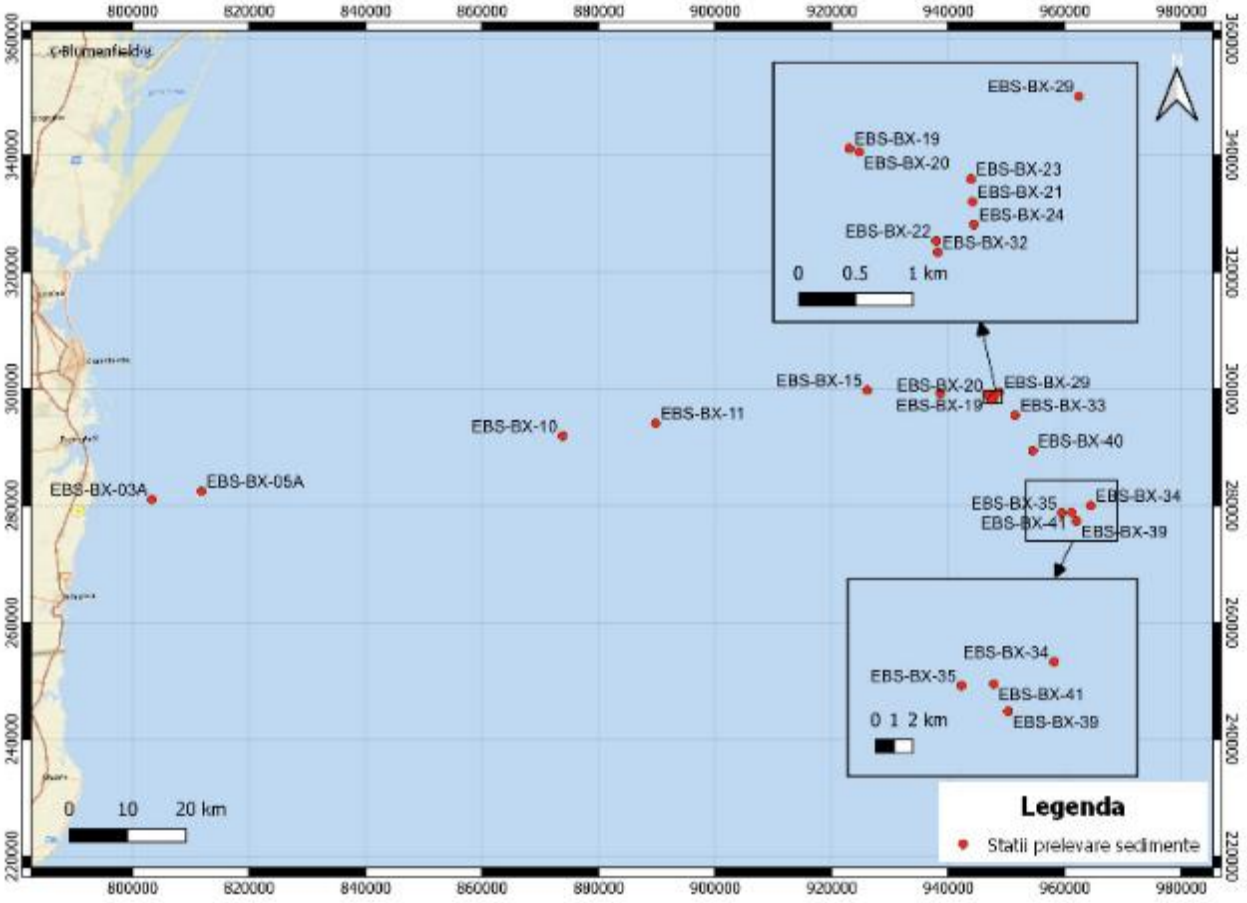


Figure 4.9 Sediment Sampling Stations - 2017 Marine Campaign

Granulometry

The sediment granulometry analysis indicated that the seabed sediments are predominantly composed of fine powders, with varying levels of sand and gravel, and in deeper sampling stations, the gravel component is generally absent. The average sediment granulometry was as follows:

- Fine powders: on average 70.21% ± 16.34 SD (standard deviation)
- Sand: on average 17.48% ± 11.63 SD
- Gravel: on average 12.32% ± 11.72 SD

Table 4.18 Sediment granulometry

No.	Sampling station ID	Sieve passes			Depth (m)
		%Fine powders	%Sands	%Gravel	
1	EBS- BX-03A	64,66	20,77	14,77	-40,01
2	EBS- BX-05A	92,15	7,85	0	-48,56
3	EBS- BX- 10	53,64	7,09	39,28	-67,98
4	EBS- BX-11	63,88	12,54	23,58	-70,33
5	EBS- BX- 15	93,95	3,58	2,47	-111,93

No.	Sampling station ID	Sieve passes			Depth (m)
		%Fine powders	%Sands	%Gravel	
6	EBS- BX-17	46,18	38,00	15,82	-119,82
7	EBS- BX-18	62,22	21,47	16,31	-125,87
8	EBS-BX-19	41,80	30,81	27,39	-134,98
9	EBS-BX-20	32,93	31,85	25,22	-123,23
10	EBS-BX-21	75,67	7,02	17,31	-126,72
11	EBS-BX-22	79,27	7,09	13,65	-126,44
12	EBS-BX-23	85,57	4,68	9,75	-125,83
13	EBS-BX-24	89,00	4,21	6,79	-126,29
14	EBS-BX-29	82,82	9,83	7,35	-129,08
15	EBS-BX-32	79,69	6,68	13,63	-122,99
16	EBS-BX-33	71,25	13,22	15,54	-135,01
17	EBS-BX-34 (nou)	67,42	32,59	0	-948,86
18	EBS-BX-35 (nou)	71,68	28,33	0	-956,90
19	EBS-BX-39	79,45	20,55	0	-1030,80
20	EBS-BX-40	64,99	35,01	0	-347,36
21	EBS-BX-41	76,11	23,89	0	-967,79
	average	70,21	17,48	12,32	
	Standard deviation	16,34	11,63	11,72	
	Variation (%)	23,3	66,5	95,1	

The analysis of the geographical distribution of fine powders (i.e., silt and clay <63µm) indicates a dominant presence of fine powders in the study area, at most sampling stations, with the highest percentage of 92.25% at sampling station EBS-BX-05A (near the shore).

Sands (>63µm to 2mm) were present at all stations, with a percentage of over 20% in almost 50% of the samples collected. The highest percentage of sand was identified at station EBS-BX-17 (38.0%).

The percentage of gravel varies from zero at deep sampling stations to 39.3% at station EBS-BX-10.

Total organic carbon (TOC) and moisture content

The results of the test for determining the percentage of total organic carbon (TOC) and moisture content are presented in Table 4.19.

Table 4.19 Total Organic Carbon and Moisture Content in Sediments

No.	Sampling station ID	TOC %	Humidity %	Depth (m)
1	EBS- BX-03A	1,20	50,1	-40,01
2	EBS- BX-05A	2,41	65,8	-48,56
3	EBS- BX- 10	1,78	67,5	-67,98
4	EBS- BX-11	1,77	67,3	-70,33
5	EBS- BX- 15	2,37	68,6	-111,93
6	EBS- BX-17	1,20	57,6	-119,82
7	EBS- BX-18	1,59	64,6	-125,87
8	EBS-BX-19	1,03	54,5	-134,98
9	EBS-BX-20	0,74	57,1	-123,23

No.	Sampling station ID	TOC %	Humidity %	Depth (m)
10	EBS-BX-21	1,72	64,9	-126,72
11	EBS-BX-22	1,58	68,4	-126,44
12	EBS-BX-23	2,00	67,2	-125,83
13	EBS-BX-24	2,03	66,0	-126,29
14	EBS-BX-29	1,75	62,3	-129,08
15	EBS-BX-32	1,74	65,0	-122,99
16	EBS-BX-33	1,68	67,3	-135,01
17	EBS-BX-34 (nou)	7,50	92,8	-948,86
18	EBS-BX-35 (nou)	7,50	88,0	-956,90
19	EBS-BX-39	4,50	78,6	-1030,80
20	EBS-BX-40	7,20	86,0	-347,36
21	EBS-BX-41	3,85	81,6	-967,79
	Average	2,72	68,72	
	Standard deviation	2,14	10,93	
	Variation (%)	78,5	15,9	
	Lazăr et al 2012 Average	3,38	Not applicable	
	Standard deviation	2,70	Not applicable	

The recorded levels of TOC (Total Organic Carbon) are high, and the sediments can be considered organically rich, ranging from 0.74% to 7.50%, with an average of 2.72% ± 2.14 SD.

The interpretation of the results obtained for TOC in the analysed sediment samples led to the following conclusion: these records reflect the dominance of fine sediment powders in the region. The lowest level of TOC was recorded at station EBS-BX-20, which coincides with the lowest percentage of fine sediment powders, thus providing a smaller surface area for the addition of organic material proportionally. TOC here is expected to reflect both autochthonous and allochthonous material. Primary production in both forms - phytoplankton and macro algae - will represent an important component of TOC, especially during bloom periods in summer. Additionally, TOC is expected to be strongly influenced by allochthonous material, which includes carbon sources entering the surrounding marine area.

The moisture content was remarkably high, ranging from 50.1% to 92.8% (average of 68.72% ± 10.93 SD) at all stations, but only four stations had moisture levels above 60%. This level of water retention is considered typical for this region in the Black Sea, with generally higher moisture percentages as the water advances in depth[3].

Hydrogen sulphide (H2S) in sediments

Hydrogen sulphide (H2S) has been analysed in sediment samples, often resulting from the microbial decomposition of organic matter in the absence of oxygen.

The concentrations of hydrogen sulphide measured in the Neptun Deep sediments are presented in Table 4.20. The analysis of the results indicates high levels in the deeper area of the study zone, with the highest concentration (871.2 uM) recorded at station EBS-BX-34 (new), with a study average of 401.8 uM ± 35.3 SD. The high concentration of hydrogen sulphide was measured at

[3] Report on the Environmental Baseline Study for the Neptun Deep Project, Benthic Solutions Ltd., 2018, pages 18-19.

station EBS-BX-20, which coincides with the presence of a seabed fault, and therefore, the result is attributed to natural gases and other deep fluids generated along the fault line.

Table 4.20 Concentration of H2S in Sediments

No.	Sampling station ID	H_2S (uM)	Concentration range	Depth (m)
1	EBS- BX-17	<0,06	low	-119,82
2	EBS- BX-18	<0,06	low	-125,87
3	EBS-BX-19	1,70	low	-134,98
4	EBS-BX-20	64,67	high	-123,23
5	EBS-BX-21	<0,06	low	-126,72
6	EBS-BX-22	<0,06	low	-126,44
7	EBS-BX-23	<0,06	low	-125,83
8	EBS-BX-24	<0,06	low	-126,29
9	EBS-BX-29	<0,06	low	-129,08
10	EBS-BX-32	<0,06	low	-122,99
11	EBS-BX-33	6,67	medium	-135,01
12	EBS-BX-34 (nou)	871,24	high	-948,86
13	EBS-BX-35 (nou)	766,15	high	-956,90
14	EBS-BX-39	436,39	high	-1030,80
15	EBS-BX-40	392,44	high	-347,36
16	EBS-BX-41	675,39	high	-967,79
17	***Average***	401,83	Not applicable	353,56
18	***Standard deviation***	350,33	Not applicable	
19	***Variation (%)***	87,20		

Hydrocarbons in sediments

The results of the analyses regarding the concentration of hydrocarbons in sediments are summarized in Table 4.21.

Table 4.21 Concentration of Hydrocarbons in Sediments

No.	Sampling station ID	THC mg/kg	Total n-alcani ng/g	Alcan %	Carbon index	Report Pristan/ fitan	Total HAP ng/g	NPD ng/g	NPD %
1	EBS- BX-03A	68,6	2.464	3,59	3,86	2,9	540,1	250,6	46,40
2	EBS- BX-05A	174,6	4.966	2,84	3,80	3,4	1.067,1	396,5	37,16
3	EBS- BX- 10	85,8	2.462	2,87	4,11	3,8	445,2	78,8	17,71
4	EBS- BX-11	51,6	2.069	4,01	4,45	3,30	305,9	67,0	21,91
5	EBS- BX- 15	42,5	2.907	6,84	3,95	1,5	653,7	146,8	22,46
6	EBS-BX-17	24,4	1.384	5,67	5,45	3,6	179,1	45,6	25,44
7	EBS-BX-18	39,9	2.646	6,62	5,06	2,4	380,5	109,2	28,71
8	EBS-BX-19	13,1	797	6,08	4,64	3,6	73,9	32,4	43,80
9	EBS-BX-20	17,6	629	3,57	2,82	2,5	117,6	24,1	20,52
10	EBS-BX-21	16,0	2.016	12,64	5,73	0,6	255,7	85,1	33,30
11	EBS-BX-22	31,3	2.130	6,80	3,90	1,2	464,6	129,8	27,93
12	EBS-BX-23	25,7	2.296	8,93	5,53	1,4	335,8	113,6	33,83
13	EBS-BX-24	18,5	1.865	10,09	5,50	1,8	266,3	99,4	37,33
14	EBS-BX-29	20,6	1.975	9,59	5,30	2,1	245,2	97,8	39,88
15	EBS-BX-32	23,3	2.088	8,95	5,20	2,9	383,1	103,3	26,97
16	EBS-BX-33	27,8	2.150	7,74	5,03	2,4	248,7	105,0	42,21

No.	Sampling station ID	THC mg/kg	Total n-alcani ng/g	Alcan %	Carbon index	Report Pristan/ fitan	Total HAP ng/g	NPD ng/g	NPD %
17	EBS-BX-34 (nou)	694,3	31.982	4,61	4,64	2,4	6.292,1	1345,3	21,38
18	EBS-BX-35 (nou)	469,1	21.240	4,53	4,75	2,3	4.233,0	939,2	22,19
19	EBS-BX-39	329,2	17.035	5,17	5,07	1,5	3.552,18	719,3	20,25
20	EBS-BX-40	428,2	25.047	5,85	5,07	2,2	4.833,5	1025,2	21,21
21	EBS-BX-41	310,3	16.845	5,43	5,51	1,7	3.025,0	593,7	19,63
	Average	*138,7*	*6.999,7*	*6,31*	*4,73*	*2,4*	*1.328,5*	*309,9*	*29,1*
	Standard deviation	*192,3*	*9.316,9*	*2,59*	*0,76*	*0,9*	*1.852,8*	*383,6*	*9,0*
	Variation%	*138,7*	*133,1*	*41,1*	*16,0*	*37,3*	*139,5*	*123,8*	*31,3*

Total hydrocarbon concentrations in sediments.

The total hydrocarbon content (THC) in sediments, measured by integrating all non-polarized components using GC analysis, indicates high concentrations ranging from 13.1 mg/kg at station EBS-BX-19 to 694.3 mg/kg at the deeper station EBS-BX-34 (new).

In areas where fine sediment powders such as silts and clays dominate, contaminants like THC are more likely to be retained in the substrate (i.e., a basin) than in areas where sandy sediments dominate due to a higher potential for adsorption onto grains.

Most stations along the continental shelf exhibited THC levels below 50 mg/kg, with higher levels found in deep-sea sediments.

Saturated/aliphatic hydrocarbons

Using Gas Chromatography (GC-FID), all samples were analysed to determine the concentration of n-alkanes. The obtained results are summarized in Table 4.21.

The total concentrations of n-alkanes were moderate and varied from 629 ng/g to 31,892 ng/g, with an average of 6,999 ng/g ± 9,317 SD. The highest concentration of n-alkanes was determined at station EBS-BX-34 (new), similar to THC, while the lowest concentration was recorded at EBS-BX-20.

The total concentration of alkanes accounted for <10% of the extracted THC (on average 6.31% ± 2.59 SD), except for stations EBS-BX-21 (12.64%) and EBS-BX-24 (10.09%). This is relatively low and is generally expected in uncontaminated marine sediments, where background hydrocarbons are continuously replenished by a low but chronic source of alkanes. In this case, it may indicate the potential for prolonged hydrocarbon migration towards the seafloor.

Carbon Preference Index (CPI).

The Carbon Preference Index (CPI) is associated with the preference for biogenic n-alkanes (i.e., a preference for odd-numbered carbon homologues, particularly around nC27-33; Sleeter et al., 1980) derived from fatty acids, alcohols, esters, and terrestrial plant waxes. CPI was calculated for all stations, and the results ranged from 2.82 to 5.73 (average of 4.73 ± 0.76 SD) for the complete saturated range (nC10-nC37). As expected, these values indicate a dominance of biogenic compounds, although it is unclear if they are entirely allochthonous in nature. Biogenic

compounds refer to chemicals that are produced by living organisms or are involved in their biological processes.

The Pristane/ Phytane report

Pristane and phytane are both isoprenoid alkanes commonly found in petroleum (Berthou and Friocourt, 1981). However, in biogenic environments, only pristane is typically found in the marine environment as it is naturally biosynthesized and a fraction product of chlorophyll phytol. Phytane is generally absent or present only at low levels in uncontaminated natural systems (Blumer and Snyder, 1965). This ratio can be taken as an indication of a depositional environment (Peters et al., 2005). The presence of both isoprenoids in similar levels is typically considered an indication of petroleum contamination.

The Pristane/ Phytane ratio varied from 0.6 to 3.8 (average of 2.4 ± 0.9 SD). All stations exhibited a dominance of biogenic pristane, except for Station EBS-BX-21, which showed a dominance of phytane from petro genic sources (ratio =<1). This could be attributed to sedimentary influence on the seafloor, resulting from planktonic contributions and terrestrial inputs.

It should be noted that the interpretation of the Pristane/Phytane ratio can often be challenging due to its erratic nature and should primarily be used to support other interpretations. The use of this ratio in interpretive discussions has faced criticism, primarily due to the natural occurrence of phytane in some older sediments and the sedimentary variability of pristane, leading to confusion induced by variability in phytoplankton numbers (Blumer and Snyder, 1965).

Polycyclic Aromatic Hydrocarbons (PAHs) in sediments.

Polycyclic Aromatic Hydrocarbons (PAHs) were analysed for each sample using gas chromatography-mass spectrometry (GC-MS) method. The analysis of samples collected from the continental shelf indicated low concentrations of total PAHs. The total PAH concentrations (2-6 compounds) showed high values in many samples ranging from 73.9 ng/g at station EBS-BX-19 to 6,292.1 ng/g at station EBS-BX-34 (new) (average of 1,328.5 ng/g ± 1,852.8 SD), with generally higher levels recorded near the coast and in deeper waters. This could be attributed, like the levels of THC and total alkanes, to the finer sediment composition in deeper stations as well as the impact of terrestrial pollution near the coastal stations.

Concentrations of heavy metals and trace metals in sediments.

The results of the analysis of heavy metals and trace metals in sediments are presented in Table 4.22.

Table 4.22 Concentrations of Heavy Metals and Trace Metals in Sediments

No.	Sampling Station ID	Arsene mg/kg	Cadmium mg/kg	Chrom mg/kg	Copper mg/kg	Lead mg/kg	Mercury mg/kg	Nickel mg/kg	Selenium mg/kg	Zinc mg/kg	Iron mg/kg	Aluminium mg/kg	Barium mg/kg	Chrom VI mg/kg
1	EBS- BX-03A	5,37	0,30	23,0	7,24	17,02	0,84	2,12	4,27	52,42	4,29	9.301	41,43	3,26
2	EBS- BX-05A	9,41	0,54	49,96	0,22	46,57	0,70	4,26	4,45	81,75	28,59	20.784	175,61	7,13
3	EBS- BX- 10	13,09	0,51	26,81	12,54	20,20	0,47	27,15	6,77	46,99	7,18	14.582	551,46	5,84
4	EBS- BX-11	1,20	0,30	15,35	10,35	23,12	0,48	15,26	5,46	38,38	9,96	8.472	398,13	2,58
5	EBS- BX- 15	11,71	0,35	25,79	14,21	20,77	0,71	3,06	6,52	47,05	10,71	15.873	486,19	1,13
6	EBS-BX-17	12,07	0,49	17,24	10,79	6,52	4,19	15,26	6,90	88,63	9,96	7.182	285,72	3,26
7	EBS-BX-18	11,03	0,32	24,23	0,44	18,14	0,48	18,49	5,63	48,78	6,22	12.128	390,91	3,79
8	EBS-BX-19	2,23	0,38	20,80	8,23	5,81	0,57	13,01	5,75	37,41	0,62	12034	323,08	<0,16
9	EBS-BX-20	5,36	0,34	8,64	6,34	4,18	0,66	7,20	5,00	18,37	9,96	3.989	99,47	2,50
10	EBS-BX-21	2,85	0,70	15,01	10,69	10,21	0,34	13,13	4,59	34,78	9,96	7.131	246,81	5,61
11	EBS-BX-22	2,75	0,33	16,52	6,45	5,79	0,34	3,92	0,44	23,52	49,80	9.350	214,44	2,96
12	EBS-BX-23	3,45	0,47	15,91	11,16	11,69	0,38	12,94	5,04	39,61	1,10	6.840	272,85	1,06
13	EBS-BX-24	3,93	0,46	17,02	10,87	9,48	0,41	14,48	5,55	39,0	4,22	8.021	396,10	1,13
14	EBS-BX-29	2,69	0,41	15,44	10,66	8,69	0,35	9,77	0,38	37,09	2,55	7.554	374,10	2,96
15	EBS-BX-32	1,25	0,26	11,15	12,40	6,18	<0,05	3,73	0,44	21,99	50,0	4.435	119,38	0,45
16	EBS-BX-33	0,82	0,37	23,31	8,53	6,78	0,38	10,13	0,27	31,43	0,63	16.544	267,83	<0,16
17	EBS-BX-34 (nou)	10,01	<0,1	17,71	42,53	23,33	<0,05	27,13	3,81	76,29	49,90	8.951	548,87	<0,16
18	EBS-BX-35 (nou)	10,49	<0,1	14,49	46,90	28,69	<0,05	29,36	3,39	68,75	50,00	7.503,4	610	<0,16
19	EBS-BX-39	13,30	1,22	19,80	57,30	26,00	0,18	42,90	2,70	77,20	17.100	11.400	369,0	<0,1
20	EBS-BX-40	14,80	2,83	25,20	23,31	21,81	0,51	15,36	1,11	97,29	7,04	16.325	1.288,6	<0,16
21	EBS-BX-41	6,94	<0,1	20,93	32,55	15,22	<0,05	22,07	2,82	52,99	49,90	12.370	239,74	3,60
	Average	*6,89*	*0,59*	*20,21*	*16,37*	*16,01*	*0,71*	*14,80*	*3,87*	*50,46*	*1.431,10*	*10.508,7*	*366,65*	*3,15*
	Standard deviation	*4,68*	*0,60*	*8,36*	*15,41*	*10,36*	*0,91*	*10,34*	*2,23*	*22,69*	*4.934,43*	*4.359,82*	*259,70*	*1,90*
	Variation%	*67,8*	*102,2*	*41,4*	*94,2*	*94,2*	*64,7*	*129,5*	*57,5*	*45,0*	*344,8*	*41,5*	*70,8*	*60,2*
	ERL	*8.2*	*1.2*	*81.00*	*34.0*	*46.70*	*0.15*	*20.90*	-	*150.0*				
	ERM	*70.00*	*9.6*	*370.00*	*270*	*218.00*	*0.71*	*51.60-*	-	*410.0*				

ERL- Effects Range-Low, ERM - Effects Range- Median

Metals are generally not harmful to organisms at concentrations typically found in marine sediments, and some, such as zinc, can be essential for a normal metabolism, although they can become toxic above a critical limit.

Cadmium levels were significantly reduced in samples collected from the study area, ranging from below the limit of detection (LOD) to 2.83 mg/kg (average of 0.59 mg/kg ± 0.60 SD), with exceedances of the ERL at sample EBS-BX-39.

Mercury (Hg) concentration varied from below the LOD at stations EBS-BX-32, EBS-BX-34 (new), EBS-BX-35 (new), and EBS-BX-41, to a high concentration of 4.19 mg/kg at station EBS-BX-17, with an average of 0.71 mg/kg ± 0.91 SD and exceedances of the ERL in almost all samples.

Lead (Pb) concentrations were moderate and ranged from 4.18 mg/kg to 46.57 mg/kg, with an average of 16.01 mg/kg ± 10.36 SD.

The concentration of naturally occurring barium (Ba) varied from 41.13 mg/kg to 1,288.63 mg/kg (average of 366.65 mg/kg ± 259.70 SD).

Chromium (Cr) concentrations ranged from 8.64 mg/kg at EBS-BX-20 to 49.96 mg/kg at station EBS-BX-05A. The levels of hexavalent chromium (Cr VI) were variable, ranging from LOD to a maximum value of 7.13 mg/kg at station EBS-BX-05A, with slightly higher levels near the shore.

Nickel (Ni) concentrations were low to moderate overall (average of 14.80 mg/kg ± 10.34 SD), with exceedances of the ERL in samples EBS-BX-10, EBS-BX-34 (new), EBS-BX-35 (new), EBS-BX-39, and EBS-BX-41.

Selenium levels ranged from 0.27 mg/kg at station EBS-BX-33 to 6.90 mg/kg at station EBS-BX-17.

Copper (Cu) concentrations varied from low to high, with an average of 16.37 mg/kg ± 15.41 SD. Higher concentrations were observed in the deeper sector of the Neptun Deep study area, particularly in samples EBS-BX-34 (new), EBS-BX-35 (new), and EBS-BX-39, exceeding the ERL (34.0 mg/kg).

Zinc (Zn) was present at moderate levels in all stations, with an average of 50.46 mg/kg ± 22.69 SD.

Arsenic (As) concentrations varied within the study area (average of 6.89 mg/kg ± 4.68 SD), with eight samples exceeding the ERL of 8.20 mg/kg.

Results of sediment sample tests conducted in the year 2023.

In the period of May-June 2023, a sediment sampling campaign was conducted in the coastal area along the gas production pipeline route and near the shoreline at water depths ranging from -2m to -40m.

A total of 13 sampling locations were established within the program, and 13 sediment samples were collected for physico-chemical analysis.

Table 4.23 Coordinates of Sediment Sampling Locations, 2023 Campaign

No.	Testing station ID	Stereo70 Coordinates	
		X	Y
1	P7	797892.711	281363.511
2	P8	797417.811	279705.604
3	P9	804686.477	280890.871
4	P10	803853.723	280612.727
5	P21	797860.906	280110.636
6	P23	799103.732	280589.567
7	T3.1	795625.573	281892.106
8	T6.5	795747.489	279583.284
9	T4.1	795781.371	280989.199
10	T3.5	796382.003	281657.859
11	T5.1	795701.131	280663.39
12	T6.1	794618.214	279684.318
13	T7.4	794156.438	280508.246

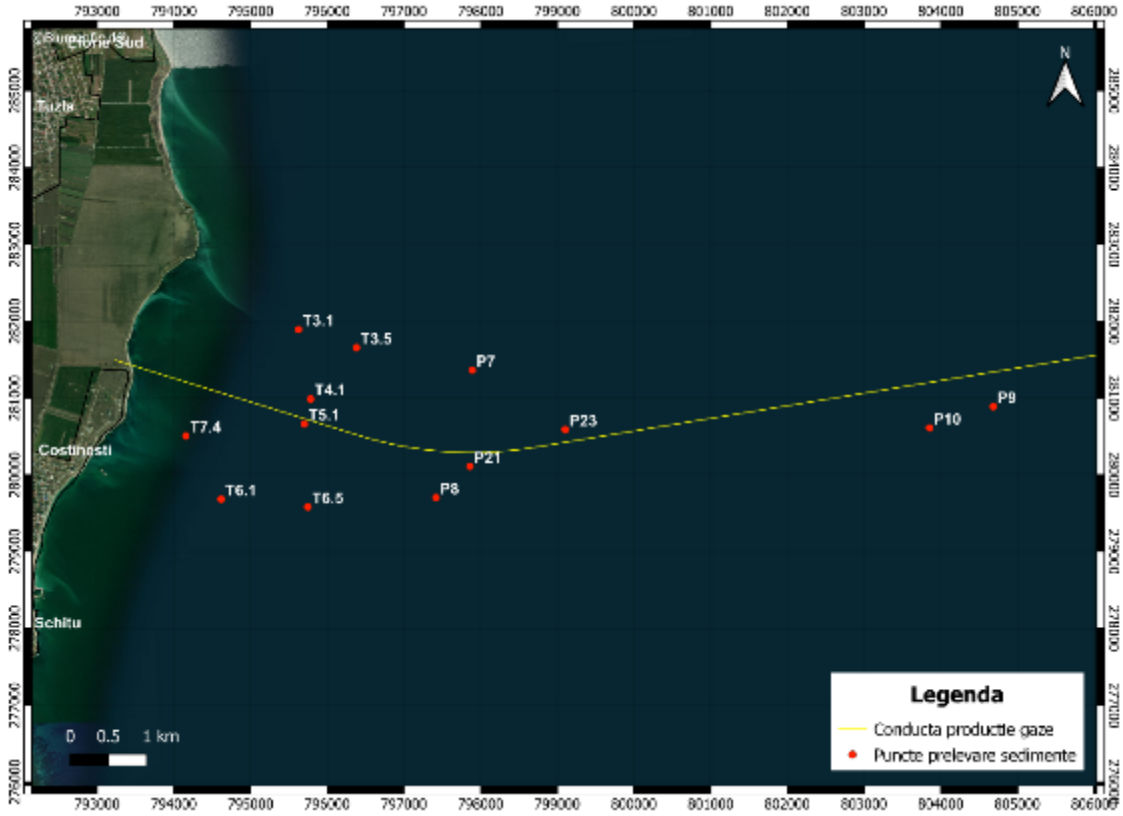


Figure 4.10 Sediment Sampling Station Locations, May-June 2023 Campaign, Blumenfield

The results of the analysis on the collected sediment samples are presented in Table 4.24.

Table 4.24 Physicochemical Analysis Results of Sediment Samples, May 2023

No.	ID sampling point	Cadmium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)	Nickel (mg/kg)	Petroleum product (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethyilbenzene (mg/kg)	Xylene (mg/kg)
1	P7	<LOQ	14,5	<LOQ	39,99	21,34	<LOQ (25,4)	nd	nd	nd	nd
2	P8	<LOQ	11,1	<LOQ	41,93	25,15	<LOQ	nd	nd	nd	nd

No.	ID sampling point	Cadmium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Zinc (mg/kg)	Nickel (mg/kg)	Petroleum product (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethyilbenzene (mg/kg)	Xylene (mg/kg)
							(34,5)				
3	P9	<LOQ	38,85	<LOQ	70,52	29,37	<LOQ (17,1)	nd	nd	nd	nd
4	P10	<LOQ	22,94	<LOQ	53,75	22,14	<LOQ (14,5)	nd	nd	nd	nd
5	P21	<LOQ	24,38	<LOQ	55,98	31,09	<LOQ (27,6)	nd	nd	nd	nd
6	P23	<LOQ	26,47	<LOQ	62,12	26,23	<LOQ (20,3)	nd	nd	nd	nd
7	T3.1	<LOQ	21,01	<LOQ	16,56	2,97	<LOQ (14,2)	nd	nd	nd	nd
8	T6.5	<LOQ	49,36	<LOQ	14,92	5,67	<LOQ (10,7)	nd	nd	nd	nd
9	T4.1	<LOQ	46,34	<LOQ	20,19	8,32	<LOQ (17,9)	nd	nd	nd	nd
10	T3.5	<LOQ	40,18	<LOQ	25,32	10,59	<LOQ (19,6)	nd	nd	nd	nd
11	T5.1	<LOQ	31,21	<LOQ	13,45	5,51	<LOQ (11,3)	nd	nd	nd	nd
12	T6.1	<LOQ	38,24	<LOQ	13,17	4,09	<LOQ (31,8)	nd	nd	nd	nd
13	T7.4	<LOQ	31,1	<LOQ	23,31	1,09	<LOQ (10,4)	nd	nd	nd	nd
Limit Order MAPM 161/2006		0,8	85	0,3	150	35	-	0,01	0,01	0,03	0,1
ERL		1,2	46,70	0,15	150	20,90					
ERM		9,6	218	0,71	410	51,60					

Legend:
ERL- Effects Range-Low, **ERM** - Effects Range- Median

Analysing the obtained data, the following aspects could be highlighted:

- The concentration of Cadmium in sediments was below the method's detection limit (0.1 mg/kg). These values at very low levels can be correlated with the data obtained for the analysed water samples, where the cadmium concentration was also lower than the method's quantification limit of 0.5 µg/L.
- In the case of Lead, the obtained results ranged from 11.1 mg/kg to 49.36 mg/kg, values below the maximum value of 85 mg/kg indicated by Order 161/2006. Most of the values were below the ERL limit, except for a single analysed sample T_6.5, which had a result of 49.36 mg/kg. The average value was 30.4 mg/kg, indicating that adverse effects on marine life are not expected.
- For Mercury, Order 161/2006 specifies an allowable limit of 0.3 mg/kg. The determined concentration for the analysed samples was below the method's detection limit of 0.1 mg/kg, which is below the ERL limit of 0.15 mg/kg and significantly lower than the ERM value of 0.71 mg/kg.
- The determined values for Zinc ranged from a minimum of 13.17 mg/kg for sample T_6.5 to a maximum of 70.52 mg/kg for sample P9. The average value was 34.70 mg/kg. All results were below the limit of 150 mg/kg specified by Order 161/2006 and the ERL limit.

- The average concentration for Nickel was 14.88 mg/kg, with values ranging from 1.09 mg/kg for sample T_7.4 to 31.09 mg/kg for sample P21. The determined values were below the limit of 35 mg/kg specified by the regulation. The samples coded with the prefix "T" had values below the ERL limit of 20.9 mg/kg, and all values were below the ERM limit of 51.6 mg/kg.
- For Petroleum Products (total petroleum hydrocarbons), all analysed samples had values below the method's quantification limit. There are no specific limits specified in the legislation for this parameter, and ERL and ERM limits were not determined.
- Mononuclear Aromatic Hydrocarbons such as benzene, toluene, and xylenes were not detected in the analysed samples. There are no established ERL and ERM limits for these compounds. Order 161/2006 specifies a maximum allowable limit of 0.01 mg/kg for benzene and toluene, 0.03 mg/kg for ethylbenzene, and 0.1 mg/kg for xylenes (total xylenes).

4.2.4 Data Collection and Inverstigation Methods

It was applied the method of reviewing of data and information of scientifical and technical nature from the documents, reports, and field studies carried out for the Neptun Deep project in the period 2018-2022.

The data regarding the initial state of the soil in the land area and the sediments in the marine area where the Neptun Deep project is located, had as a source of information both data from the specialized literature and results of the field studies carried out by the project owner during the period 2017 -2023, as follows:

Specialty literature:

- Geotectonics of Romania - Sandulescu M., 1984;
- Geology of the platform units and the North-Dobrogean Orogen - Ionesi L., 1994;
- Stratigraphic and tectonic synthesis of the Romanian Black Sea shelf and correlation with major land structure - C. Dinu, HK Wong, D. Tambrea, 2002;
- Field studies:
- Geotechnical Study for the Neptun Deep project - Geoservices & Technical consulting SRL 2021;
- Pedological study no. 341/16.06.2021 – Office of Pedology and Agrochemical Studies (OSPA);
- Geophysical interpretation report, archaeological diagnostic investigations, for the Neptun Deep project - National Institute for Marine Geology and Geo-ecology Research and Development (GeoEcoMar), 2020;
- Geotechnical and Marine Environmental Survey - GeoQuip Marine, 2017;
- Report on the initial state of the marine environment *(Environmental Baseline Survey Report)* - GeoQuip Marine, 2018;
- Study on initial investigations on soil and water - Jacobs (Halcrow Romania), 2019;
- Report on sediment quality indicators, coastal area of the Neptun Deep Project – Blumenfield, 2023

Field investigation methods involved taking soil and sediment samples and analyzing them in specialized laboratories for technical environmental analysis.

Sediment samples were taken with a bodengraifer (van veen graab), from aboard ships during marine expeditions, properly preserved and transported ashore. When they arrived at the laboratory, they were coded, the condition of the samples was checked for compliance with conservation requirements.

Chemical analyzes were performed according to standard methods for the determination of required chemical parameters. Where applicable, the results obtained were compared with legal references regarding maximum values for soil and marine sediment quality indicators.

4.3 DESCRIPTION OF THE WATER ENVIRONMENT FACTOR

4.3.1 Onshore Project Site

a) Surface Water

According to the updated Management Plan (2021) of the Danube River, Danube Delta, Dobrogea Hydrographic Basin, and Coastal Waters, the onshore project site is located within the Dobrogea Hydrographic Basin, covering an area of 10,712.65 km2.

The nearest registered surface watercourse to the onshore project site is the Tătlăgeacul Mare River, which is located over 5 km southwest of the project site. Other surface watercourses (rivers/creeks) within approximately a 20 km radius around the project site include Biruința, Dereaua, Tătlăgeacul Mic, and Albești.

The closest lakes to the onshore project site are Techirghiol Lake (Tuzla Lagoon), located 3.6 km north of the project, Techirghiol Lake (the freshwater section of the lake), situated 5.5 km northwest of the project, Tătlăgeac Lake, located 8 km south of the project, and Mangalia Lake, situated 20 km south of the project.

No surface watercourses (rivers or creeks) have been identified within the onshore project site.

The Black Sea is located approximately 60 m east of the eastern boundary of the onshore project site.

b) Groundwater

b.1 Characterization of groundwater from bibliographic sources

According to the information from the updated Management Plan (2021) of the Danube River, Danube Delta, Dobrogea Hydrographic Basin, and Coastal Waters, the onshore project site overlaps with three groundwater bodies: **RODL10 South Dobrogea, RODL04 Cobadin - Mangalia, and RODL06 Plaforma Valahă.**

Table 4.25 Groundwater Bodies in the Onshore Project Site Area

No.	Code	Name of the groundwater body	Type of water body	Quantitative state	Chemical state
1	RODL04	Cobadin – Mangalia	Depth	Good	Weak (significant exceedances of the quality standard for nitrates and localized exceedances for phosphates
2	RODL06	Platforma Valahă	Depth	Good	Good

No.	Code	Name of the groundwater body	Type of water body	Quantitative state	Chemical state
3	RODL10	South Dobrogea	Acvifer	Good	Weak (significant exceedances of the quality standard for nitrates and local exceedances for nitrogen, chlorides, and phosphates)

(Source: Updated Management Plan (2021) of the Danube River, Danube Delta, Dobrogea Hydrographic Basin, and Coastal Waters, pg. 308-322)

The onshore project's relation to groundwater is shown in Figure 4.11 below:

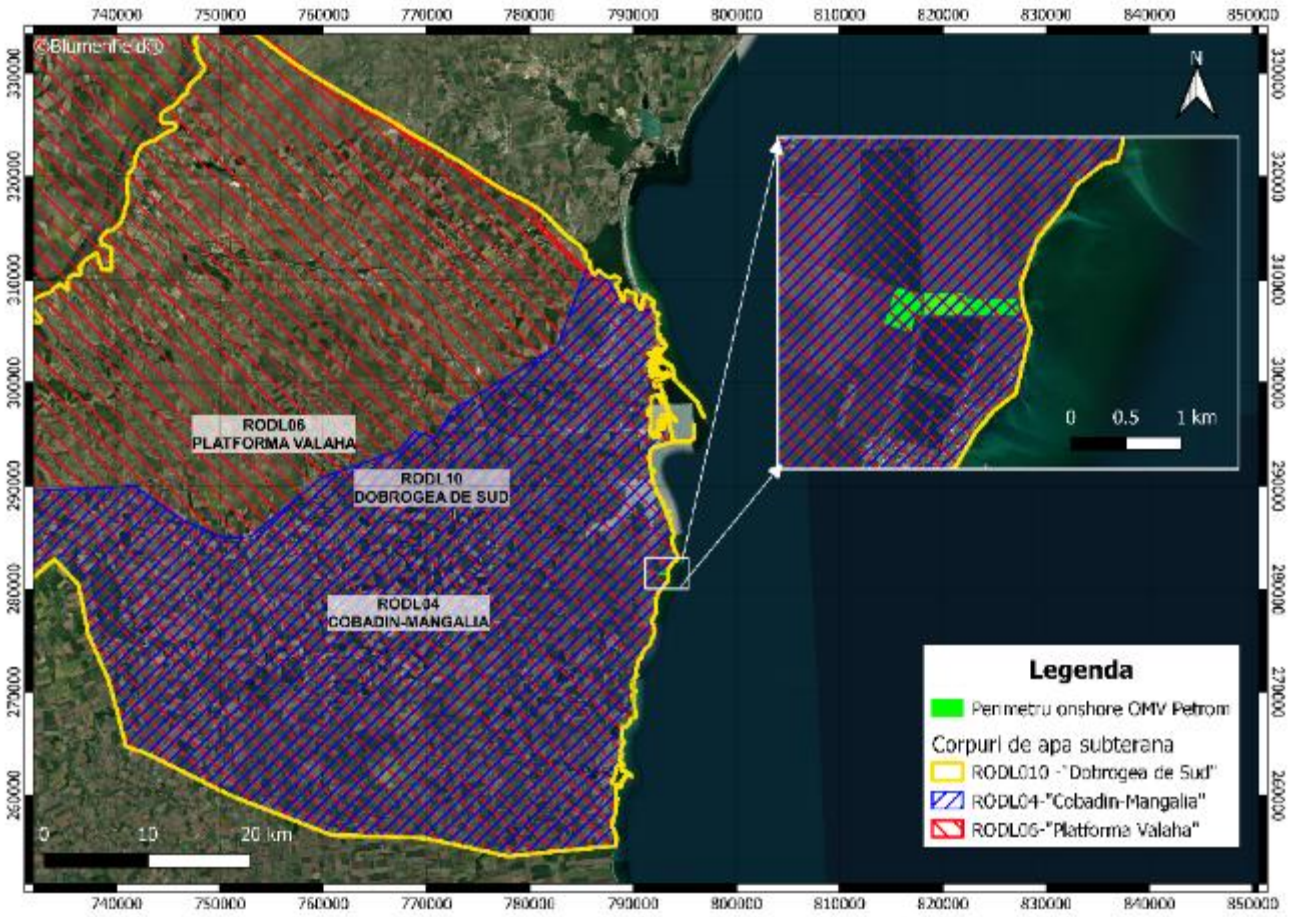


Figure 4.11 Identified Groundwater Bodies in the Project Area

The description of the characteristics of the groundwater bodies from the Updated Management Plan (2021) of the Danube River, Danube Delta, Dobrogea Hydrographic Basin, and Coastal Waters - Annexes, is as follows:

Groundwater body RODL04 - Cobadin-Mangalia

RODL04 (Cobadin – Mangalia) is of fractured-karstic type, developed in hard rocks, predominantly limestone and is a transboundary water body (with Bulgaria).

The deep groundwater body is accumulated in eolian and loessial Sarmatian limestone deposits located in the south-eastern part of Dobrogea. The Sarmatian limestone deposits form a plate with thicknesses ranging from 10 to 150 meters, gently sloping eastward, and contain free water

levels that represent the main source of supply for the coastline south of Eforie Nord. At the base of the Sarmatian limestones, there is a layer of Senonian chalks that act as the impermeable bed of the aquifer. At the upper part, the Sarmatian aquifer complex is generally covered by permeable Pleistocene loess deposits (Middle and Upper), but locally, there are also impermeable clay layers of Lower Pleistocene age. The piezometry suggests a flow from the Prebalkan Platform to the north and from the Cobadin Plateau to the east. Hydraulic gradients range between 0.004 and 0.01. In the eastern part of Southern Dobrogea, the levels of the Sarmatian aquifer are under pressure. In the Albești valley area, as well as in the Danube-Black Sea canal area, groundwater drainage from the Sarmatian can be deduced.

The aquifer is mainly recharged by precipitation and diffuse losses of water from existing irrigation systems.

Regarding hydrogeological parameters, it is observed that transmissivities (T) typically vary between 50 and 1,500 m^2/day, and the obtained discharge rates (Q) range from 0.02 to 10 l/s for heads ranging from 0.5 to 10 m.

The groundwater body RODL06 – Wallachian Plain

RODL06 (Wallachian Plain) is under pressure, being stationed in barremian-jurassic deposits, has a significant econimic importance and is a transboundary water body (with Bulgaria).

This deep groundwater body has a large extent, partially covering the Wallachian Plain, and is described below in two zones that present different levels of knowledge and exploitation: the Dobrogea de Sud development zone and the Giurgiu - Călărași zone.

In the Dobrogea de Sud development zone, the deep aquifer - partially with a water table (adjacent to the Danube) - is confined in Jurassic and Barremian limestone and dolomite formations, sometimes fractured and karstified, with regional extent (approximately 4500 km^2) throughout the entire South Dobrogea region.

The main conclusive elements are:

- The natural recharge area located in the southwestern part of the region.
- The main flow direction oriented WSW - ENE.
- The major drainage area located in the Siutghiol Lake area.
- The existence of local peculiarities regarding recharge (from the surface or through drainage), drainage, the major hydrogeological role of deep fractures in the Tuzla-Topraisar horst area, as well as pressure relationships with the upper aquifer.
- Actual flow velocities ranging from 120 to 1800 m/year and groundwater flow directions in different sub-regional areas.

In terms of hydrogeological characteristics, the following should be noted:

- Hydraulic gradients with values ranging from 0.0002 to 0.0016.
- The water table level is artesian, except in certain areas towards the Danube where it is free and around Tătlăgeac Lake.
- The main hydrogeological parameters are evaluated as follows: T = 1000 - 100,000 m^2/day and Q = 5-150 l/s for elevation differences of a few meters.

The groundwater body RODL10 – South Dobrogea

The groundwater body is unconfined and of poro-permeable or fissured type. It is located in current and subcurrent alluvial deposits (attributed to the Holocene), loess deposits (Upper Pleistocene-Holocene), loess (Middle Pleistocene-Upper Pleistocene), as well as at the boundary between loess/loessoid/red clays (the latter attributed to the Lower Pleistocene) and the terminal part of the Sarmatian deposits (Cotu Văii Formation), Upper Badenian (Seimeni Formation), or Lower Cretaceous. Due to lithological composition, geomorphological characteristics, and structural-tectonic conditions, the body exhibits significant variations both quantitatively and qualitatively, both horizontally and vertically.

It should be noted that three hydrogeological boreholes were drilled in the Techirghiol area, namely 5130, 5131, and 5132. In the case of borehole 5130, drilled to a depth of 35.1 m, the interval of 23-33 m was captured, with a discharge of 6.1 l/s, an elevation difference of 6 m, a water table depth of 1.25 m, hydraulic conductivity of 9.8 m/day, and an influence radius of 189 m. In borehole 5131, drilled to a depth of 50.5 m, the interval of 10-16 m was captured, with a discharge of 8.3 l/s, an elevation difference of 3.45 m, a water table depth of 1.06 m, hydraulic conductivity of 6.8 m/day, and an influence radius of 172 m. In borehole 5132, drilled to a depth of 40 m, the interval of 10-35 m was captured, with a discharge of 4.16 l/s, an elevation difference of 3.65 m, a water table depth of 2.05 m, hydraulic conductivity of 4.65 m/day, and an influence radius of 182 m.

b.2 Characterization of groundwater from field studies

For the characterization of groundwater in the project's onshore location, groundwater samples were collected in the year 2022. The groundwater samples were collected as follows: 8 samples from private and public wells located in the towns of Tuzla and Costinești,.

Details regarding the location of the sampling points are presented in Table 4.26 and Figure 4.12 below.

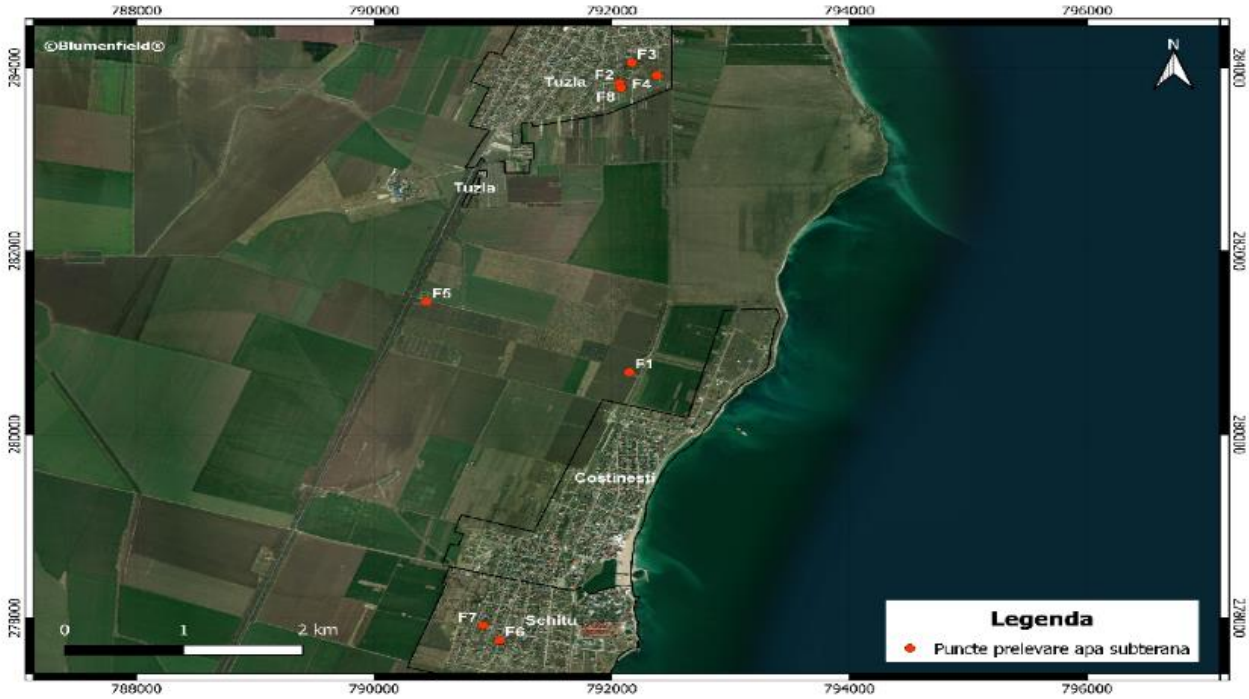


Figure 4.12 Groundwater Sampling Points

Table 4.26 Groundwater Sampling Points

Sampling location		Sampling date	Sampling points coordinates				Sampling location information
			Stereo 70 X (m) North	Stereo 70 Y (m) East	Geographic WGS 84 Lat (N)	Geographic WGS 84 Long (E)	
F1	Tuzla, at the administrative border Tuzla/Costinești Owner: Micu Liviu	28.04.2022	280.678,85	792.148,97	43°58'00.80"	28°38'21.50"	Drilled well. Water used for domestic purposes. Water table at a depth of 28m below ground level.
F2	Tuzla, Pescarilor Street, No. 3 Owner: Tudor Mircea	26.04.2022	283.830,08	792.065,12	43°59'42.86"	28°38'24.09"	The well is not frequently used, reserved as a backup. Water table at a depth of 5.5 m below ground level.
F3	Tuzla, Frunzelor Street, No. 13 Owner: Nitu Marin	26.04.2022	284.055,71	792.167,45	43°59'50.01"	28°38'29.13"	The well is not frequently used, reserved as a backup. Water table at a depth of 19.5 m below ground level.
F4	Tuzla, Pasajului Street, No. 102. Owner: Marta Cristina	27.04.2022	283.919,11	792.381,13	43°59'45.28"	28°38'38.43"	Drilled well, reserved as a backup. Water table at a depth of 40m below ground level.
F5	Tuzla Farm, adjacent to DN 39	26.04.2022	281.446,76	790.439,02	43°58'28.12"	28°37'6.45"	No data available for the well. A double sample was taken.
F6	Costinești, Radarului Street, No. 48, Owner: Dolana Gheorghe	27.04.2022	277.755,84	791.055,81	43°56'27.83"	28°37'26.68"	Costinești, Radarului Street, No. 48 Owner: Dolana Gheorghe
F7	Costinești, Paltinilor St., No. 42 Owner: Popa Gheorghe	27.04.2022	277.919,41	790.918,50	43°56'33.32"	28°37'20.86"	Private well used only as a backup solution The water table at a depth of 19 m bgl.
F8	Tuzla, Belsugului Street, No. 42 Owner: Cioara Maria	26.04.2022	283.781.29	792.078,66	43°59'41.20"	28°38'24.70"	Source of drinking water. Water table at a depth of 7.8m below ground level.

Table 4.27 Results of groundwater samples tests

No.	Parameter	M.U.	Limit values Order 621/2014			Sampling points								
			RODL04	RODL06	RODL10	F1 28 m	F2 5,5 m	F3 19,5 m	F4 40 m	F5 70 m	F6 21,2 m	F7 19 m	F8 7,80 m	QA/QC
1	Colour	_	-	-	-	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
	(apparent/true)	-	-	-	-	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
2	Nitrates	mg NO_3/l	-	-	-	18,1	205	235	48	12,5	230	220	560	12,0
3	N-NO_3	mgN/l	-	-	-	4,1	46	53	10,8	2,8	52,1	49,7	127	2,71
4	Nitrites	mg NO_2/l	0,5	0,5	0,5	0,02	0,05	0,12	0,01	<0,01	0,08	<0,01	0,03	<0,01
5	N-NO_2	mgN/l	-	-	-	0,006	0,015	0,036	0,003	<0,003	0,024	<0,003	0,009	<0,003
6	Kjeldahl Nitrogen	mgN/l	-	-	-	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5	<0,5
7	Total nitrogen (calculated)	mgN/l	-	-	-	4,14	46,1	53,2	10,8	2,8	52,1	50	127	2,71
8	Ammonium	mgNH_4/l	0,7	0,5	1,0	0,03	0,12	0,10	0,03	0,01	0,05	0,06	0,04	0,01
9	Ammoniacal nitrogen	mgN/l	-	-	-	0,02	0,09	0,08	0,02	0,01	0,04	0,05	0,03	0,01
10	Total suspended solids	mg/l	-	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2
11	Total Dissolved Solids	mg/l	-	-	-	1380	2070	2420	1760	110	2174	1860	2870	1170
12	Total Organic Carbon	mg/l	-	-	-	1,21	3,74	5,19	2,43	1,14	4,87	1,97	3,08	1,19
	Metal content in groundwater													
13	Barium (Ba)	µg/l	-	-	-	105	193	24,2	68,7	75,7	81,1	286	204	75,8
14	Cadmium (Cd)	µg/l	5,0	5,0	5,0	0,01	0,01	0,01	0,02	<0,005	0,10	0,02	<0,005	<0,005
15	Chromium (Cr)	µg/l	-	-	-	35,2	18,8	9,48	57,2	32,6	9,50	11,8	14,0	34,3
16	Copper (Cu)	µg/l	100	100	100	2,20	1,19	3,43	17,1	<0,2	2,50	7,28	0,92	<0,2
17	Mercury (Hg)	µg/l	1,0	1,0	1,0	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01
18	Nickel (Ni)	µg/l	200	200	200	2,20	1,21	1,84	0,42	0,06	1,02	1,00	0,33	0,06
19	Lead (Pb)	µg/l	10	10	10	0,17	0,10	0,29	0,86	0,03	0,52	0,15	0,05	0,03
20	Zinc (Zn)	µg/l	5000	5000	5000	24,4	24,5	7,47	36	8,37	156	62,9	6,35	8,98
	Polycyclic Aromatic Hydrocarbons (PAHs) (detection limit of the method 0.0005 µg/l for each component) nd- not detectable.													
21	Naphthalene	µg/l	-	-	-	0,007	0,010	0,006	0,006	0,012	0,007	0,005	0,007	0,012
22	2-methyl-naphthalene	µg/l	-	-	-	0,004	nd	0,003	0,004	0,004	0,004	0,003	0,003	0,004
23	1-methyl-naphthalene	µg/l	-	-	-	0,003	0,005	0,003	0,002	0,004	0,002	0,002	0,002	0,004
24	Acenaphthylene	µg/l	-	-	-	0,002	0,001	nd	0,001	nd	0,001	0,001	0,001	nd
25	Acenaphthene	µg/l	-	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
26	Fluorene	µg/l	-	-	-	0,003	0,003	nd	nd	0,002	nd	nd	nd	0,002
27	Phenanthrene	µg/l	-	-	-	0,005	0,006	0,003	0,003	0,004	0,005	0,003	0,003	0,004
28	Anthracene	µg/l	-	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd

No.	Parameter	M.U.	Limit values Order 621/2014			Sampling points								
			RODL04	RODL06	RODL10	F1 28 m	F2 5,5 m	F3 19,5 m	F4 40 m	F5 70 m	F6 21,2 m	F7 19 m	F8 7,80 m	QA/QC
29	Fluoranthene	µg/l	-	-	-	0,002	0,004	nd	nd	0,002	0,003	nd	nd	0,002
30	Pyrene	µg/l	-	-	-	0,005	0,003	nd	nd	0,002	0,002	nd	0,003	0,002
31	Benzo (a)anthracene	µg/l	-	-	-	nd	0,004	0,001	0,001	0,002	0,001	0,001	0,001	0,002
32	Chrysene	µg/l	-	-	-	nd	0,002	nd	nd	nd	0,002	0,001	0,001	nd
33	Benzo (b) fluoranthene	µg/l	-	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
34	Benzo (k) fluoranthene	µg/l	-	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
35	Benzo (e) pyrene	µg/l	-	-	-	nd	0,001	nd	nd	nd	nd	nd	nd	nd
36	Benzo (a) pyrene	µg/l	-	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
37	Indeno (1,2,3-cd) pyrene	µg/l	-	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
38	Dibenz (a,h) anthracene	µg/l	-	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
39	Benzo (g,h,i) perylene	µg/l	-	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
40	**Total PAH**	µg/l	-	-	-	***0,035***	***0,039***	***0,016***	***0,017***	***0,032***	***0,027***	***0,016***	***0,022***	***0,032***
	Total Petroleum Hydrocarbons (TPH) content (detection limit of the method is 0.5 µg/l for each component)													
41	C5- 12	µg/l				1,2	2,8	1,4	0,9	1,2	1,3	1,9	1,3	1,4
42	C13-40	µg/l				30,3	43,7	26,3	26,2	16,4	10,3	23,8	14,5	15,2
43	***TPH-GS***	***µg/l***				***32,1***	***46,5***	***27,7***	***27,1***	***17,6***	***11,6***	***25,7***	***15,8***	***16,6***
44	C5	%	-	-	-	0	0	0	0	0	0	0	0	0
	C6		-	-	-	0	0	0	0	0	0	0	0	0
	C7 (%)		-	-	-	0	0	0	0	0	0	0	0	0
	C8 (%)		-	-	-	0	0	0	0	0	0	0	0	0
	C9 (%)		-	-	-	0	0	0	0	0	0	0	0	0
	C10 (%)		-	-	-	0	0	0	0	0	0	0	0	0
	C11 (%)		-	-	-	0,6	1,3	1,2	0,5	0,7	1,1	1,7	1,0	1,1
	C12 (%)		-	-	-	3,3	4,6	4,0	2,9	6,2	10,2	5,5	7,1	7,0
	C13 (%)		-	-	-	1,3	4,6	2,5	0,9	1,5	2,9	0,1	3,4	2,5
	C14 (%)		-	-	-	1,4	5,4	1,8	1,1	4,1	4,2	0,4	6,7	2,8
	C15 (%)		-	-	-	1,5	5,4	1,8	2,0	4,0	4,5	3,1	8,3	6,8
	C16 (%)		-	-	-	1,0	1,3	0,1	0,5	1,5	2,3	1,4	1,9	4,8
	C17 (%)		-	-	-	1,7	0,5	0,1	0,5	3,9	3,2	1,3	3,4	6,6
	C18 (%)		-	-	-	2,4	6,2	0,1	0,5	5,2	6,1	12,9	2,3	7,0
	C19-C20 (%)		-	-	-	4,9	6,6	1,6	1,5	5,9	12,5	14,0	3,4	8,2
	C21-C22 (%)		-	-	-	8,7	2,0	1,6	6,1	3,9	8,0	2,2	3,5	5,4

No.	Parameter	M.U.	Limit values Order 621/2014			Sampling points								
			RODL04	RODL06	RODL10	F1 28 m	F2 5,5 m	F3 19,5 m	F4 40 m	F5 70 m	F6 21,2 m	F7 19 m	F8 7,80 m	QA/ QC
	C23 (%)		-	-	-	4,4	3,0	0,6	6,4	1,3	2,1	3,3	1,5	1,3
	C24 (%)		-	-	-	5,6	2,2	0,8	7,6	4,6	1,7	1,2	1,5	1,5
	C25-C26 (%)		-	-	-	8,1	4,2	2,5	12,8	1,1	3,4	3,0	3,7	2,7
	C27-C28 (%)		-	-	-	6,6	4,9	8,2	10,1	9,4	3,6	2,9	2,8	2,7
	C29-C30 (%)		-	-	-	8,6	9,5	12,2	10,7	7,8	6,3	6,0	3,1	1,9
	C31-C32 (%)		-	-	-	9,3	9,8	13,8	10,3	5,2	3,7	7,2	4,8	1,7
	C33-C34 (%)		-	-	-	8,2	8,1	13,0	6,9	3,5	2,5	8,1	6,9	1,7
	C35-C40 (%)		-	-	-	22,4	20,2	34,0	18,1	21,4	21,7	25,6	34,6	34,2
	Carbon Preference Index (CPI): nC12-20, nC21-36, nC12-36	µg/l	-	-	-	<0,1	<0,1	<0,1		<0,1	<0,1	<0,1	<0,1	<0,1
	nC12-20 (%)	%	-	-	-	17,4	34,6	12,2	10,4	32,2	45,8	38,8	36,5	45,7
	nC21-36 (%)		-	-	-	59,6	43,9	52,6	71,0	45,8	31,3	33,9	27,9	19,0
	C12-34					77,1	78,5	64,8	81,4	78,0	77,1	72,7	64,4	64,6
	Concentrations of certain organic compounds (detection limit of the method dibenzothiophene 0.0005 µg/l, Pristane 0.5 µg/l, Phytane 0.5 µg/l) nd - not detectable.													
45	Dibenzothiophene (DBT)	µg/l				nd	nd	nd	nd	nd	nd	nd	nd	nd
46	Pristane	µg/l				nd	nd	nd	nd	nd	nd	nd	nd	nd
47	Phytane	µg/l				nd	nd	nd	nd	nd	nd	nd	nd	nd

The analyses on groundwater samples were performed for the project holder by Bálint Analitika Kft Laboratory. According to the report, the results obtained indicate a good chemical condition of the water from all analysed samples.

4.3.2 The project's offshore location

4.3.2.1 Generalities

The study on the ecological status of the Black Sea marine ecosystem according to the requirements of Article 17 of the Directive for the Marine Strategy Framework (MSFD), conducted by the National Institute for Research and Development of Marine Geology and Geo-ecology (INCDM Gr. Antipa) in 2018, aims to assess the ecological status based on the criteria and indicators specified in Decision 2017/848/EU. The study was conducted for each of the water bodies delineated for MSFD, depending on data availability.

From the spatial distribution of decadal mean values of salinity, using available data from the World Ocean Data and INCDM, as well as monthly average values of chlorophyll-a for the period 07.2002-10.2013, Romanian marine waters were classified into four water bodies as follows:

- BLK_RO_RG_TT03 - Waters with variable salinity - waters with variable salinity located in the northern part, directly influenced by the Danube, from the river's mouth into the Black Sea, southwards to Portița, at depths of up to 30m. The waters are delineated by a seasonal average salinity of up to 8.0 PSU and an annual average of up to 14.5 PSU.
- BLK_RO_RG_CT - Coastal waters - coastal waters from the central to the southern part (from Portița to Vama Veche), from the baseline to the 30m isobath. The waters are delineated by a seasonal average salinity of 8 - 16 PSU and an annual average of up to 16.0 PSU.
- BLK_RO_RG_MT01 - Marine waters - the marine waters from the 30m isobath to 200m; waters within and outside the continental shelf, delineated by a seasonal and annual average salinity ranging from 16 - 17.5 PSU.
- BLK_RO_RG_MT02 - Open waters - the open marine waters, delineated by a seasonal and annual average salinity higher than 17.5 PSU, with the perimeter established for water depths of at least 200m.

The project section located at sea can be found in the coastal water body BLK_RO_RG_CT and the marine water body BLK_RO_RG_MT01, as shown in Figure no. 4.13 below.

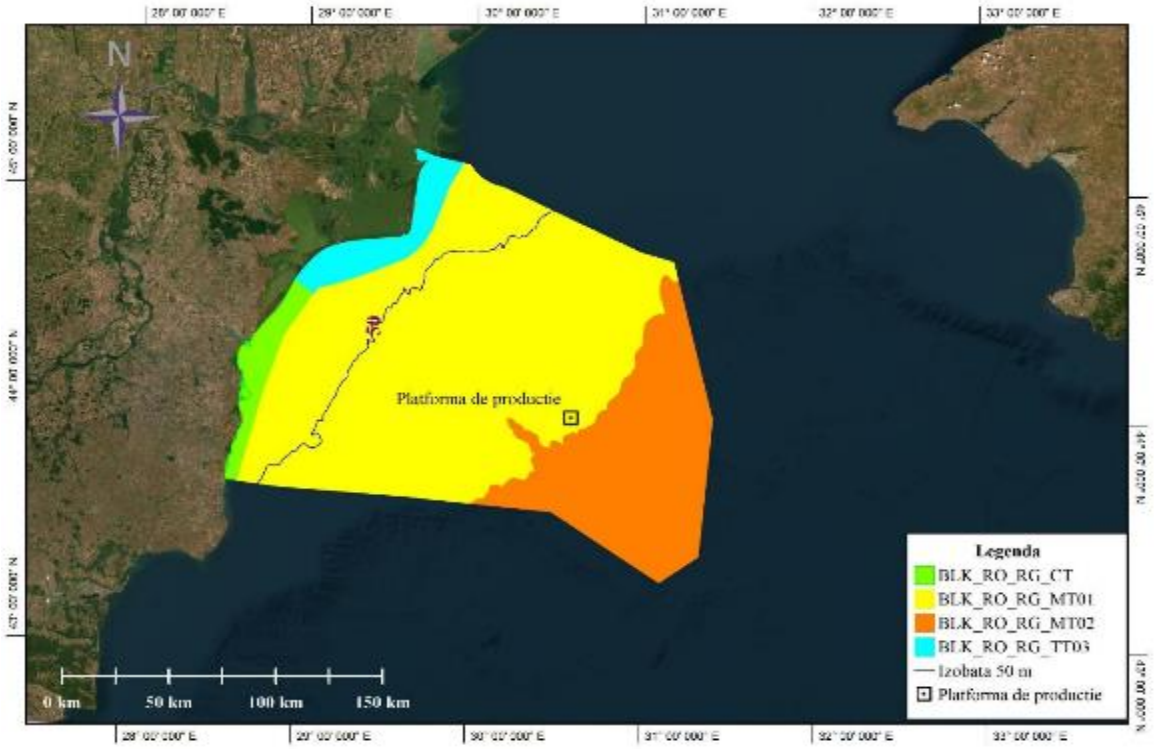


Figure 4.13 Location of the production platform relative to the marine waters.

4.3.2.2 Coastal Water (surface water)

According to the updated Management Plan for the Danube River, Danube Delta, Dobrogea Hydrographic Basin, and Coastal Waters, the coastal water body BLK_RO_RG_CT is classified by typology as follows:

- RO_CT01 - shallow coastal waters with sandy substrate located between Periboina and Cape Singol (including Mangalia Lake)
- RO_CT02 - shallow coastal waters with mixed substrate located between Cape Singol and Vama Veche

The studied project is located in the coastal waters with the code RO_CT02, and the abiotic parameters for this area are as follows:

- Salinity (‰): 14-18
- Tidal influence: negligible
- Depth (m): <30
- Wave exposure: moderate
- Mixing characteristics: permanently stratified
- Current velocity (knots): <0.5 - 1
- Average substrate composition: sand, pebbles
- Multiannual average water temperature (℃): 12-13
- Ice coverage duration: irregular

The water body RO_CT02 is divided into two sub-bodies: ROCT02_B1 Cape Singol - Eforie Nord and ROCT02_B2 Eforie Nord - Vama Veche.

References[4] regarding the ecological status of the water body ROCT02_B2 indicate a poor ecological status and a good chemical status.

As part of the field studies to assess the initial status of the water in the coastal area of the project, surface water samples were collected during two campaigns, one in 2022 and the other in May-June 2023.

In the 2022 campaign, 4 surface water samples were collected, including:

- 3 surface water samples (near the project location, upstream, and downstream of the project location)
- 1 duplicate surface water sample

Details of the sampling stations for surface water are presented in Table 4.28 (2022), and the locations of the sampling points in the area are shown in Figure 4.14 below.

Laboratory analytical results were compared with the regulations in Romania (Order 161/2006 for the approval of the Normative regarding the classification of the quality of surface waters for the determination of the ecological status of water bodies). It was found that there was an exceedance of nitrate nitrogen in all samples collected.

Order no. 161/2006 includes quality standards for determining the ecological and chemical status of coastal waters. As the surface water sampling points are located in areas affected by human activities (beach/coastal zone), the results were also compared with the quality standards provided for the class "Anthropogenic Impact State of Waters," as defined by Order no.161/2006.

Laboratory analysis results for surface water samples (Black Sea) are presented in Table 4.29 below.

Figure 4.14 Sampling points for surface water samples

[4] Annex 6.1 A to the Updated Management Plan of the Danube River, Danube Delta, Dobrogea Hydrographic Basin, and Coastal Waters

Table 4.28 Surface water sampling points (2022 campaign)

Sampling point		Sampling date	The coordinates of the sampling point				Information about the sampling point	Observations regarding the sample	Weather conditions
			Stereo 70 X (m) North	Stereo 70 Y (m) East	Geografic WGS 84 Lat (N)	Geographic WGS 84 Long (E)			
AS1 – Black Sea	The Black Sea - administrative boundary between Costinești and Tuzla	26.04.2022	281501.54	793420.44	43°58'25.56"	28°39'20.11"	The coastal area, at the boundary between Tuzla and Costinești Double sample collection - QA QC 2	Colourless, odourless	Sun, outdoor temperature 14°C
AS2 - Black Sea	The Black Sea - Costinești locality downstream of the project area	26.04.2022	280548.79	793146.40	43°57'55.14"	28°39'05.91"	The coastal area of the Black Sea in the vicinity of Costinești locality downstream of the project area, near the 'Pofta Pescarului' restaurant	Colourless, odourless	Sun, outdoor temperature 15°C
AS3 - Black Sea	The Black Sea - Tuzla locality upstream of the project area	26.04.2022	282846.08	794270.18	43°59'07.81"	28°40'00.90"	The coastal area of the Black Sea in the vicinity of Tuzla locality upstream of the project area, Cape Tuzla	Colourless, odourless	Sun, outdoor temperature 16°C

Table 4.29 Results of physicochemical tests for surface water

No.	Indicator	M.U	Quality standards			Sampling points			
			Ecological state	Zone of impact of anthropogenic activities	Chemical status - hazardous substances	AS1	AS2	AS3	QA QC
	Analiza chimică								
1	Culoare (aparentă si reală)	_	_	_	_	0/0	0/0	0/0	0/0
2	Total Suspended Solids	mg/l	_	_	_	<2,0	<2,0	<2,0	<2,0
3	Total Dissolved Solids	mg/l	_	_	_	22.100	21.700	22.400	21.500
4	Ammonium	mg /l	_	_	_	<0,01	<0,01	0,09	<0,01
5	Ammoniacal nitrogen	mgN/l	0.1	0.1	_	<0,01	<0,01	0,07	<0,01
6	Total Organic Carbon - TOC	mg/l	_	_	_	3,07	2,79	2,81	2,91

No.	Indicator	M.U	Quality standards			Sampling points			
			Ecological state	Zone of impact of anthropogenic activities	Chemical status - hazardous substances	AS1	AS2	AS3	QA QC
7	Nitrates	mg NO_3/l			_	0,6	0,4	1,9	0,7
	N-NO_3 (nitrogen from nitrates)	mgN/l	0,03	0,03		0,14	0,09	0,43	0,15
8	Nitrites	mgNO_2 /l			_	<0,01	<0,01	<0,01	<0,01
	N-NO_2 (nitrogen from nitrites)	mgN/l	1,5	1,5		<0,003	<0,003	<0,003	<0,003
9	Total nitrogen	mg N/l	_	_	_	<0,5	0,7	<0,5	<0,5
	Metal content								
10	Barium (Ba)	mg/l	_	_	0,2	0,0135	0,0104	0,0121	0,0128
11	Cadmium (Cd)	mg/l	0,005	0,005	0,001	0,00002	0,00004	0,00002	0,00002
12	Total Chromium (Cr)	mg/l	0,1	0,1	0,0025	0,00058	0,00086	0,00084	0,00064
13	Copper (Cu)	mg/l	0,03	0,03	0,0013	0,00074	0,00074	0,00092	0,00064
14	Lead (Pb) and compounds	mg/l	0,01	0,01	0,0017/ 0,0004	0,00034	0,00038	0,00130	0,00036
15	Mercury (Hg) and componds	mg/l	0,001	0,001	0,001	<0,00001	<0,00001	<0,00001	<0,00001
16	Nickel (Ni) and compounds	mg/l	0,1	0,1	0,0021/ 0,0013	0,00084	0,00084	0,00099	0,00078
17	Zinc (Zn)	mg/l	0,05	0,05	_	0,00925	0,0124	0,0118	0,00872
	The content of Polycyclic Aromatic Hydrocarbons								
18	Naphthalene	µg/l	_	_	2,4	0,010	0,008	0,010	0,010
	2-methyl-naphthalene	µg/l	_	_	_	0,003	nd	0,004	0,003
	1-methyl-naphthalene	µg/l	_	_	_	0,004	0,003	0,003	0,004
19	Acenaphthylene	µg/l	_	_	_	0,004	0,003	0,003	0,004
20	Acenaften	µg/l	_	_	_	0,001	nd	0,001	0,001
21	Fluorene	µg/l	_	_	_	0,001	nd	0,001	0,001

No.	Indicator	M.U	Quality standards			Sampling points			
			Ecological state	Zone of impact of anthropogenic activities	Chemical status - hazardous substances	AS1	AS2	AS3	QA QC
22	Phenanthrene	µg/l	_	_	0,03	0,006	0,008	0,006	0,006
23	Anthracene	µg/l	_	_	0,063	nd	nd	nd	nd
24	Fluoranthen	µg/l	_	_	0,09	0,002	nd	0,001	0,002
25	Pyrene	µg/l	_	_	_	0,001	nd	0,001	0,001
26	Benzo (a)anthracene	µg/l	_	_	0,01	0,001	0,003	0,001	0,001
27	Crisene	µg/l	_	_	_	0,001	nd	0,001	0,001
28	Benzo (b)fluoranthene	µg/l	_	_	0,025	nd	nd	nd	nd
29	Benzo (k)fluoranthene	µg/l	_	_	0,025	nd	nd	nd	nd
30	Benzo (a)pyrene	µg/l	_	_		nd	nd	nd	nd
31	Indeno (1.2.3-cd)pyrene	µg/l	_	_	_	nd	nd	nd	nd
32	Benzo (g.h.i)Perylene	µg/l	_	_	0,025	nd	nd	nd	nd
33	Dibenzo (a.h)anthracene	µg/l	_	_	_	nd	nd	nd	nd
35	Sum of PAHs	µg/l	_	_	_	0,033	0,033	0,033	0,033
36	**Total Petroleum Hydrocarbons** C5-12, C13-40	µg/l	-	-	200	22,8	37,8	16,7	20,6
	Carbon fractions of hydrocarbons								
37	C5 (%)	%	_	_	_	0	0	0	0
	C6 (%)		_	_	_	0	0	0	0
	C7 (%)		_	_	_	0	0	0	0
	C8 (%)		_	_	_	0	0	0	0
	C9 (%)		_	_	_	0	0	0	0
	C10 (%)		_	_	_	0	0	0	0

No.	Indicator	M.U	Quality standards			Sampling points			
			Ecological state	Zone of impact of anthropogenic activities	Chemical status - hazardous substances	AS1	AS2	AS3	QA QC
	C11 (%)		_	_	_	1,0	1,2	2,0	1,8
	C12 (%)		_	_	_	5,0	3,6	6,2	8,0
	C13 (%)		_	_	_	2,5	2,3	1,9	7,4
	C14 (%)		_	_	_	1,6	2,1	2,1	6,4
	C15 (%)		_	_	_	1,8	3,3	3,5	6,0
	C16 (%)		_	_	_	0,2	1,3	1,8	1,8
	C17 (%)		_	_	_	0,3	1,5	6,0	2,0
	C18 (%)		_	_	_	0,4	0,9	6,0	1,0
	C19-C20 (%)		_	_	_	2,2	3,2	11,0	2,8
	C21-C22 (%)		_	_	_	1,5	7,7	10,1	4,0
	C23 (%)		_	_	_	1,3	4,0	4,6	0,7
	C24 (%)		_	_	_	1,6	4,4	3,7	1,1
	C25-C26 (%)		_	_	_	6,8	6,8	4,2	3,1
	C27-C28 (%)		_	_	_	9,6	5,8	4,4	6,9
	C29-C30 (%)		_	_	_	12,7	6,1	7,3	10,2
	C31-C32 (%)		_	_	_	10,0	5,7	4,6	9,5
	C33-C34 (%)		_	_	_	8,1	4,5	1,8	7,2
	C35-C40 (%)		_	_	_	33,4	35,5	18,7	20,1
38	C10-C40 (mg/L)	µg/l	_	_	_				
	nC12-20 (%)	%	_	_	_	13,9	18,3	38,6	35,3
	nC21-36 (%)		_	_	_	51,6	45,1	40,7	42,5

No.	Indicator	M.U	Quality standards			Sampling points			
			Ecological state	Zone of impact of anthropogenic activities	Chemical status - hazardous substances	AS1	AS2	AS3	QA QC
	nC12-36 (%)		_	_	_	65,5	63,3	79,3	77,8
	Organic compounds								
39	Dibenzothiophene (DBT)	µg/l	_	_	_	nd	nd	nd	nd
40	Pristane	µg/l	_	_	_	nd	nd	nd	nd
41	Phytane	µg/l	_	_	_	nd	nd	nd	nd

nd – below the limit of detection (LOD); LOD - Dibenzothiophene 0,0005 µg/l, pristane 0,5 µg/l, phytane 0,52 µg/l, PAH – 0,0005 µg/l on each component

In the field studies conducted by Blumenfield® in May-June 2023 to collect data on the current environmental condition at the project site, 13 water samples were collected from the coastal and marine area of the project site (Figure 4.15).

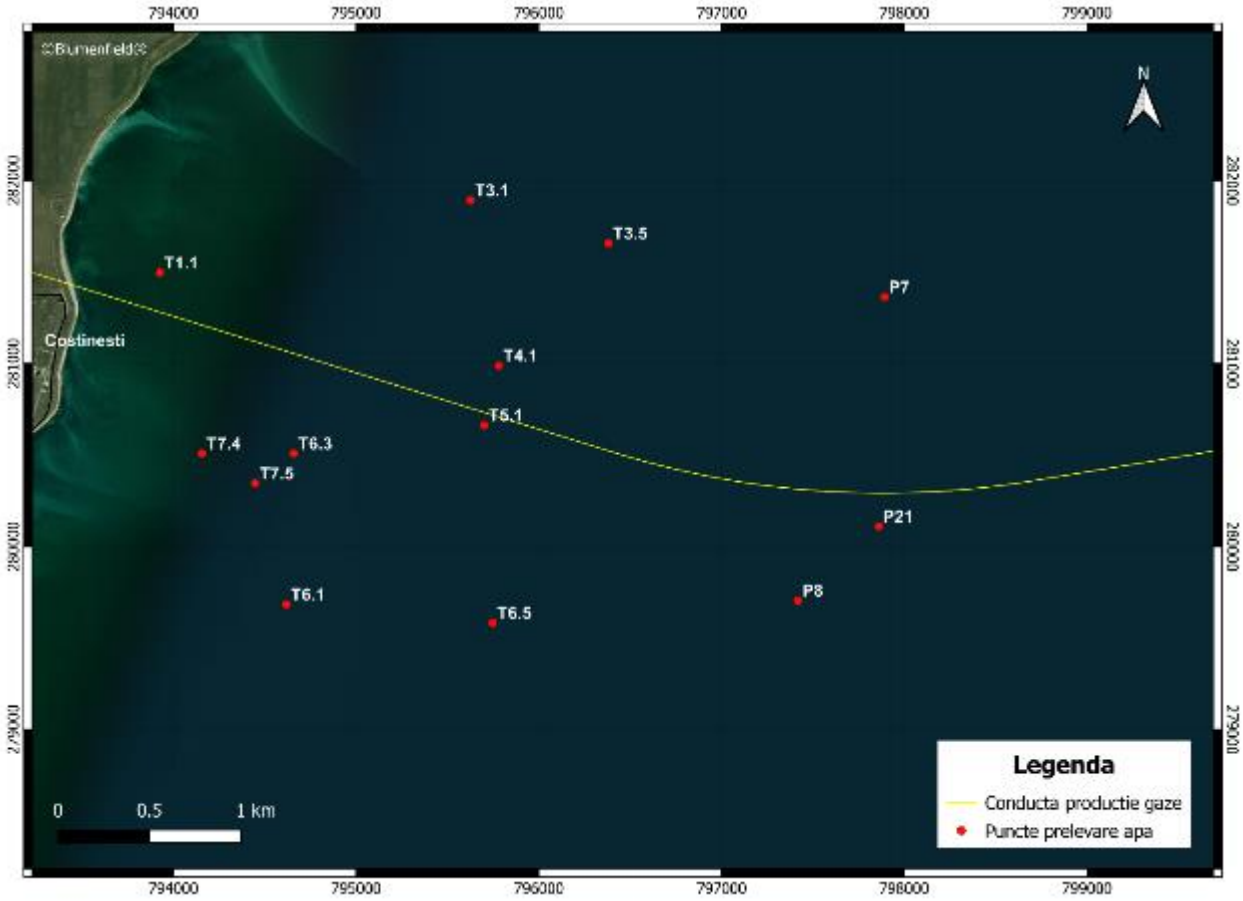


Figure 4.15 Location of coastal and marine water sampling stations relative to the positioning of the gas production pipeline, Neptun Deep Project (Blumenfield, May 2023)

The inventory of coordinates in the Stereo 70 system for the coastal water sampling points is presented in Table 4.30, and their locations on the map of the Black Sea can be found in Figure 4.16. The results of the physicochemical analysis of the coastal water samples are presented in Table 4.31

Table 4.30 Coordinates of coastal water sampling points in May 2023

Nr. crt	Point denomination	Coordinates Stereo70	
		X	Y
1	T1.1	793925.193	281496.752
2	T6.1	794618.214	279684.318
3	T6.3	794657.756	280508.988
4	T7.5	794447.200	280345.633
5	T7.4	794156.438	280508.246

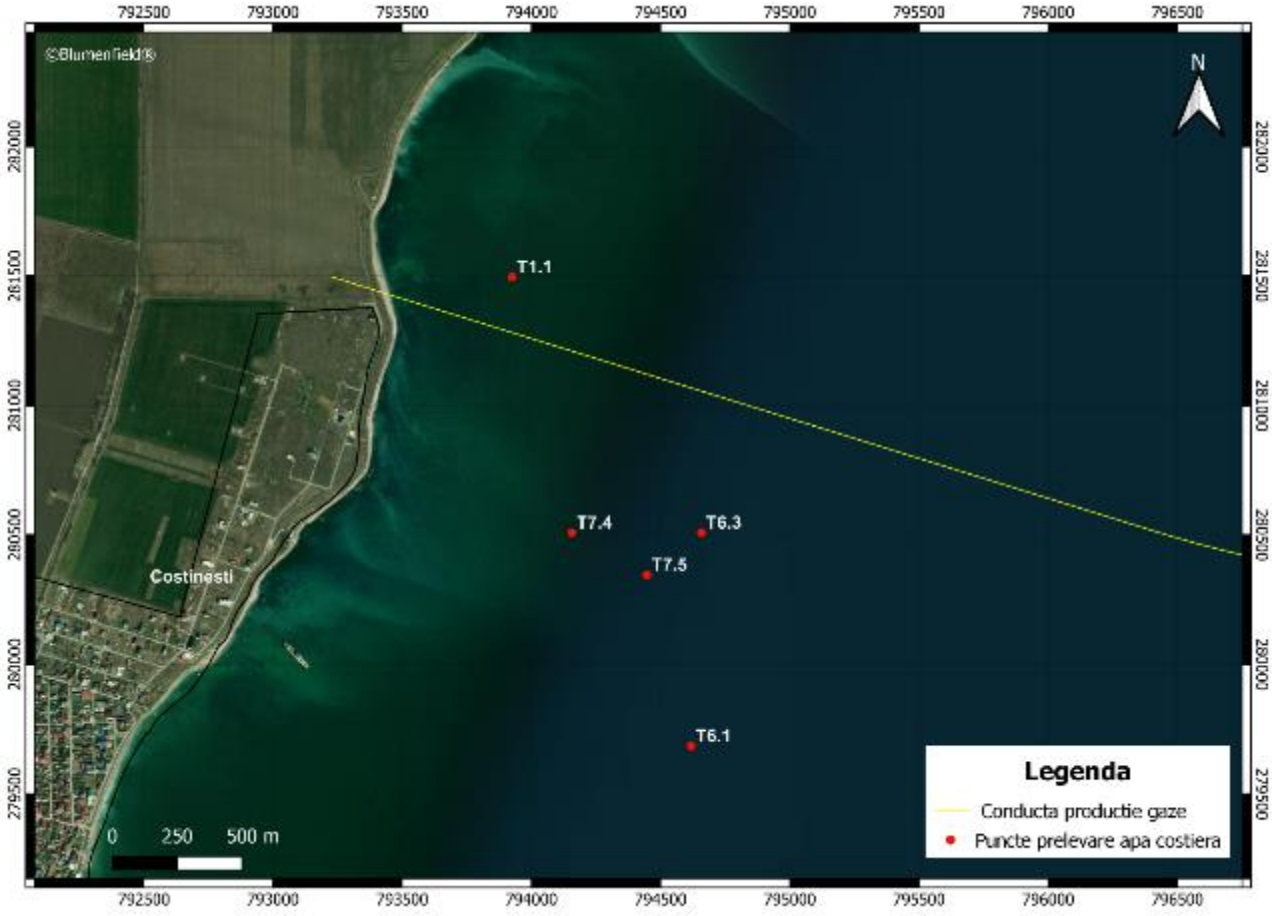


Figure 4.16 Coastal water sampling points in 2022

Table 4.31 Results of the tests on coastal water samples, 2023

Parameter		Quality standards (Order 161/2006)			Sampling points				
	M.U	Ecological state	Zone of anthropogenic activities impact	Chemical status - hazardous substances	T 1.1	T 6.1	T 6.3	T 7.5	T 7.4
pH	units	6,5- 9,0	6,5-9,0	-	8,3	8,3	8,3	8,3	8,3
Temperature	°C	-	-	-	15,20	14,70	14,90	15,10	15,20
Conductivity	(mS/cm)	-	-	-	21,30	21,20	21,30	21,30	21,20
Salinity	PSU	-	-	-	12,36	12,68	12,66	12,66	10,57
Turbidity	NTU	-	-	-	1,00	0,30	0,80	1,70	0,20
Total dissolved solids	g/l	-	-	-	10,28	10,53	10,48	10,52	10,45
O_2 dissolved	mgO_2/l	6,2	6,2	-	8,89	8,69	8,72	8,93	9,08
$N\text{-}NO_2$	mgN /l	1,5	1,5	-	0,0054	0,0048	0,0053	0,0053	0,0055
$N\text{-}NO_3$	mgN /l	0,03	0,03	-	0,055	0,019	<LOQ	0,137	0,046
Total Phosphorus	mg/l	0,1	0,1	-	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
Total suspended solids	mg/l	-	-	-	64,90	87,80	19,70	21,00	18,30
Petroleum product	mg/l	-	-	0,2	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
Cadmium	µg/l	5,0	5,0	1,0	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
Lead	µg/l	10,0	10,0	1,7	20,44	29,02	28,64	29,58	28,61
Mercury	µg/l	1,0	1,0	1,0	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
Zinc	µg/l	50,0	50,0	-	21,78	21,93	22,24	10,96	9,68
Nickel	µg/l	100	100	2,1	1,46	1,15	1,71	1,88	1,16
Benzene	µg/l	-	-	1,0	nd	nd	nd	nd	nd
Toluene	µg/l	-	-	10,0	nd	nd	nd	nd	nd
Ethylbenzene	µg/l	-	-	10,0	nd	nd	nd	nd	nd
Xylenes	µg/l	-	-	10,0	nd	nd	nd	nd	nd

Analysing the obtained results, the following can be observed:

- The water temperature at the surface in the coastal zone at the time of sampling varied between 14.70°C and 20.7°C.
- The pH values were approximately 8.3 units in most of the samples, falling within the specifications indicated in the current legislation.
- Conductivity results were close to those determined for seawater, with values ranging narrowly between 21.2 mS/cm and 21.3 mS/cm.
- Salinity determinations indicated values around 12.5 PSU, except for sample T7.4, which recorded a value of 10.57 PSU. The concentration of Total Dissolved Solids (TDS) showed very close values, with the mean result being 10.45 g/l, and values ranging from 10.28 g/l to 10.53 g/l. The obtained values for salinity and TDS concentration are similar, confirming the correlation between these two parameters for water characterization.
- Turbidity measured in NTU (Nephelometric Turbidity Units) indicated clear water, with values varying from 0.20 to 1.7 NTU.
- Total Suspended Solids (TSS) registered higher values than seawater, with an average value of 42.34 mg/l. The highest value of 87.8 mg/l was obtained for sample T6.1, followed by point T1.1 with a result of 64.9 mg/l. The other points recorded values ranging from 17.7 mg/l to 21 mg/l.
- Dissolved Oxygen in coastal waters was close to saturation, with concentrations ranging from approximately 8.69 mg/l to 10.02 mg/l in the upper layer, which exceeds the minimum value indicated in Order 1621 of 6.2 mg/l.
- Nitrites showed a constant trend around the mean value of 0.0052 mgN/l, with concentrations ranging narrowly from 0.0048 mgN/l to 0.0055 mgN/l.
- For nitrates, sample T6.3 resulted below the quantification limit of 0.009 mgN/l, while the minimum value of 0.019 mgN/l was recorded at point T6.1, and the maximum value of 0.137 mgN/l was at point T7.5.
- Total Phosphorus was below the quantification limit of 0.04 mg/l in all analysed samples.
- The monoaromatic compounds, such as benzene, toluene, and xylene, were not detected in any of the samples and were reported as non-detectable. These results correlate with the petroleum product, for which the results were below the quantification limit of 0.12 mg/l in the analysed samples.
- The analysed metals were cadmium, lead, mercury, zinc, and nickel, with the following results:
- Cadmium and mercury were below the quantification limits of 0.5 µg/l and 0.05 µg/l, respectively.

- Concentrations for lead ranged from 2.29 µg/l for sample T11, while for samples T1.1, T6.1, T6.3, T7.5, and T7.4, values were higher, ranging between 20.44 µg/l and 29.58 µg/l.

- Zinc ranged from 9.68 µg/l to 22.24 µg/l, with a mean result of 17.37 µg/l, and the average value for coastal water was lower than that for seawater (26.04 µg/l).

- Nickel values ranged from 1.15 µg/l to 1.88 µg/l, with a mean result of 1.48 µg/l, and all results were below the limits indicated in Order 161/2006.

A total of **8 water samples were collected from the marine area of the project site,** and the coordinates of the sampling locations are presented in Table 4.32. The positioning of these locations on the map of the Black Sea can be found in Figure 4.17, below

Table 4.32 Inventory of coordinates for marine water sampling locations, May 2023

No.	Location name	Stereo70 coordinates	
		X	Y
1	P7	797892.711	281363.511
2	P8	797417.811	279705.604
3	P21	797860.906	280110.636
4	T3.1	795625.573	281892.106
5	T6.5	795747.489	279583.284
6	T4.1	795781.371	280989.199
7	T3.5	796382.003	281657.859
8	T5.1	795701.131	280663.390

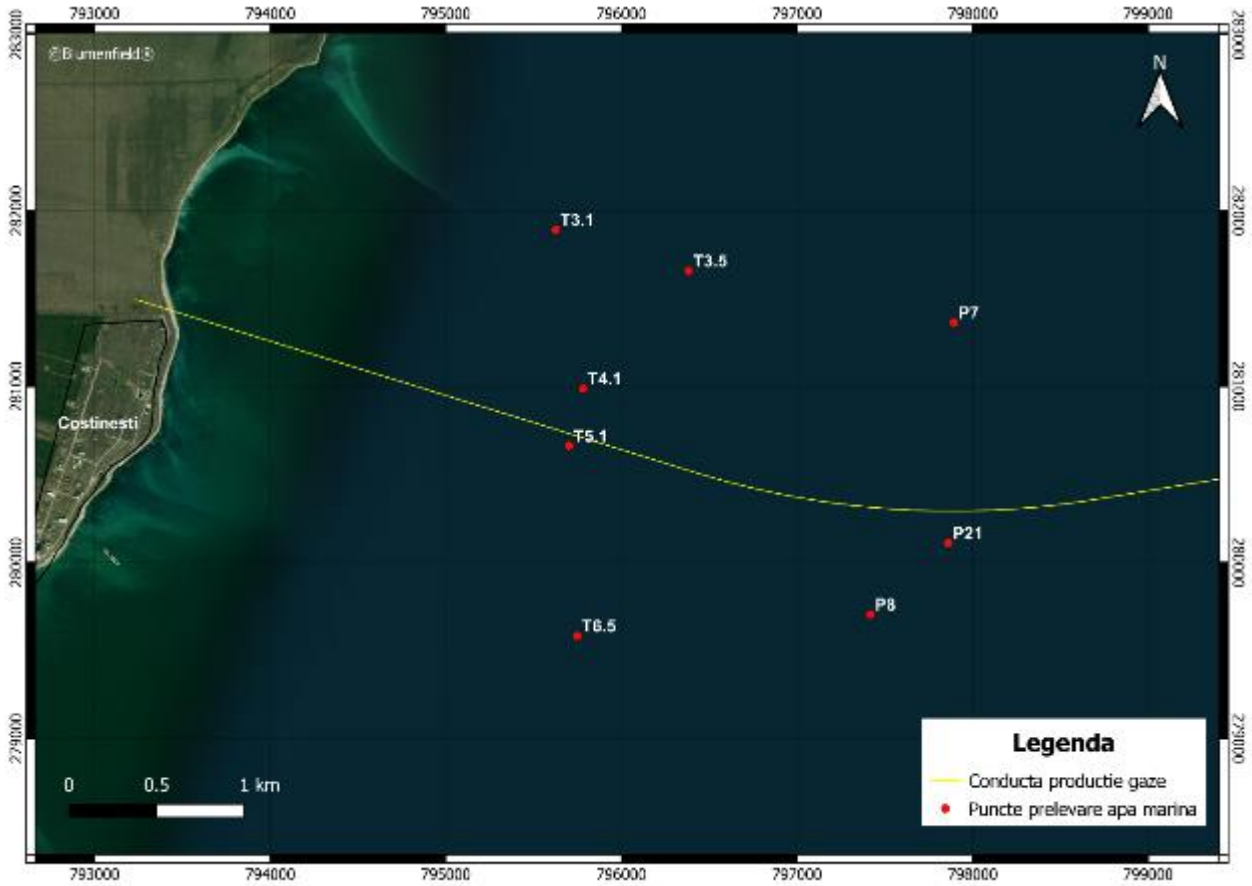


Figure 4.17 Positioning of marine water sampling locations, May 2023 campaign

The obtained results are shown in Table 4.33 below.

Table 4.33 Results of marine water samples analysis, May 2023

Parameter	M.U	Sampling points							
		P7	P8	P21	T3.1	T6.5	T 4.1	T3.5	T5.1
pH	units	8,3	8,8	8,3	8,3	8,3	8,3	8,3	8,3
Temperature	°C	23,6	21,3	20,9	14,7	15,1	14,9	14,5	14,7
Conductivity	(mS/cm)	24	24,4	24,3	20,5	20,4	20,4	20,3	20,3
Salinity	PSU	14,7	14,8	14,6	12,33	12,4	12,23	10,23	12,35
Turbidity	NTU	1,09	1,01	1,58	0,5	0,7	0,4	0,7	0,5
Total dissolved solids	g/l	24	24,4	24,3	10,2	10,31	10,30	10,17	10,27
O_2 disolved	mgO2/l	9,1	9,93	9,47	8,69	8,72	8,93	9,08	8,89
N-NO_2	mgN /l	0,0062	0,0053	0,0054	0,028	0,0059	0,0045	0,0055	0,0052
N-NO_3	mgN /l	0,011	0,047	0,041	<LOQ	<LOQ	<LOQ	0,136	<LOQ
Total Phpsphorus	mg/l	0,076	0,06	0,11	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
Total suspended solids	mg/l	3,3	36,5	54,5	6,2	15,5	4,4	6,2	15,7
Petroleum product	mg/l	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
Cadmium	µg/l	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
Lead	µg/l	2,33	2,02	2,23	22,82	29,73	26,19	18,11	26,76
Mercury	µg/l	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ	<LOQ
Zinc	µg/l	53,66	12,98	18,52	43,59	12,79	20,68	25,49	20,63
Nickel	µg/l	1,34	1,15	0,68	1,53	0,57	1,28	1,39	2,01
Benzene	µg/l	nd	nd	nd	nd	nd	nd	nd	nd
Toluene	µg/l	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	µg/l	nd	nd	nd	nd	nd	nd	nd	nd
Xylene	µg/l	nd	nd	nd	nd	nd	nd	nd	nd

Regarding the results obtained for the water samples collected from the marine area[5] of the project site during the May 2023 campaign, the following discussions can be made:

- The water temperature at the surface at the time of sample collection varied between 14.9°C and 20.7°C.

- The pH values were around 8.3 pH units in most samples, with the exception of a pH value of 8.8 for sample P8.

- Conductivity, salinity, and total dissolved solids are correlated parameters. Conductivity is associated with salinity, and salinity is determined by the quantity of substances dissolved in water. Conductivity ranged between 20.3 mS/cm and 24.4 mS/cm, with the highest value of 24.4 mS/cm observed in sample P8. For samples with higher conductivity, the concentration of total dissolved solids was also higher, ranging from 10.2 g/l to 24.4 g/l with an average of 16.24 g/l. Salinity varied between 10.2 PSU and 14.7 PSU, with higher values for samples P7, P8, and P21, where both conductivity and total dissolved solids were also higher.

- Turbidity measurements, expressed in NTU (Nephelometric Turbidity Unit), showed values ranging from 0.5 to 1.58 NTU. A value of 0 NTU indicates clear water. The maximum turbidity value of 1.58 NTU was obtained in sample P8, corresponding to the highest suspended matter concentration of 54.5 mg/l among the analysed samples.

- Suspended matter concentrations exhibited a wide range of values, from a minimum of 3.3 mg/l to a maximum of 54.5 mg/l, with an average of 18.52 mg/l. Sample P8 recorded the highest suspended matter concentration of 36.5 mg/l, followed by sample P21 with 54.5 mg/l, while the other samples had lower values, ranging up to 15.7 mg/l.

- Dissolved oxygen was close to saturation in the well-mixed upper layer, with concentrations ranging from approximately 8.69 mg/l to 9.93 mg/l, providing a suitable environment for marine life development.

- Nitrite concentrations were determined for all samples and ranged from 0.0052 mg N/l to 0.028 mg N/l, with an average value of 0.0082 mg N/l. These values were below the limit specified in Order 161/2006 (1.5 mg/l).

- Nitrate concentrations were obtained for samples P7, P8, P21, T3.1, and T3.5, while the other samples had values below the method's quantification limit of 0.009 mg/l. The average result for these five points was 0.058 mg N/l, with the maximum value of 0.136 mg N/l observed in sample T3.5.

[5] With the consideration of the definition of coastal waters according to Water Law no. 107/1996, the marine area of Romania's territorial waters in the Black Sea begins where the coastal waters end, specifically from beyond 1 nautical mile, measured from the shoreline. Order no. 161/2006 issued by the Ministry of Environment and Water Management, approving the Normative on the classification of surface waters for determining the ecological status of water bodies, establishes maximum permissible references only for coastal waters

- Total phosphorus was determined in samples P7, P8, and P21, while the other samples had values below the quantification limit of 0.04 mg/l. The highest determined value was 0.11 mg/l, and the lowest was 0.06 mg/l.

- The monoaromatic compounds benzene, toluene, and xylene were not detected in the analysed samples and were reported as not detectable, which correlates with the petroleum product, where the results were below the quantification limit of 0.12 mg/l for the analysed samples.

- The analysed metals were cadmium, lead, mercury, zinc, and nickel, with the following discussions on the results:

    - Cadmium concentrations were below the method's quantification limit of 0.5 µg/l in all analysed samples.

    - Lead concentrations were lower in samples P7, P8, and P21, with values of 2.33 µg/l, 2.02 µg/l, and 2.23 µg/l, respectively, while the other samples had concentrations ranging from 18.11 µg/l to 29.73 µg/l, with an average of 18.34 µg/l.

    - Mercury concentrations in all samples were lower than the quantification limit of 0.05 µg/l.

    - Zinc concentrations ranged from 12.79 µg/l in sample T6.5 to 53.66 µg/l in sample P7. The average result for all samples was 26.04 µg/l, which is below the limit of 50 µg/l specified in Order 161/2006 for ecological status and areas impacted by anthropogenic activities.

    - Nickel concentrations ranged from 0.56 µg/l in sample T6.5 to 2.01 µg/l in sample T5.1, with an average of 1.24 µg/l for all results.

4.3.2.3 Hydrological data of the Black Sea from the offshore location of the project

The project's infrastructure in the offshore zone traverses several different and unique physiographic provinces, including the shoreline zone, the continental shelf/platform, and the slope from the platform to the basin. The Pelican reservoir and the offshore production platform are situated on the continental shelf, approximately 160 km offshore. The Domino reservoir area is located on the middle slope, with the first drilling centre located about 26 km from the offshore production platform.

The water depth within the Neptun Deep perimeter varies from 700 to 1,100 m in the Domino reservoir area to 120 to 130 m on the continental shelf, in the Pelican South reservoir and production platform area. The basin slope separates the Domino and Pelican South reservoirs. Along the production pipeline route on the continental shelf, the water depth decreases from 120 m to between 10 to 15 m in the proposed area for the shore crossing microtunnel. Figure 4.18 illustrates a depth profile along the Neptun Deep project development area.

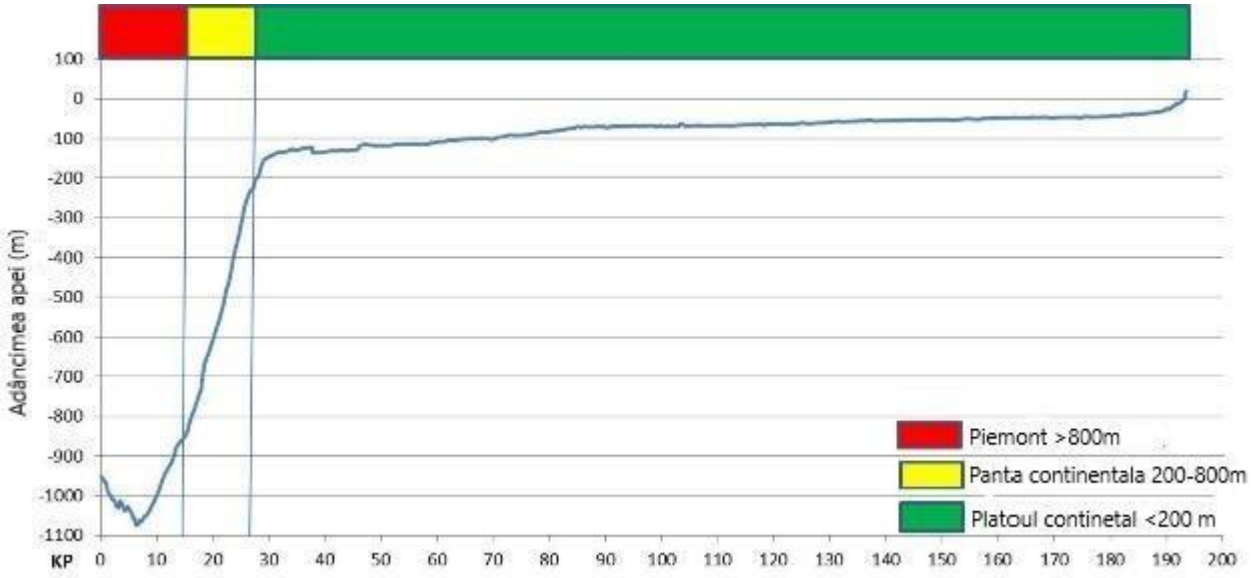


Figure 4.18 Depth profile along the Neptun Deep project development area

The water depth in the production platform and drilling centres area is presented in Table no. 4.34.

Table 4.34 Water Depth Intervals in the Offshore Facilities Area of the Project

The project component	Water depth
The offshore production platform	120 – 130 m
The drilling centre Pelican Sud	120 – 130 m
The drilling centre Domino 1	970 – 980 m
The drilling centre Domino 2	945 – 955 m

The meteorological and oceanographic data in the offshore area of the project were characterized in the (*"Black Sea Metocean Criteria for Neptun Block Development – URC, TJ Moffett, F. Chen")* study conducted in 2014 by ExxonMobil to characterize the meteorological and oceanographic data in five regions located in the western part of the Black Sea, necessary for the design of the project facilities.

According to this study, the water levels in the western Black Sea are influenced by tidal and non-tidal components, primarily due to wind-induced waves. The variations in tidal water levels are marginal, with an average spring tide amplitude of 0.02 m in the Constanta area.

In the offshore area of the project, the dominant wave directions are from the south to the west. The dominant wave direction for the nearshore section, Region 1, is towards the west or coastline, and in the location of the offshore production platform, for Regions 2 to 4, the direction is southwest. The direction in the slope area, Region 5, is towards the south. The prevailing wind conditions are from the northern sectors for all locations in the offshore development zone of the project.

The surface circulation in the Black Sea is a cyclonic current system composed of the Rim Current, with several anticyclonic eddies closer to the coast.

Hydrodynamic conditions in the offshore area of the project

For the characterization of the current hydrodynamic conditions in the offshore area relevant to the project facilities (e.g., the corridor of the natural gas production pipeline), Halcrow Romania (Jacobs), through its subcontractor, the National Institute for Research and Development of Marine Geology and Geoecology (GeoEcoMar), collected and analysed data on currents in the Black Sea (e.g., speed and direction), water column characteristics (conductivity and temperature), and meteorological data for the period from July 2018 to December 2020. The data was provided by three permanent buoys, EuxRo01, EuxRo02, and EuxRo03, operated by GeoEcoMar and installed in the Black Sea.

The three permanent buoys operated by GeoEcoMar collect data on hydrodynamic conditions (current speed and direction), hydrographic conditions (water temperature and conductivity), and meteorological conditions (wind speed, wind direction, air temperature, and air pressure) in the Romanian waters of the Black Sea continental shelf.

The buoys are equipped to provide real-time bidirectional data communication, provided by the Operational Data Centre located at GeoEcoMar - Constanța Branch. They record and transmit hourly oceanographic data (water current speed and direction, conductivity, temperature) and meteorological data (wind speed and direction, temperature, and pressure).

The three oceanographic buoys – EuxRo01, EuxRo02, and EuxRo03 are anchored approximately 120 km offshore the Romanian coast in the Black Sea, at water depths ranging from 75 to 90 meters. The general positioning of the three oceanographic buoys is presented in Figure 4.19 below.

The coordinates and water depth for the three oceanographic buoys operated by GeoEcoMar are presented in Table 4.35 below.

Table 4.35 Coordinates and Water Depth for the Oceanographic Buoys Operated by GeoEcoMar

Buoy Name	Latitude	Longitude	Water depth (m)
EuxRo01	44° 42' 28,19" N	30° 46' 34,20" E	81
EuxRo02	44° 19' 37,80" N	30° 25' 32,40" E	92
EuxRo03	43° 58' 34,80" N	29° 56' 08,40" E	75

Figure 4.19 Location of the 3 oceanographic buoys operated by GeoEcoMar

Each buoy consists of two main units, namely a Surface Unit - SRB and an Underwater Tsunami Module - UTM.

The SRB is equipped with an environmental monitoring package, mounted on the buoy's mast at a depth of 5 meters, which includes a Doppler current meter, classic CTD sensors (conductivity, temperature, and depth), and a meteorological station (the meteorological station is included only on EuxRo01 and EuxRo03).

Table 4.36 presents a summary of the statistics regarding the general trends recorded at each buoy during the period from July 2018 to December 2020.

Table 4.36 Statistics on General Hydrodynamic Trends Recorded during the Period July 2018 - December 2020

Period	The station (beacon)	General trends
July 2018 - December 2018	EuxRo01 (SRB)	For the period July to December 2018, the highest current speeds at EuxRo01 were recorded in September, with a maximum value of 61.2 cm/s on September 25th, flowing southwards. The highest average monthly current speed was recorded in July, with an average current speed of 11.1 cm/s, flowing northwards.

Period	The station (beacon)	General trends
		The minimum value of the current speed was recorded on August 25th, with a value of 0.02 cm/s. The average current speed for the entire period remained fairly consistent from month to month, with an overall average current speed of 10.2 cm/s.
	EuxRo02 (SRB)	For the period July to December 2018, the highest current speeds at EuxRo02 were recorded in September, with a maximum value of 69.9 cm/s on September 25th, flowing southwards. The highest average monthly current speed was also recorded in September, with an average current speed of 16.1 cm/s, flowing northwards. The minimum value of the current speed was recorded on December 5th, with a value of 0.13 cm/s. The average current speed for the entire period remained relatively consistent throughout the data collection period, with an overall average current speed of 12.3 cm/s. The highest average current speed was 16.9 cm/s in September, while the lowest average monthly speed of 9.6 cm/s was recorded in December.
	EuxRo03 (SRB)	For the period July to December 2018, the highest current speeds at EuxRo03 were recorded in September, with a maximum value of 65.5 cm/s on September 24th, flowing southwards. The highest average monthly current speed was recorded in November, with an average current speed of 15.3 cm/s, flowing southwards. The minimum value of the current speed was recorded on December 28th, with a value of 0.12 cm/s. The average current speed for the entire period was fluctuating, with an increase in November and a decrease in December, resulting in an overall average current speed of 12.2 cm/s.
January 2019 - June 2019	EuxRo01 (SRB)	For the period January to June 2019, the highest current speeds at EuxRo01 were recorded in May, with a maximum value of 85.5 cm/s on May 2nd, flowing southwards. The highest average monthly current speed was recorded in May, with an average current speed of 24.2 cm/s, flowing northwards. The minimum value of the current speed was recorded on March 19th, with a value of 0.04 cm/s. The average current speed between January and April remained fairly consistent from month to month, with average current speeds ranging from 9.1 to 11.9 cm/s. In general, the currents were higher in May and June, with average speeds of 24.2 and 15.6 cm/s, respectively.
	EuxRo02 (SRB)	For the period January to June 2019, the highest current speeds at EuxRo02 were recorded in May, with a maximum value of 54.7 cm/s on May 8th, flowing southwards. The highest average monthly current speed was recorded in June, with an average current speed of 17 cm/s, flowing northwards. The minimum value of the current speed was recorded on March 22nd, with a value of 0.04 cm/s. The average current speed for the entire period was fluctuating, with a decrease in March and an increase in May and June, resulting in an overall average current speed of 12.8 cm/s.

Period	The station (beacon)	General trends
	EuxRo03 (SRB)	For the period of January to June 2019, the highest current speeds at EuxRo03 were recorded in June, with a maximum value of 77 cm/s on June 29th, flowing southwards. The highest average monthly current speed was recorded in June, with an average current speed of 20.6 cm/s, flowing southwards. The minimum value of the current speed was recorded on March 13th, with a value of 0.5 cm/s. The average current speed for the entire period was fluctuating, with an increase in May and June, resulting in an overall average current speed of 13.9 cm/s.
July 2019 - December 2019	EuxRo01 (SRB)	For the period of July to December 2019, the highest current speeds at EuxRo01 were recorded in August, with a maximum value of 70.09 cm/s on August 4th, flowing southwards. The highest average monthly current speed was recorded in July, with a value of 16.7 cm/s, flowing southwards. The minimum value of the current speed was recorded on September 8th, with a value of 0.19 cm/s. The average current speed from July to September decreased from 16.7 cm/s to 13.94 cm/s. The average current speed then increased in the last three months of the year (October, November, and December), with the average current speed rising from 8.4 cm/s to 10.11 cm/s. The overall average current speed (July to December) was 11.81 cm/s.
	EuxRo02 (SRB)	For the period of July to December 2020, the highest current speeds at EuxRo02 were recorded in August, with a maximum value of 55.15 cm/s on the 4th, flowing southwards. The highest average monthly current speed was recorded in August, with an average current speed of 16.52 cm/s, flowing southwards. The minimum value of the current speed was recorded on July 2nd, with a value of 0.17 cm/s. The average current speed for the entire period remained relatively consistent throughout the data collection period, with an overall average current speed of 12.88 cm/s. The highest average current speed was 14.52 cm/s in July, while the lowest average monthly current speed of 10.09 cm/s was recorded in October
	EuxRo03 (SRB)	For the period of July to December 2019, the highest current speeds at EuxRo03 were recorded in August, with a maximum value of 59.04 cm/s on August 23rd, flowing southwards. The highest average monthly current speed was recorded in August, with an average current speed of 14.14 cm/s, flowing southwards. The minimum value of the current speed was recorded on November 14th, with a value of 0.1 cm/s. The average current speed for the entire period was variable, reaching a peak in August at 14.14 cm/s, decreasing to 7.31 cm/s in October, and having an overall average current speed of 10.54 cm/s
	EuxRo03 (UTM)	For the period of November to December 2019, the highest current speeds at EuxRo03 were recorded in December, with a maximum value of 17.93 cm/s on December 6th, flowing southwards. The highest average monthly current speed was

Period	The station (beacon)	General trends
		recorded in December, with an average current speed of 5.66 cm/s, flowing westwards. The minimum value of the current speed was recorded on December 11th, with a value of 0.34 cm/s. The average current speed for the entire period remained relatively constant, with an overall average current speed of 5.58 cm/s.
January 2020 - June 2020	EuxRo01 (SRB)	For the period of January to June 2020, the highest current speeds at EuxRo01 were recorded in May, with a maximum value of 53.75 cm/s on May 13th, flowing southwards. The highest average monthly current speed occurred in June, with an average current speed of 17.02 cm/s, flowing southwards. The minimum value of the current speed was recorded on June 24th, with a value of 0.04 cm/s. The average current speed for January, February, and April remained fairly consistent, with average current speeds ranging from 9.31 cm/s to 10.82 cm/s. Overall, the currents were higher in March, May, and June, with average speeds ranging from 15.53 cm/s to 17.02 cm/s, resulting in an overall average current speed from January to June of 13.21 cm/s.
	EuxRo02 (SRB)	For the period of January to June 2020, the highest current speeds at EuxRo02 were recorded in May, with a maximum value of 65.48 cm/s on May 18th, flowing southwards. The highest average monthly current speed was recorded in June, with an average current speed of 17.96 cm/s, flowing southwards. The minimum value of the current speed was recorded on February 19th, with a value of 0.09 cm/s. The average current speed for January, February, and April was lower, ranging from 9.41 cm/s to 11.41 cm/s, and higher in March, May, and June, ranging from 14.69 cm/s to 17.96 cm/s, resulting in an overall average current speed of 13.63 cm/s.
	EuxRo03 (SRB)	For the period of January to June 2020, the highest current speeds at EuxRo03 were recorded in June, with a maximum value of 59.69 cm/s on June 25th, flowing southwards. The highest average monthly current speed was recorded in June, with an average current speed of 17.06 cm/s, flowing southwards. The minimum value of the current speed was recorded on May 4th, with a value of 0.15 cm/s. The average current speed for the entire period fluctuated, decreasing from 11.52 cm/s in January to 8.88 cm/s in March, then increasing to 17.06 cm/s in June. The overall average current speed from January to June was 12.12 cm/s
	EuxRo03 (UTM)	For the period of January to June 2020, the highest current speeds at EuxRo03 were recorded in April, with a maximum value of 25.04 cm/s on April 6th, flowing southwards. The highest average monthly current speed was recorded in April, with an average current speed of 6.56 cm/s, flowing southwards. The minimum value of the current speed was recorded on January 11th, with a value of 0.13 cm/s.

Period	The station (beacon)	General trends
		The average current speed for the entire period remained fairly constant, with an overall average current speed of 5.48 cm/s
July 2020 - December 2020	EuxRo01 (SRB)	For the period of July to November 2020, the highest current speeds at EuxRo01 were recorded in July, with a maximum value of 73.84 cm/s on July 8th, flowing southwards. The highest average monthly current speed was recorded in July, with an average current speed of 16.88 cm/s, flowing southwards. The minimum value of the current speed was recorded on October 21st, with a value of 0.14 cm/s. The average current speed decreased from July to September, from 16.88 cm/s to 10.96 cm/s, and remained constant in the last two months of the year (October and November), with average current speeds of 10.25 cm/s and 9.97 cm/s, resulting in an overall average current speed of 12.22 cm/s.
	EuxRo02 (SRB)	For the period of July to December 2020, the highest current speeds at EuxRo02 were recorded in July, with a maximum value of 58.28 cm/s on July 8th, flowing southwards. The highest average monthly current speed was recorded in November, with an average current speed of 14.70 cm/s, flowing southwards. The minimum value of the current speed was recorded on September 7th, with a value of 0.05 cm/s. The average current speed in July and November was high (13.95 and 14.70, respectively), and it remained constant for the rest of the data collection period, resulting in an overall average current speed of 11.60 cm/s.
	EuxRo03 (SRB)	For the period of July to December 2020, the highest current speeds at EuxRo03 were recorded in August, with a maximum value of 78.27 cm/s on August 8th, flowing southwards. The highest average monthly current speed was recorded in July, with an average current speed of 16.44 cm/s, flowing southwards. The minimum value of the current speed was recorded on September 7th, with a value of 0.11 cm/s. The average current speed was higher in July and August compared to the rest of the data collection period, resulting in an overall average current speed of 11.58 cm/s.
	EuxRo03 (UTM)	For the period of July to October 2020, the highest current speeds at EuxRo03 were recorded in September, with a maximum value of 12.31 cm/s on September 19th, flowing northwards. The highest average monthly current speed was recorded in July, with an average current speed of 4.51 cm/s, flowing southwards. The minimum value of the current speed was recorded on September 17th, with a value of 0.11 cm/s. The average current speed for the entire data collection period remained constant, resulting in an overall average current speed of 4.38 cm/s.

4.3.2.4 Analysis of water quality indicators in the offshore area of the project.

The study of the initial state of the marine environment conducted in 2017 also involved a campaign of seawater sampling along the gas production pipeline route and from the offshore location of the project's components. The sampling stations are presented in Figure 4.20 below:

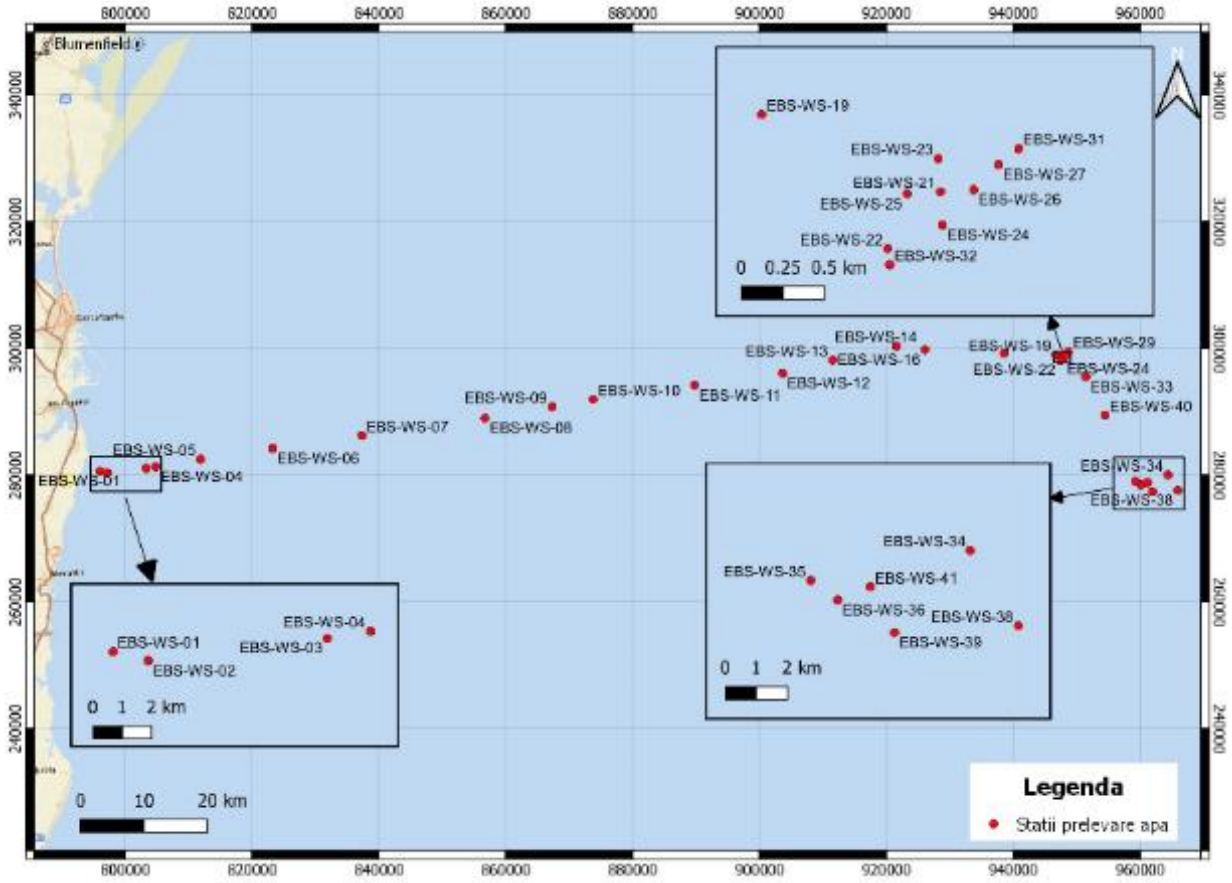


Figure 4.20 The water sampling stations

The coordinates of the water sampling stations are presented in Table 4.37 below.

Table 4.37 The coordinates of the water sampling stations

No.	Sampling station	STEREO COORDINATES 70		WGS 84 COORDINATES /TM 30NE		Water depth (m)
		EAST	NORTH	EAST	NORTH	
1	EBS-WS-01	795982,683	280650,620	394670	4868830	-25,12
2	EBS-WS-02	797173,753	280343,821	395839	4868451	-30,02
3	EBS-WS-03	803274,635	281109,113	401970	4868840	-40,01
4	EBS-WS-04	804754,122	281347,533	403460	4868987	-43,10
5	EBS-WS-05	811845,384	282514,908	410603	4869716	-48,56
6	EBS-WS-06	823213,431	284232,659	422044	4870731	-46,97
7	EBS-WS-07	837282,119	286227,673	436194	4871856	-52,98
8	EBS-WS-08	856716,687	288979,734	455739	4873405	-59,95
9	EBS-WS-09	867301,361	290770,466	466401	4874539	-65,06
10	EBS-WS-10	873757,229	291947,511	472909	4875315	-67,98
11	EBS-WS-11	889763,535	294155,266	489000	4876530	-70,33
12	EBS-WS-12	903674,185	296068,771	502983	4877580	-80,00

No.	Sampling station	STEREO COORDINATES 70		WGS 84 COORDINATES /TM 30NE		Water depth (m)
		EAST	NORTH	EAST	NORTH	
13	EBS-WS-13	911539,930	298167,744	510952	4879187	-91,95
14	EBS-WS-14	921584,576	300358,759	521098	4880751	-105,05
15	EBS-WS-16	926095,365	299784,161	525558	4879900	-113,72
16	EBS-WS-18	938545,284	299215,672	537930	4878565	-125,87
17	EBS-WS-19	946678,904	299001,141	546022	4877849	-134,98
18	EBS-WS-21	947754,347	298536,925	547065	4877320	-126,72
19	EBS-WS-22	947437,401	298194,149	546728	4876998	-126,44
20	EBS-WS-23	947740,956	298736,801	547064	4877520	-125,83
21	EBS-WS-24	947766,737	298336,988	547065	4877120	-126,29
22	EBS-WS-25	947554,410	298524,535	548865	4877320	-123,35
23	EBS-WS-26	947954,346	298548,316	547265	4877319	-123,61
24	EBS-WS-27	948104,560	298699,123	547424	4877460	-127,07
25	EBS-WS-29	948685,755	299457,683	548050	4878180	-129,08
26	EBS-WS-31	948224,007	298795,840	547549	4877549	-126,84
27	EBS-WS-32	947449,408	298097,551	546734	4876901	-122,99
28	EBS-WS-33	951438,709	295518,806	562518	4857863	-135,01
29	EBS-WS-34 (nou)	964408,587	280041,994	562518	4857863	-948,86
30	EBS-WS-35 (nou)	959244,568	279074,848	557313	4857218	-956,90
31	EBS-WS-36	960119,926	278439,558	558146	4856531	-981,02
32	EBS-WS-38	965961,439	277607,968	563915	4855342	-1061,20
33	EBS-WS-39	961949,451	277387,623	558904	4855370	-1030,80
34	EBS-WS-40	954469,504	289444,362	553195	4867845	-347,34
35	EBS-WS-41	961174,482	278865,162	559223	4856890	-967,79

The results of the water and CTD (Conductivity, Temperature, Depth) analysis are summarized in the paragraphs below.

The water column profile

The water column structure was analysed using a multiparameter seawater instrument that measures oxygen saturation, temperature, conductivity, and pressure.

In general, a notable change in temperature (thermocline) can be observed around the water depth contour of 25 meters, where the seawater temperature decreases significantly, and remaining constant at around 8.5℃. The anoxic condition of the water column was consistently recorded at approximately 90 meters to 100 meters water depth.

Temperature profiles were comparable throughout, sharply decreasing at around 25 meters to 30 meters water depth and then remaining constant towards the seabed.

Salinity was also consistent among the points, rapidly increasing up to around 90 meters depth and then gradually decreasing to approximately 22.3 PSU (Practical Salinity Unit) at the seabed. These results suggest the presence of a cold intermediate layer between approximately 30 meters and 90 meters depth below sea level.

Dissolved oxygen content is high in the surface mixed layer and also decreases at around 90 meters depth, with limited dissolved oxygen beyond this point, confirming the anoxic state of the water column beyond approximately 100 meters water depth.

The physico-chemical parameters of seawater

The water samples were taken from the aforementioned sampling stations, at different depths of the water column.

Oxygen consumption

The levels of biochemical and chemical oxygen consumption were measured at six stations (EBSWS21 to EBS-WS26) in the Neptun Dee offshore project area. The average biochemical oxygen consumption (BOD5) was found to be 6.48 mg O2/l ± 3.76 SD, while the average chemical oxygen consumption was 5.83 mg O2/l ± 0.78 SD. Higher biochemical oxygen consumption (BOD5) was generally observed in the surface water layers at all stations.

The levels of biochemical and chemical oxygen consumption are presented in Table 4.38.

Table 4.38 Results of oxygen consumption (mg O2/l)

Sampling station	Biochemical oxygen consumption (CBO5) (mg O_2/l)	Chemical oxygen consumption (CCO-Mn) (mg O_2/l)
EBS-WS21 A	2,05	6,80
EBS-WS21 B	2,30	5,78
EBS-WS21 C	6,45	5,78
EBS-WS21 D	3,00	6,46
EBS-WS21 E	3,05	5,10
EBS-WS22 A	1,25	5,44
EBS-WS22 B	4,95	6,40
EBS-WS22 C	6,40	3,84
EBS-WS22 D	5,05	5,44
EBS-WS22 E	4,75	5,12
EBS-WS23 A	2,25	7,04
EBS-WS23 B	4,70	5,44
EBS-WS23 C	3,35	5,12
EBS-WS23 D	6,80	5,78
EBS-WS23 E	7,20	5,78
EBS-WS24 A	3,55	7,04
EBS-WS24 B	4,85	6,08
EBS-WS24 C	9,15	5,12
EBS-WS24 D	12,65	6,08
EBS-WS24 E	12,10	5,44
EBS-WS25 A	1,85	5,76
EBS-WS25 B	4,90	6,40
EBS-WS25 C	5,00	7,36
EBS-WS25 D	8,60	6,08
EBS-WS25 E	11,85	6,08
EBS-WS26 A	7,55	4,16
EBS-WS26 B	13,55	6,40
EBS-WS26 C	11,30	5,76
EBS-WS26 D	11,55	5,44
EBS-WS26 E	12,40	6,40

Sampling station	Biochemical oxygen consumption (CBO5) (mg O_2/l)	Chemical oxygen consumption (CCO-Mn) (mg O_2/l)
Average	**6,48**	**5,83**
Standard deviation	**3,76**	**0,78**
Variation (%)	**58,0**	**13,4**

Hydrogen sulfide

Very low levels or levels below the limit of detection (LOD) of hydrogen sulphide were observed in the shallower waters of the drilling area, with the highest concentration recorded at the deepest layer (1012 m water depth) at station EBS-WS39 (493.71 μM). A general trend of increasing hydrogen sulphide concentration with increasing water depth, especially along the continental shelf, was observed.

Hydrogen sulphide concentrations are presented in Table 4.39 below.

Table 4.39 Results regarding Hydrogen Sulphide Concentrations (μM-l)

Sampling point	Water depth (m)	H_2S (μM)	Concentration Range
EBS-WS01 B	12	0,12	low
EBS-WS01 D	6	0,56	low
EBS-WS04 A	36	<0,06	low
EBS-WS04 E	2	<0,06	low
EBS-WS08 A	53	<0,06	low
EBS-WS08 E	2	<0,06	low
EBS-WS11 A	64	<0,06	low
EBS-WS11 E	2	<0,06	low
EBS-WS12 A	74	<0,06	low
EBS-WS12 E	2	<0,06	low
EBS-WS13 A	85	<0,06	low
EBS-WS13 E	2	<0,06	low
EBS-WS16 A	108	<0,06	low
EBS-WS16 E	2	<0,06	low
EBS-WS18 A	120	<0,06	low
EBS-WS18 E	2	<0,06	low
EBS-WS19 A	129	<0,06	low
EBS-WS19 D	33	<0,06	low
EBS-WS19 E	2	<0,06	low
EBS-WS21 A	118	<0,06	low
EBS-WS21 B	91	<0,06	low
EBS-WS21 D	30	<0,06	low
EBS-WS21 E	2	<0,06	low
EBS-WS22 A	118	0,9	low
EBS-WS22 E	2	<0,06	low
EBS-WS33 A	129	8,49	medium
EBS-WS33 B	98	<0,06	low
EBS-WS33 E	2	0,45	low
EBS-WS34 A	963	426,84	high
EBS-WS34 B	250	76,62	high
EBS-WS34 C	125	28,4	medium
EBS-WS34 E	2	0,22	low

Sampling point	Water depth (m)	H_2S (μM)	Concentration Range
EBS-WS35 A	934	390,53	high
EBS-WS35 B	250	84,74	high
EBS-WS35 C	125	8,73	medium
EBS-WS35 E	2	<0,06	high
EBS-WS39 A	1012	493,71	medium
EBS-WS39 B	250	98,13	high
EBS-WS39 C	125	26,89	medium
EBS-WS39 E	2	0,28	low
EBS-WS40 A	338	103,84	high
EBS-WS40 B	249	57,03	high
EBS-WS40 C	125	10,36	medium
EBS-WS40 E	2	<0,06	low
Average	**N/A**	**41,33**	**N/A**
Standard deviation	**N/A**	**112,25**	**N/A**
Variation (%)	**N/A**	**271,6**	**N/A**

Nutrients and other parameters

Most of the analysed parameters were below the limit of detection (LOD), but where recorded, concentrations were generally higher in deeper zones, as well as in the deeper layers of the respective water sampling station. This trend was observed for concentrations of silica, ammonium nitrogen, and to some extent, phosphates.

Phosphate levels have been previously reported to range from 0.05 mg/l to 0.23 mg/l in 2013 (Fugro EMU, 2013) and below the limit of detection (LOD) to 0.24 mg/l in 2015 (Fugro, 2015), which, except for one higher value at station EBS-WS08 (0.37 mg/l), are similar to the values recorded during the mentioned studies. An unusually high value of orthophosphate (1.13 mg/l) was observed at station EBS-WS08 at ~15m water depth, with no correlations to other observed parameters, thus cannot be further explained.

Nutrient levels are presented in Table 4.40 below.

Table 4.40 Nutrient concentrations in water (mg/l)

Sampling point	SiO2 (mg/l)	Si (Disolved) (mg/l)	Ammoniacal nitrogen concentrations (mg/l)	Nitrite nitrogen concentrations (mg/l)	Nitrate nitrogen concentrations (mg/l)	Sulphide concentrations (mg/l)	Phosphorus from phosphates (mg/l)	Orthophosphates (mg/l)	Total nitrogen (mg/l)	Depth (m)
EBS-WS01 A	<2,14	<1	0,17	<0,01	<0,2	<0,02	0,09	0,28	<1	16
EBS-WS01 B	<2,14	<1	0,18	<0,01	<0,2	<0,02	0,09	0,28	<1	12,75
EBS-WS01 C	<2,14	<1	0,18	<0,01	<0,2	<0,02	0,09	0,28	2	9,75
EBS-WS02 D	<2,14	<1	0,18	<0,01	<0,2	<0,02	0,09	0,28	<1	6
EBS-WS02 E	<2,14	<1	0,19	<0,01	<0,2	<0,02	0,07	0,21	<1	2,5
EBS-WS04 A	<2,14	<1	0,17	<0,01	<0,2	<0,02	0,07	0,21	<1	37
EBS-WS04 B	<2,14	<1	0,17	<0,01	<0,2	<0,02	0,07	0,21	<1	33,75
EBS-WS04 C	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,09	0,28	<1	22,75
EBS-WS04 D	<2,14	<1	0,2	<0,01	<0,2	<0,02	0,06	0,18	<1	11,5
EBS-WS04 E	<2,14	<1	0,17	<0,01	<0,2	<0,02	0,09	0,28	1	2,75
EBS-WS08 A	<2,14	<1	0,19	<0,01	<0,2	<0,02	0,1	0,31	2	54
EBS-WS08 B	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,08	0,25	5	42
EBS-WS08 C	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,09	0,28	<1	28
EBS-WS08 D	<2,14	<1	0,17	<0,01	<0,2	<0,02	0,37	1,13	<1	14,5
EBS-WS08 E	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,09	0,28	2	2,75
EBS-WS11 A	<2,14	<1	0,17	<0,01	<0,2	<0,02	0,1	0,31	<1	65,25
EBS-WS11 B	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,09	0,28	<1	49,75
EBS-WS11 C	<2,14	<1	0,17	<0,01	<0,2	<0,02	0,08	0,25	<1	33,75
EBS-WS11 D	<2,14	<1	0,19	<0,01	<0,2	<0,02	0,07	0,21	<1	16,75
EBS-WS11 E	<2,14	<1	0,19	<0,01	<0,2	<0,02	0,1	0,31	<1	2,75
EBS-WS12 A	<2,14	<1	0,2	<0,01	<0,2	<0,02	0,09	0,28	<1	75
EBS-WS12 B	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,09	0,28	<1	60
EBS-WS12 C	<2,14	<1	0,18	<0,01	<0,2	<0,02	0,08	0,25	<1	39,75
EBS-WS12 D	<2,14	<1	0,18	<0,01	<0,2	<0,02	0,05	0,15	<1	21
EBS-WS12 E	<2,14	<1	0,19	<0,01	<0,2	<0,02	0,09	0,28	<1	2,75
EBS-WS13 A	<2,14	<1	0,2	<0,01	<0,2	<0,02	0,1	0,31	<1	86,25
EBS-WS13 B	<2,14	<1	0,19	<0,01	<0,2	<0,02	0,09	0,28	<1	66,25

Sampling point	SiO2 (mg/l)	Si (Disolved) (mg/l)	Ammoniacal nitrogen concentrations (mg/l)	Nitrite nitrogen concentrations (mg/l)	Nitrate nitrogen concentrations (mg/l)	Sulphide concentrations (mg/l)	Phosphorus from phosphates (mg/l)	Orthophosphates (mg/l)	Total nitrogen (mg/l)	Depth (m)
EBS-WS13 C	<2,14	<1	0,15	<0,01	<0,2	<0,02	0,06	0,18	<1	45
EBS-WS13 D	<2,14	<1	0,17	<0,01	<0,2	<0,02	0,01	0,03	<1	23
EBS-WS13 E	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,01	0,03	<1	2,75
EBS-WS16 A	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,04	0,12	2	109,25
EBS-WS16 B	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,02	0,06	<1	82,75
EBS-WS16 C	<2,14	<1	0,15	<0,01	<0,2	<0,02	0,01	0,03	<1	55
EBS-WS16 D	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,02	0,06	<1	27,75
EBS-WS16 E	<2,14	<1	0,15	<0,01	<0,2	<0,02	<0,01	<0,03	2	2,5
EBS-WS18 A	<2,14	1,3	0,2	<0,01	2,2	<0,02	0,09	0,28	<1	121,5
EBS-WS18 B	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,03	0,09	2	92,25
EBS-WS18 C	<2,14	<1	0,15	<0,01	<0,2	<0,02	0,01	0,03	<1	60,5
EBS-WS18 D	<2,14	<1	0,15	0,01	<0,2	<0,02	0,01	0,03	1	30,5
EBS-WS18 E	<2,14	<1	0,15	<0,01	0,4	<0,02	<0,01	<0,03	<1	2,5
EBS-WS19 A	<2,14	<1	0,19	<0,01	<0,2	<0,02	0,05	0,15	<1	130,5
EBS-WS19 B	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,03	0,09	<1	99
EBS-WS19 C	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,02	0,06	<1	66
EBS-WS19 D	<2,14	<1	0,16	<0,01	2,5	<0,02	<0,01	<0,03	<1	33,75
EBS-WS19 E	<2,14	<1	0,16	<0,01	<0,2	<0,02	<0,01	<0,03	<1	2,5
EBS-WS21 A	<2,14	1	0,17	<0,01	<0,2	<0,02	0,06	0,18	<1	119,25
EBS-WS21 B	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,02	0,06	1	92
EBS-WS21 C	<2,14	<1	0,17	<0,01	<0,2	<0,02	0,02	0,06	<1	61,75
EBS-WS21 D	<2,14	<1	0,17	<0,01	<0,2	<0,02	0,01	0,03	<1	30,75
EBS-WS21 E	<2,14	<1	0,16	<0,01	<0,2	<0,02	<0,01	<0,03	<1	2,25
EBS-WS22 A	2,57	1,2	0,19	<0,01	<0,2	<0,02	0,11	0,34	2	119,25
EBS-WS22 B	<2,14	<1	0,17	<0,01	<0,2	<0,02	0,06	0,18	<1	91,75
EBS-WS22 C	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,02	0,06	<1	62
EBS-WS22 D	<2,14	<1	0,15	<0,01	<0,2	<0,02	<0,01	<0,03	<1	30,75
EBS-WS22 E	<2,14	<1	0,18	<0,01	<0,2	<0,02	<0,01	<0,03	<1	2,5
EBS-WS33 A	<2,14	<1	0,25	<0,01	<0,2	<0,02	0,11	0,34	<1	130,25

Sampling point	SiO2 (mg/l)	Si (Disolved) (mg/l)	Ammoniacal nitrogen concentrations (mg/l)	Nitrite nitrogen concentrations (mg/l)	Nitrate nitrogen concentrations (mg/l)	Sulphide concentrations (mg/l)	Phosphorus from phosphates (mg/l)	Orthophosphates (mg/l)	Total nitrogen (mg/l)	Depth (m)
EBS-WS33 B	2,57	1,2	0,18	<0,01	<0,2	<0,02	0,02	0,06	2	99,25
EBS-WS33 C	<2,14	<1	0,17	<0,01	<0,2	<0,02	0,02	0,06	<1	66
EBS-WS33 D	<2,14	<1	0,19	<0,01	<0,2	<0,02	<0,01	<0,03	<1	33,75
EBS-WS33 E	<2,14	<1	0,15	<0,01	<0,2	<0,02	<0,01	<0,03	3	2,5
EBS-WS34 A	12,2	5,7	1,1	<0,01	<0,2	<0,02	0,19	0,58	3	973,75
EBS-WS34 B	5,99	2,8	0,4	<0,01	<0,2	<0,02	0,14	0,43	2	251
EBS-WS34 D	3,64	1,7	0,32	<0,01	<0,2	<0,02	0,15	0,46	1	126,25
EBS-WS34 C	<2,14	<1	0,15	<0,01	<0,2	<0,02	0,02	0,06	<1	50,75
EBS-WS34 E	<2,14	<1	0,16	<0,01	<0,2	<0,02	<0,01	<0,03	<1	2,5
EBS-WS35 A	14,1	6,6	1,2	<0,01	<0,2	<0,02	0,21	0,64	2	945,75
EBS-WS35 B	6,21	2,9	0,3	<0,01	<0,2	<0,02	0,14	0,43	1	251
EBS-WS35 C	3,42	1,6	0,28	<0,01	<0,2	<0,02	0,17	0,52	1	126
EBS-WS35 D	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,1	0,31	<1	50,75
EBS-WS35 E	<2,14	<1	0,19	<0,01	<0,2	<0,02	0,08	0,25	<1	2,5
EBS-WS39 A	12,4	5,8	1,2	<0,01	<0,2	0,62	0,2	0,61	2	1023,5
EBS-WS39 B	5,14	2,4	0,3	<0,01	<0,2	<0,02	0,13	0,4	<1	251
EBS-WS39 C	3,64	1,7	0,32	<0,01	<0,2	<0,02	0,15	0,46	4	126,25
EBS-WS39 D	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,01	0,03	2	50,75
EBS-WS39 E	<2,14	<1	0,18	<0,01	<0,2	<0,02	<0,01	<0,03	2	2,5
EBS-WS40 A	5,35	2,5	0,4	<0,01	<0,2	<0,02	0,11	0,34	1	341
EBS-WS40 B	5,35	2,5	0,3	<0,01	<0,2	<0,02	0,13	0,4	3	251,25
EBS-WS40 C	<2,14	<1	0,25	<0,01	<0,2	<0,02	0,12	0,37	<1	126
EBS-WS40 D	<2,14	<1	0,16	<0,01	<0,2	<0,02	0,02	0,06	<1	50,5
EBS-WS40 E	<2,14	<1	0,17	<0,01	<0,2	<0,02	<0,01	<0,03	1	2,5
Average	5,8	2,73	0,23	0,01	1,7	0,62	0,08	0,25	2	N/A
Standard deviation	3,9	1,82	0,19	N/A	1,1	N/A	0,06	0,19	0,98	N/A
Variation (%)	66,8	66,9	86,3	N/A	66,8	N/A	74,9	74,9	49	N/A

Total Hydrocarbon Concentrations

Low levels of total hydrocarbons (THC) were recorded in all samples. No alkanes or polycyclic aromatic hydrocarbons (PAHs) were detected.

The levels of total hydrocarbons are presented in Table 4.41.

Table 4.41 Total hydrocarbon concentrations in water (µg/l)

Sampling point	THC (µg/l)	Sampling point	THC (µg/l)	Sampling point	THC (µg/l)	Sampling point	THC (µg/l)
EBS-WS01 A	7,7	**EBS-WS12 A**	4,4	**EBS-WS19 A**	5,4	**EBS-WS34 A**	5,9
EBS-WS01 B	5,9	**EBS-WS12 B**	7,5	**EBS-WS19 B**	5,5	**EBS-WS34 B**	8,2
EBS-WS01 C	4,3	**EBS-WS12 C**	4,2	**EBS-WS19 C**	4,7	**EBS-WS34 D**	6,5
EBS-WS01 D	5,7	**EBS-WS12 D**	2,8	**EBS-WS19 D**	4,0	**EBS-WS34 C**	9,5
EBS-WS01 E	2,6	**EBS-WS12 E**	2,2	**EBS-WS19 E**	5,0	**EBS-WS34 E**	3,7
EBS-WS04 A	4,4	**EBS-WS13 A**	2,3	**EBS-WS21 A**	9,2	**EBS-WS35 A**	9,2
EBS-WS04 B	4,7	**EBS-WS13 B**	2,2	**EBS-WS21 B**	6,9	**EBS-WS35 B**	2,6
EBS-WS04 C	7,2	**EBS-WS13 C**	5,9	**EBS-WS21 C**	5,0	**EBS-WS35 C**	2,9
EBS-WS04 D	3,2	**EBS-WS13 D**	6,6	**EBS-WS21 D**	4,7	**EBS-WS35 D**	6,3
EBS-WS04 E	3,5	**EBS-WS13 E**	4,1	**EBS-WS21 E**	3,4	**EBS-WS35 E**	6,0
EBS-WS08 A	3,9	**EBS-WS16 A**	4,7	**EBS-WS22 A**	4,0	**EBS-WS39 A**	4,3
EBS-WS08 B	5,3	**EBS-WS16 B**	3,7	**EBS-WS22 B**	4,1	**EBS-WS39 B**	n/a
EBS-WS08 C	6,7	**EBS-WS16 C**	5,6	**EBS-WS22 C**	7,2	**EBS-WS39 C**	n/a
EBS-WS08 D	5,4	**EBS-WS16 D**	6,7	**EBS-WS22 D**	6,9	**EBS-WS39 D**	5,6
EBS-WS08 E	7,8	**EBS-WS16 E**	2,8	**EBS-WS22 E**	5,9	**EBS-WS39 E**	5,2
EBS-WS11 A	6,4	**EBS-WS18 A**	6,4	**EBS-WS33 A**	8,0	**EBS-WS40 A**	4,9
EBS-WS11 B	7,0	**EBS-WS18 B**	5,6	**EBS-WS33 B**	5,2	**EBS-WS40 B**	5,0
EBS-WS11 C	3,5	**EBS-WS18 C**	3,4	**EBS-WS33 C**	7,5	**EBS-WS40 C**	3,0
EBS-WS11 D	4,6	**EBS-WS18 D**	3,8	**EBS-WS33 D**	4,7	**EBS-WS40 D**	7,7
EBS-WS11 E	8,1	**EBS-WS18 E**	2,9	**EBS-WS33 E**	7,4	**EBS-WS40 E**	4,3
Average	**5,28**						
Standard deviation	**1,78**						
Variation (%)	**33,8**						

Concentrations of heavy metals

Concentrations of heavy metals in water were variable, with higher concentrations generally found in the deeper layers of the respective sampling station.

Cadmium concentration generally decreases with distance from the shore, and a similar trend was observed for the element nickel. No apparent variation was found between different depths of the water for both metals.

Mercury levels were variable throughout, with the highest concentrations recorded in the middle of the water column.

Zinc levels in the water were mostly below the limit of detection (LOD) and were only recorded in higher concentrations along the continental shelf.

The concentrations of heavy metals are presented in Table 4.42.

Table 4.42 The concentration of heavy metals (µg/l)

Sampling station	Barium (µg/l)	Cadmium (µg/l)	Chrom (µg/l)	Copper (µg/l)	Lead (µg/l)	Mercury (µg/l)	Nickel (µg/l)	Zinc (µg/l)	Depth (m)
EBS-WS01 A	51,75	119,08	69,12	116,34	36,48	2,16	75,44	14,06	16
EBS-WS01 B	76,82	120	96,2	33,78	46,66	18,76	79,66	<1,00	12,75
EBS-WS01 C	77,92	118,04	67,48	40,38	35,44	13,12	73,98	<1,00	9,75
EBS-WS02 D	76,52	119,88	83,96	188,08	43,58	18,22	79,51	<1,00	6
EBS-WS02 E	75,58	116,96	79,78	40,26	43,02	17,46	77,25	<1,00	2,5
EBS-WS04 A	99,68	120,24	115,18	91,1	43,7	16,04	77,17	<1,00	37
EBS-WS04 B	39,86	121,84	68,4	30,22	50,12	19,38	85,01	<1,00	33,75
EBS-WS04 C	35,48	122,24	79,96	70,66	50,48	16,08	83,68	<1,00	22,75
EBS-WS04 D	63,2	121,58	66,68	26,6	47,62	19,72	83,18	<1,00	11,5
EBS-WS04 E	77,58	126,64	61,54	48	49,98	<0,05	82,28	0,7	2,75
EBS-WS08 A	78,72	122,34	77,72	54,7	49,34	16,48	83,18	2,72	54
EBS-WS08 B	47,3	121,9	96,72	81,8	49,36	12,94	84,08	2,82	42
EBS-WS08 C	45,48	121,8	78,84	55,68	48,28	14,64	84,02	10,64	28
EBS-WS08 D	49,46	121,68	60	2,8	47,02	<0,05	81,88	<1,00	14,5
EBS-WS08 E	76	121,7	49,48	12,5	48,12	<0,05	82,3	24,36	2,75
EBS-WS11 A	10,08	83,98	84,06	345	<0,20	93,58	62,48	<1,00	65,25
EBS-WS11 B	11,14	86,58	36,56	129,3	<0,20	94,36	68,9	<1,00	49,75
EBS-WS11 C	4,58	85,98	76,42	251,16	<0,20	94,82	45,64	<1,00	33,75
EBS-WS11 D	<0,10	86,68	133,36	189,78	<0,20	94,58	67,92	<1,00	16,75
EBS-WS11 E	3,9	86,58	105,38	227,18	<0,20	96,94	69,66	154,5	2,75
EBS-WS12 A	23,92	88,22	131,04	226,18	<0,20	92,1	69,18	<1,00	75
EBS-WS12 B	2,6	87,82	82,38	188,52	<0,20	94,04	70,12	164,8	60
EBS-WS12 C	6,56	84,92	78,14	197,28	<0,20	93,32	65,26	<1,00	39,75
EBS-WS12 D	<0,10	88,28	129,98	173,18	<0,20	94,58	68,98	<1,00	21
EBS-WS12 E	2,68	86,44	130,34	243,18	<0,20	97,12	68,32	<1,00	2,75
EBS-WS13 A	36,76	88,36	132,74	240,54	<0,20	92,76	69,72	28,3	86,25
EBS-WS13 B	<0,10	86,52	119,02	215,84	<0,20	119,76	68,2	<1,00	66,25
EBS-WS13 C	<0,10	86,84	95,68	<0,10	<0,20	<0,05	68,66	<1,00	45
EBS-WS13 D	<0,10	87,62	100,9	26,4	<0,20	90,6	71,8	<1,00	23
EBS-WS13 E	<0,10	86,52	119,94	153,92	<0,20	79,2	65,8	<1,00	2,75
EBS-WS16 A	153,26	63,66	281,9	284,7	36,8	86,14	47,86	<1,00	109,25
EBS-WS16 B	<0,10	67,86	262,68	222,2	48	72,6	66,38	<1,00	82,75
EBS-WS16 C	47,44	70,46	254,92	224,4	2,44	81,98	76,88	174,1	55
EBS-WS16 D	40,84	61,9	249,18	202,82	44,68	83,44	50,78	<1,00	27,75
EBS-WS16 E	29,58	67,3	217,1	216,46	46,44	78,06	65,86	<1,00	2,5
EBS-WS18 A	79,4	67,36	261,96	331,6	51,94	94,18	67,56	30,16	121,5
EBS-WS18 B	59,24	67,1	279,58	254,64	46,6	54,7	64,2	<1,00	92,25
EBS-WS18 C	35,48	67,14	234,2	288,52	38,02	69,26	62,76	<1,00	60,5
EBS-WS18 D	28,6	67,14	223,4	242,86	49,3	77	62,76	<1,00	30,5
EBS-WS18 E	45,14	66,26	211,9	190,84	45,5	80,6	61,44	<1,00	2,5
EBS-WS19 A	95,8	66,42	236,5	257,32	47,14	82,5	61,68	<1,00	130,5
EBS-WS19 B	66,16	66,24	243,94	292,88	49,18	83,34	62,62	<1,00	99
EBS-WS19 C	<0,10	67,64	92,68	82,46	46,68	70,76	66,54	<1,00	66
EBS-WS19 D	48,76	67,32	187,92	128,68	48,66	79,6	64,86	<1,00	33,75

Sampling station	Barium (µg/l)	Cadmium (µg/l)	Chrom (µg/l)	Copper (µg/l)	Lead (µg/l)	Mercury (µg/l)	Nickel (µg/l)	Zinc (µg/l)	Depth (m)
EBS-WS19 E	14,98	66,74	84,22	43,64	43,84	76,7	61,98	<1,00	2,5
EBS-WS21 A	43	52,03	43,6	30,63	20,8	48,78	30	28,14	119,25
EBS-WS21 B	<0,10	52,92	28,16	24,78	25,75	48,95	34,38	<1,00	92
EBS-WS21 C	<0,10	26,53	16,16	13,72	12,87	24,83	17,36	4,44	61,75
EBS-WS21 D	<0,10	27,15	15,1	27,95	14,08	24,58	14,78	<1,00	30,75
EBS-WS21 E	1,51	10,77	6,21	11,71	5,48	10,03	7,36	<1,00	2,25
EBS-WS22 A	<0,10	10,95	4,8	11,9	5,73	9,95	8,43	<1,00	119,25
EBS-WS22 B	<0,10	10,57	6,47	4,13	5,69	9,67	8,45	<1,00	91,75
EBS-WS22 C	<0,10	10,71	6,38	14,01	5,69	9,58	8,22	<1,00	62
EBS-WS22 D	<0,10	10,81	3,64	18,01	5,71	9,96	8,29	<1,00	30,75
EBS-WS22 E	<0,10	11,06	5,27	20,75	5,58	9,98	7,93	<1,00	2,5
EBS-WS33 A	0,33	10,78	5,21	19,47	5,22	9,99	7,9	<1,00	130,25
EBS-WS33 B	<0,10	10,71	6,46	18,92	5,56	9,19	7,66	<1,00	99,25
EBS-WS33 C	<0,10	10,8	5,71	12,45	5,22	9,42	6,9	<1,00	66
EBS-WS33 D	<0,10	10,79	5,13	14,77	5,6	9,9	7,26	<1,00	33,75
EBS-WS33 E	<0,10	10,84	24,02	13,39	5,11	10,02	6,87	2,42	2,5
EBS-WS34 A	34,88	23,99	17,32	256,38	<0,20	15,78	6,52	13,92	973,75
EBS-WS34 B	38,34	24,44	13,99	133,08	<0,20	13,99	6,05	2,7	251
EBS-WS34 D	32,12	24,38	15,83	155,65	<0,20	16,32	5,81	0,28	126,25
EBS-WS34 C	4,03	24,39	15,16	160,61	<0,20	16,28	5,67	8,39	50,75
EBS-WS34 E	10,34	24,19	14,74	69,73	<0,20	16,22	6,17	8,29	2,5
EBS-WS35 A	39,9	24,19	15,1	119,64	<0,20	16,72	5,98	<1,00	945,75
EBS-WS35 B	<0,10	24,77	13,44	<0,10	<0,20	15,16	6,28	<1,00	251
EBS-WS35 C	10,5	25,8	14,03	120,59	<0,20	15,82	6,49	11,05	126
EBS-WS35 D	<0,10	24,37	14,55	<0,10	<0,20	15,42	7,05	13,46	50,75
EBS-WS35 E	<0,10	24,53	9,59	<0,10	<0,20	15,74	6,42	12,8	2,5
EBS-WS39 A	9,73	24,5	7,32	<0,10	<0,20	15,88	6,61	17,67	1023,5
EBS-WS39 B	<0,10	24,62	6,7	<0,10	<0,20	15,87	6,69	16,86	251
EBS-WS39 C	<0,10	24,59	6,25	<0,10	<0,20	16,06	6,64	17,01	126,25
EBS-WS39 D	<0,10	24,55	7,01	<0,10	<0,20	16,11	6,49	22,6	50,75
EBS-WS39 E	5,3	24,45	7,65	<0,10	<0,20	16,16	6,16	27,88	2,5
EBS-WS40 A	21,97	24,19	8,44	90,87	<0,20	16,15	6,28	17,44	341
EBS-WS40 B	27,39	24,11	10,57	<0,10	<0,20	16,1	6,42	22,97	251,25
EBS-WS40 C	22,09	24,28	10,24	<0,10	<0,20	16,22	6,26	14,75	126
EBS-WS40 D	<0,10	24,28	10,27	18,19	<0,20	15,99	6,08	<1,00	50,5
EBS-WS40 E	21,47	23,84	14,95	8,13	<0,20	15,93	6,13	5,38	2,5
Average	40,4	61	80,6	121,1	32,6	42,8	43,3	28,2	N/A
Standard deviation	31,5	39,2	82,5	100,2	18,8	35,6	31,7	46,2	N/A
Variation (%)	77,9	64,3	102,5	82,7	57,7	83,1	73,2	163,7	N/A

Chlorophyll, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Total Organic Carbon (TOC), Spectral Absorption, and pH

The concentration of chlorophyll showed a general pattern of highest levels found in surface layers, decreasing in the mid-depth layers, and slightly increasing in the bottom water layer. The highest concentrations of all three photosynthetic pigments (a, b, and c) were recorded in the

bottom layer of station EBS-WS33, yielding values of 13.53 mg/m^3, 17.86 mg/m^3, and 21.69 mg/m^3, respectively.

Total Suspended Solids (TSS) ranged from 4 mg/l to 186 mg/l with an average concentration of 95.5 mg/l ± 40.7 SD.

The pH concentrations showed a decreasing trend with depth.

The levels of chlorophyll, TSS, TDS, TOC, spectral absorption, and pH are presented in Table 4.43

Table 4.43 Chlorophyll concentrations, TSS, TDS, TOC, Spectral absorption and pH

Sampling station	Chlorophyll A (mg/m^3)	Chlorophyll B (mg/m^3)	Chlorophyll C (mg/m^3)	Total Suspended Solids (mg/l)	Total Dissolved Solids (mg/l)	Total Organic Carbon (mg/l)	Spectral Absorption Coefficient			pH @~20°C	Apparent Color	Water depth (m)
							436nm (m-1)	525nm (m-1)	620nm (m-1)			
EBS-WS01 A	6.8	5.17	6.95	104	24861	6.36	0.13	0.05	0.02	8.34	Transparent -lights	16
EBS-WS01 B	4.07	3.36	4.26	41	18692	6.66	0.28	0.18	0.13	8.32	Transparent -lights	12.75
EBS-WS01 C	5.05	4.16	5.8	48	18504	6.71	0.31	0.21	0.17	8.32	Transparent -lights	9.75
EBS-WS02 D	4.29	3.2	4.35	111	18490	6.6	0.17	0.1	0.08	8.35	Transparent -lights	6
EBS-WS02 E	10.47	11.37	15.16	12	19341	6.87	0.065	0.015	0.003	8.31	Transparent -lights	2.5
EBS-WS04 A	6.21	6.55	7.8	85	19816	5.55	0.05	0.01	0	7.99	Transparent -lights	37
EBS-WS04 B	3.34	3.79	5.29	117	18125	6.44	0.42	0.3	0.24	8.08	Transparent -lights	33.75
EBS-WS04 C	7.8	8.03	10.79	122	17878	6.53	0.22	0.12	0.06	8.18	Transparent -lights	22.75
EBS-WS04 D	7.39	5.33	7.26	71	28704	6.49	0.22	0.14	0.11	8.27	Transparent -lights	11.5
EBS-WS04 E	4.57	2.4	3.91	99	20131	6.48	0.33	0.22	0.16	8.21	Transparent -lights	2.75
EBS-WS08 A	4.22	5.44	6.77	96	23857	6.68	0.32	0.25	0.22	8.11	Transparent -lights	54
EBS-WS08 B	2.55	3.08	3.23	84	26595	6.58	0.17	0.09	0.06	8.08	Transparent -lights	42
EBS-WS08 C	7.18	9.78	12.4	165	23592	6.68	0.14	0.1	0.09	8.07	Transparent -lights	28
EBS-WS08 D	4.47	5.14	6.34	112	27485	5.57	0.17	0.07	0.05	8.18	Transparent -lights	14.5
EBS-WS08 E	4.33	3.92	5.07	96	23100	5.63	0.07	0.02	0.02	8.19	Transparent -lights	2.75
EBS-WS11 A	3.55	4.47	5.27	91	23197	6.52	0.03	0.005	0.015	7.97	Transparent -lights	65.25
EBS-WS11 B	1.1	1.39	1.67	97	24200	5.41	0.06	0.03	0.035	8.04	Transparent -lights	49.75
EBS-WS11 C	3.06	3.82	4.62	96	21129	5.61	0.01	0	0	8.2	Transparent -lights	33.75
EBS-WS11 D	9.09	10.63	12.81	77	25168	6.23	0.055	0.027	0.035	8.39	Transparent -lights	16.75
EBS-WS11 E	7.56	8.56	9.53	125	22853	5.64	0.037	0.012	0.022	8.4	Transparent -lights	2.75
EBS-WS12 A	3.45	4.25	5.55	113	26226	15.57	0.04	0.02	0.01	7.96	Transparent -lights	75
EBS-WS12 B	3.42	4.14	4.95	74	17424	15.82	0.07	0.04	0.03	8.12	Transparent -lights	60
EBS-WS12 C	5.59	6.92	8.28	120	22453	15.32	0.032	0.007	0	8.1	Transparent -lights	39.75
EBS-WS12 D	2.45	2.17	3.1	120	21130	16.59	0.035	0.01	0.003	8.29	Transparent -lights	21
EBS-WS12 E	5.74	6.69	8.2	116	17809	16.35	0.038	0.01	0.005	8.41	Transparent -lights	2.75
EBS-WS13 A	0.6	0.78	0.91	118	24110	5.17	0.18	0.14	0.12	8	Transparent -lights	86.25
EBS-WS13 B	1.85	2.34	2.86	102	27704	9.8	0.12	0.08	0.06	8.07	Transparent -lights	66.25

Sampling station	Chlorophyll A (mg/m³)	Chlorophyll B (mg/m³)	Chlorophyll C (mg/m³)	Total Suspended Solids (mg/l)	Total Dissolved Solids (mg/l)	Total Organic Carbon (mg/l)	Spectral Absorption Coefficient			pH @~20°C	Apparent Color	Water depth (m)
							436nm (m-1)	525nm (m-1)	620nm (m-1)			
EBS-WS13 C	2.89	3.75	4.48	115	22556	12.06	0.19	0.15	0.13	8.08	Transparent -lights	45
EBS-WS13 D	3.25	3.42	4.03	117	28018	12.09	0.11	0.07	0.06	8.25	Transparent -lights	23
EBS-WS13 E	3.26	3.61	5.05	7	22635	11.29	0.3	0.21	0.16	8.28	Transparent -lights	2.75
EBS-WS16 A	1.72	2.24	2.74	138	26936	4.34	0.25	0.19	0.16	7.93	Transparent -lights	109.25
EBS-WS16 B	1.06	1.4	1.72	4	12417	5.33	0.19	0.14	0.11	8.21	Transparent -lights	82.75
EBS-WS16 C	1.12	1.41	1.72	125	27237	5.85	0.35	0.29	0.26	8.13	Transparent-lights	55
EBS-WS16 D	0.85	1.42	1.92	18	27057	5.55	0.18	0.13	0.1	8.16	Transparent -lights	27.75
EBS-WS16 E	3.1	3.42	4.31	6	21121	8.4	0.29	0.22	0.18	8.21	Transparent -lights	2.5
EBS-WS18 A	3.51	4.57	5.36	126	20922	4.48	0.27	0.21	0.18	7.92	Transparent -lights	121.5
EBS-WS18 B	2.15	2.77	3.39	106	29804	5.35	0.23	0.18	0.16	7.96	Transparent -lights	92.25
EBS-WS18 C	2.49	3.25	3.86	125	23041	5.42	0.15	0.1	0.08	8.12	Transparent -lights	60.5
EBS-WS18 D	3.07	3.72	4.37	129	19009	5.61	0.2	0.16	0.14	8.21	Transparent -lights	30.5
EBS-WS18 E	2.76	3.18	3.74	119	20583	5.5	0.08	0.05	0.04	8.29	Transparent -lights	2.5
EBS-WS19 A	8.05	10.27	12.24	122	28504	4.43	0.18	0.13	0.1	7.89	Transparent -lights	130.5
EBS-WS19 B	7.04	9.06	10.94	8	24313	4.73	0.11	0.07	0.06	7.91	Transparent -lights	99
EBS-WS19 C	0.83	1.06	1.25	104	20005	4.97	0.16	0.11	0.09	8.06	Transparent -lights	66
EBS-WS19 D	5.01	6.29	7.48	96	23300	5.32	0.23	0.17	0.15	8.2	Transparent -lights	33.75
EBS-WS19 E	3.06	2.74	3.44	97	29313	5.47	0.15	0.1	0.08	8.36	Transparent -lights	2.5
EBS-WS21 A	8.3	10.79	13	10	23789	10.02	0.1	0.07	0.05	7.95	Transparent -lights	119.25
EBS-WS21 B	1.73	2.24	2.74	103	20062	9.76	0.19	0.13	0.09	7.92	Transparent -lights	92
EBS-WS21 C	0.77	0.97	1.23	25	21672	10.88	0.14	0.09	0.07	8.03	Transparent -lights	61.75
EBS-WS21 D	3.85	4.28	5.18	126	18502	10.3	0.09	0.06	0.04	8.28	Transparent -lights	30.75
EBS-WS21 E	0.89	0.86	1.07	84	24938	8.7	0.14	0.09	0.07	8.35	Transparent -lights	2.25
EBS-WS22 A	5.2	6.74	7.91	65	23166	13.27	0.12	0.09	0.09	7.82	Transparent -lights	119.25
EBS-WS22 B	2.24	2.99	3.6	93	26642	14.66	0.035	0.012	0.007	7.86	Transparent -lights	91.75
EBS-WS22 C	2.04	2.5	2.96	86	20790	13.86	0.13	0.07	0.05	7.79	Transparent -lights	62
EBS-WS22 D	3.83	4.74	6.1	118	26301	14.35	0.08	0.05	0.04	8.08	Transparent -lights	30.75
EBS-WS22 E	4.41	5.29	6.63	80	24491	16.31	0.12	0.08	0.06	8.24	Transparent -lights	2.5
EBS-WS33 A	13.53	17.86	21.69	122	24050	4.27	0.08	0.04	0.04	7.95	Transparent -lights	130.25

Sampling station	Chlorophyll A (mg/m³)	Chlorophyll B (mg/m³)	Chlorophyll C (mg/m³)	Total Suspended Solids (mg/l)	Total Dissolved Solids (mg/l)	Total Organic Carbon (mg/l)	Spectral Absorption Coefficient			pH @~20°C	Apparent Color	Water depth (m)
							436nm (m-1)	525nm (m-1)	620nm (m-1)			
EBS-WS33 B	0.7	0.85	1.01	137	23735	5.05	0.13	0.09	0.09	7.9	Transparent -lights	99.25
EBS-WS33 C	1.37	1.75	2.12	15	31975	5.57	0	0	0	7.94	Transparent -lights	66
EBS-WS33 D	6.1	7.75	8.85	97	26301	5.88	0	0	0	8.14	Transparent -lights	33.75
EBS-WS33 E	2.88	2.89	3.5	11	21061	6.33	0.035	0.005	0.015	8.3	Transparent -lights	2.5
EBS-WS34 A	2.07	2.74	3.42	110	26772	6.24	0.06	0.007	0	7.72	Transparent -lights	973.75
EBS-WS34 B	0.68	1.03	1.63	23	19964	5.34	0.3	0.2	0.16	7.91	Transparent -lights	251
EBS-WS34 C	3.94	5.19	6.51	97	29744	4.91	0.46	0.36	0.33	7.86	Transparent -lights	126.25
EBS-WS34 D	6.95	9.37	11.91	120	19082	5.43	0.58	0.4	0.29	8.12	Transparent -lights	50.75
EBS-WS34 E	1.95	1.99	2.97	73	20041	5.94	0.1	0.04	0.03	8.3	Transparent -lights	2.5
EBS-WS35 A	5.12	6.6	8.1	97	20687	16.15	0.09	0.03	0.01	7.65	Transparent -lights	945.75
EBS-WS35 B	1.49	2.05	2.79	134	23597	12.89	0.03	0.005	0	7.7	Transparent -lights	251
EBS-WS35 C	1.98	2.72	3.62	138	17706	12.84	0.022	0	0	7.86	Transparent -lights	126
EBS-WS35 D	1.46	1.88	2.32	75	21577	13.32	0.07	0.05	0.04	8	Transparent -lights	50.75
EBS-WS35 E	1.68	0.95	1.79	89	26278	14.36	0.05	0.01	0.005	8.3	Transparent -lights	2.5
EBS-WS39 A	1.81	2.43	3.34	118	23127	8.85	0.16	0.1	0.06	7.66	Transparent -lights	1023.5
EBS-WS39 B	1.85	2.68	3.35	186	26990	7.13	0.19	0.15	0.12	7.75	Transparent -lights	251
EBS-WS39 C	0.2	0.44	0.88	148	24656	7.7	0.12	0.08	0.06	7.89	Transparent -lights	126.25
EBS-WS39 D	<0.1	<0.1	0.16	107	20283	8.56	0.3	0.2	0.16	8.12	Transparent -lights	50.75
EBS-WS39 E	3.02	3.6	4.95	110	19675	7.64	0.095	0.032	0.02	8.26	Transparent -lights	2.5
EBS-WS40 A	2.52	3.34	4.17	143	27060	6.3	0.11	0.05	0.04	7.78	Transparent -lights	341
EBS-WS40 B	0.87	1.23	1.8	126	26740	6.61	0.23	0.13	0.09	7.84	Transparent -lights	251.25
EBS-WS40 C	2.21	3.06	4.03	145	29171	5.77	0.22	0.12	0.08	7.92	Transparent -lights	126
EBS-WS40 D	2.31	3	3.74	131	23641	5.71	0.16	0.09	0.07	8.12	Transparent -lights	50.5
EBS-WS40 E	7.42	6.15	8.32	127	20518	6.49	0.21	0.14	0.12	8.35	Transparent -lights	2.5
Average	3.7	4.3	5.3	95.5	23176.6	8.2	0.154	0.1	0.08	8.08	N/A	N/A
Standard deviation	2.6	3.1	3.8	40.7	3685.4	3.7	0.111	0.086	0.072	0.19	N/A	N/A
Variation (%)	69.3	71.8	71.1	42.6	15.9	44.7	71.9	86.3	90.2	2.4	N/A	N/A

An update on the data collected during the monitoring campaigns in 2017 was carried out during the marine expeditions in March 2021 when measurement campaigns of chemical parameters in the water column (CTD), coupled with water sampling, were conducted in the area of the production platform and the drilling centre Domino 2 (Figure no. 4.21). These measurements were taken at water depths ranging from 50 to 100 meters (production platform location) and 860 to 950 meters (Domino 2 drilling centre location).

The field investigations were conducted by GeoEcoMar on the research vessel R/V Mare Nigrum, and the results of these investigations are presented below.

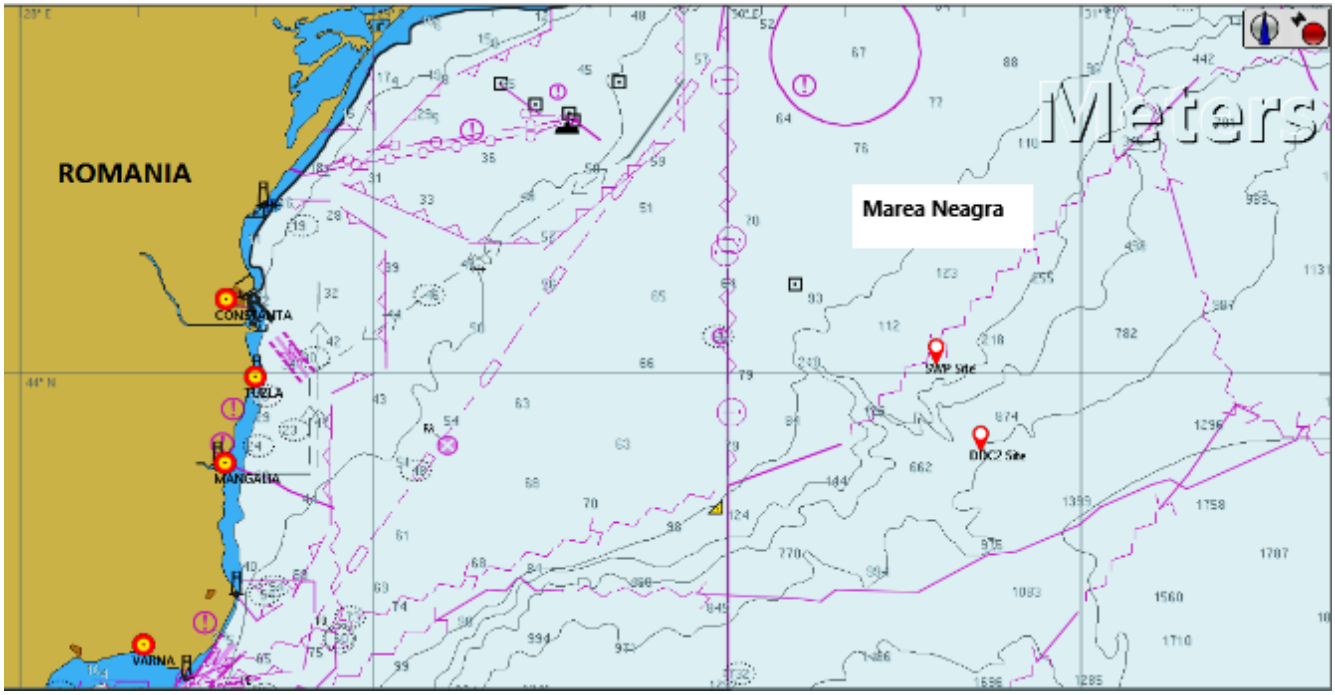


Figure 4.21 Measurements of CTD profiles and water sampling points, March 2021

For each location, three water column profiles were collected for CTD measurements (the first in the morning, the second at midday, and the last in the evening) using a CTD profiler attached to the water sampler. The profiles included the following measured or derived parameters: Pressure/depth, Sigma-theta (σT), Temperature, Conductivity/salinity, Dissolved oxygen concentration/dissolved oxygen saturation, Fluorescence, Beam attenuation/light transmission through water.

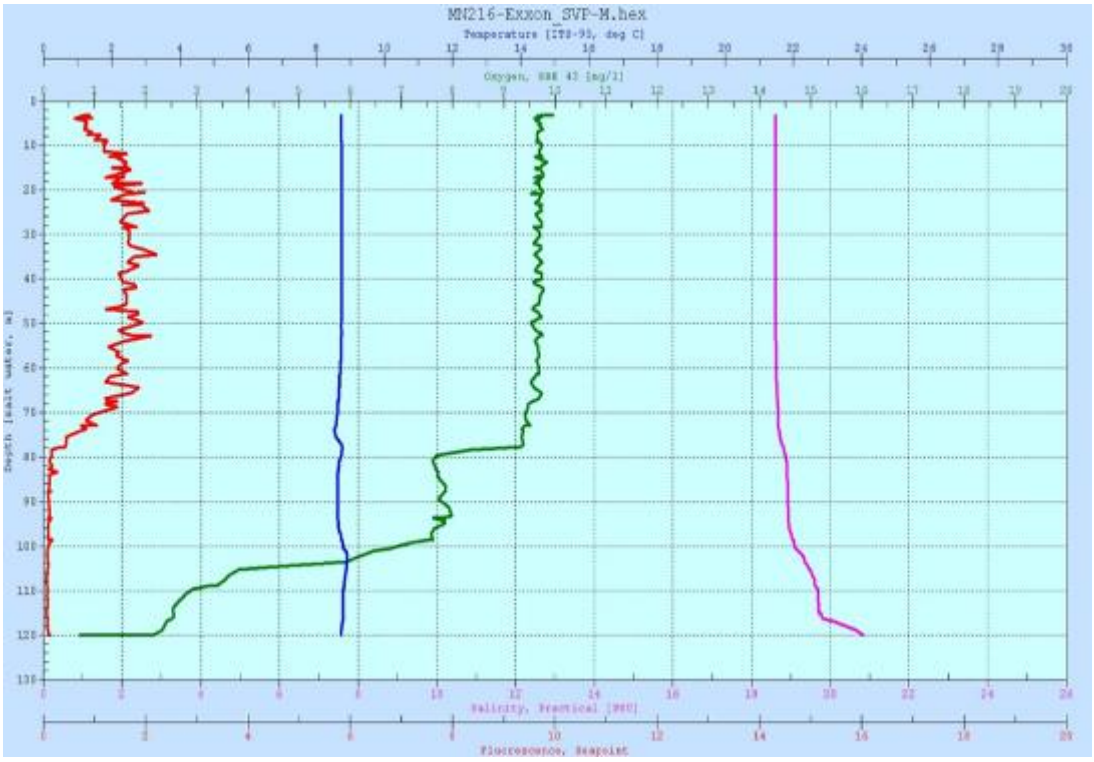
Simultaneously with the CTD profiles, three sets of water samples were collected, and water turbidity measurements were conducted on board the vessel. The same procedure was followed for measuring sulphide (S2-) concentrations in the water column. Additionally, the collected water samples were filtered, and the filters were immediately frozen for subsequent chlorophyll analysis at the GeoEcoMar laboratory. The results of the measurements for sulphide and chlorophyll are presented in the tables below:

Table 4.44 Analysis Results for sulfides and chlorophyll on marine water samples, March 2021

Sampling station	Profile	Data	Depth (m)	Sulfides mg/l	Chlorophyll (µm/l)		
					a	b	c
SWP	1	25.03.2021	50	0.00	< LOD	< LOD	< LOD

Sampling station	Profile	Data	Depth (m)	Sulfides mg/l	Chlorophyll (µm/l)		
					a	b	c
Platform		M – (morning)	60	0.00	< LOD	< LOD	< LOD
			70	0.00	< LOD	< LOD	< LOD
			80	0.00	< LOD	< LOD	< LOD
			90	0.00	< LOD	< LOD	< LOD
			100	0.00	< LOD	< LOD	< LOD
	2	25.03.2021 A – (midday)	50	0.00	< LOD	< LOD	< LOD
			60	0.00	< LOD	< LOD	< LOD
			70	0.00	< LOD	< LOD	< LOD
			80	0.00	< LOD	< LOD	< LOD
			90	0.00	< LOD	< LOD	< LOD
			100	0.00	< LOD	< LOD	< LOD
	3	21.03.2021 N – (evening)	50	0.00	< LOD	< LOD	< LOD
			60	0.00	< LOD	< LOD	< LOD
			70	0.00	< LOD	< LOD	< LOD
			80	0.00	< LOD	< LOD	< LOD
			90	0.00	< LOD	< LOD	< LOD
			100	0.00	< LOD	< LOD	< LOD
DODC 2 Domino	1	25.03.2021 M – morning)	950	8,775	< LOD	< LOD	< LOD
			940	8,975	< LOD	< LOD	< LOD
			930	9,475	< LOD	< LOD	< LOD
			920	9,275	< LOD	< LOD	< LOD
			910	8,575	< LOD	< LOD	< LOD
			900	8,625	< LOD	< LOD	< LOD
	2	25.03.2021 A – (midday)	930	8,950	< LOD	< LOD	< LOD
			920	8,350	< LOD	< LOD	< LOD
			910	9,100	< LOD	< LOD	< LOD
			900	8,150	< LOD	< LOD	< LOD
			890	8,450	< LOD	< LOD	< LOD
			880	8,650	< LOD	< LOD	< LOD
	3	25.03.2021 N – (evening)	930	9,525	< LOD	< LOD	< LOD
			910	10,150	< LOD	< LOD	< LOD
			890	10,550	< LOD	< LOD	< LOD
			880	9,800	< LOD	< LOD	< LOD
			870	9,100	< LOD	< LOD	< LOD
			860	7,650	< LOD	< LOD	< LOD
					LOD limit of detection 0.004 µg/L		

In Figures No. 4.22 - 4.27, the temperature, salinity, dissolved oxygen, and fluorescence profiles against water depth are presented from the CTD data collected at the production platform and Domino 2 drilling centre locations during the morning, midday and evening.



Fluorescence
Temperature[°C]
Oxigen[mg/l]
Salinity [salinity units]

Figure 4.22 Marine production platform: CTD measurements - morning profile, March 2021

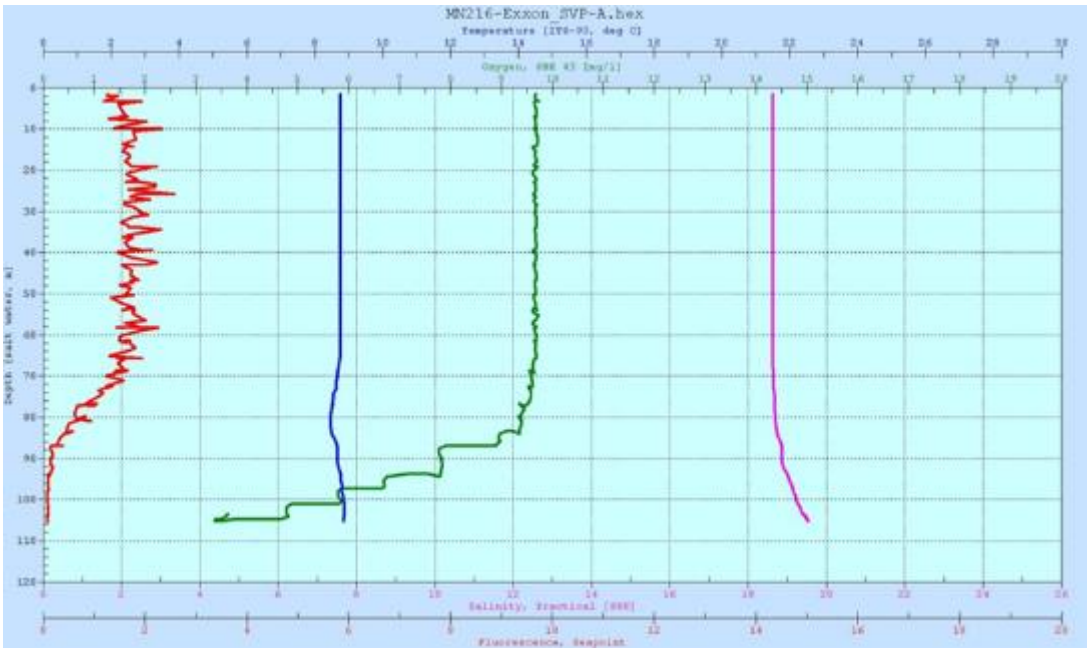


Figure 4.23 Marine production platform: CTD measurements - midday profile, March 2021

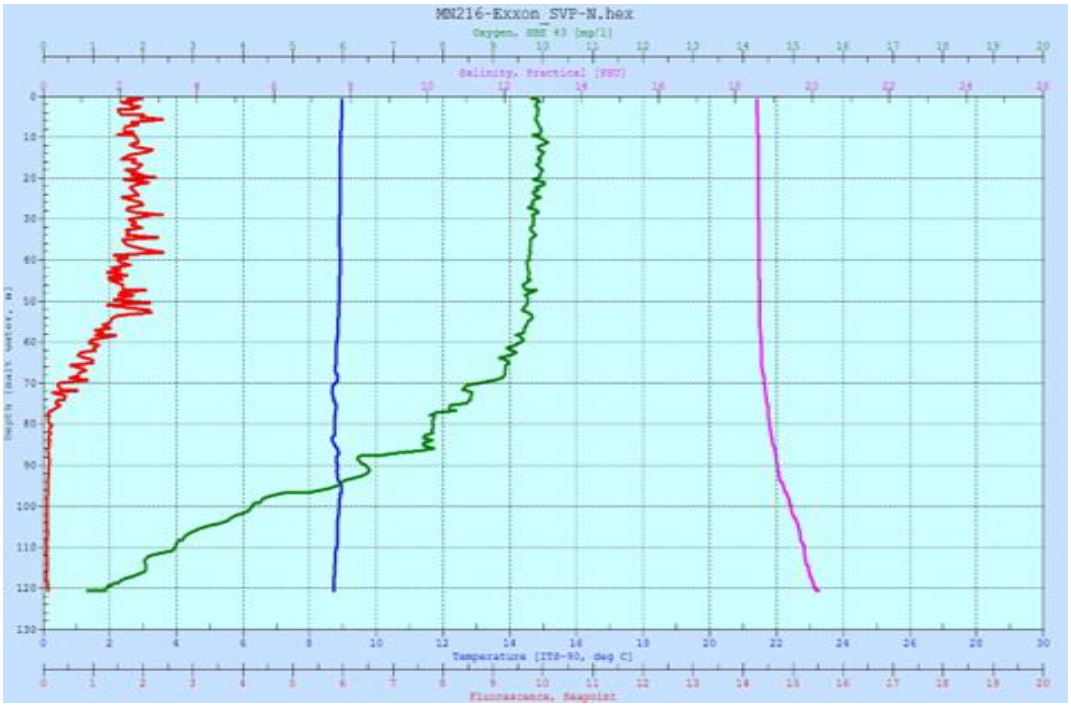


Figure 4.24 Marine production platform: CTD measurements - evening profile, March 2021.

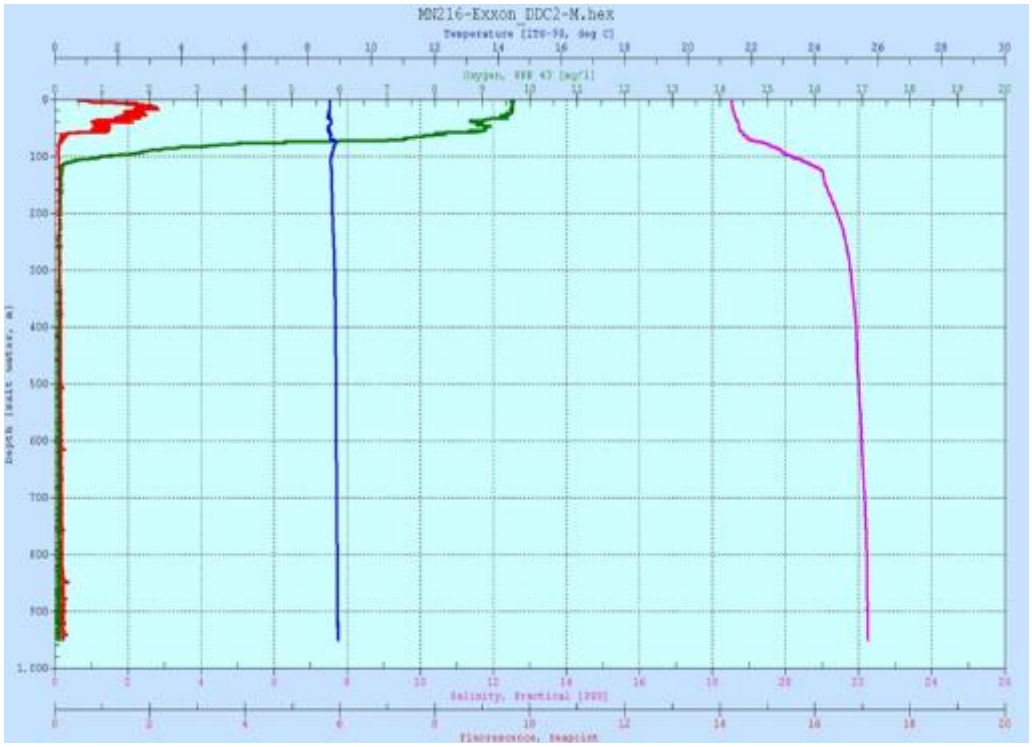


Figure 4.25 Domino 2 drilling centre: CTD measurements - morning profile, March 2021

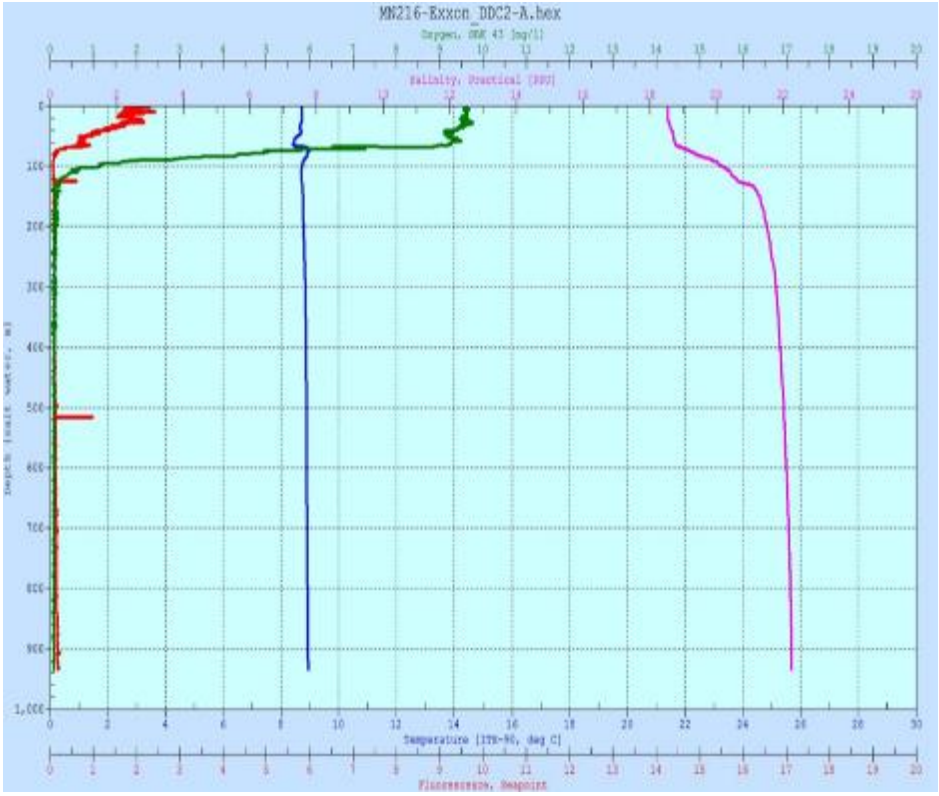


Figure 4.26 Domino 2 drilling centre: CTD measurements - midday profile, March 2021

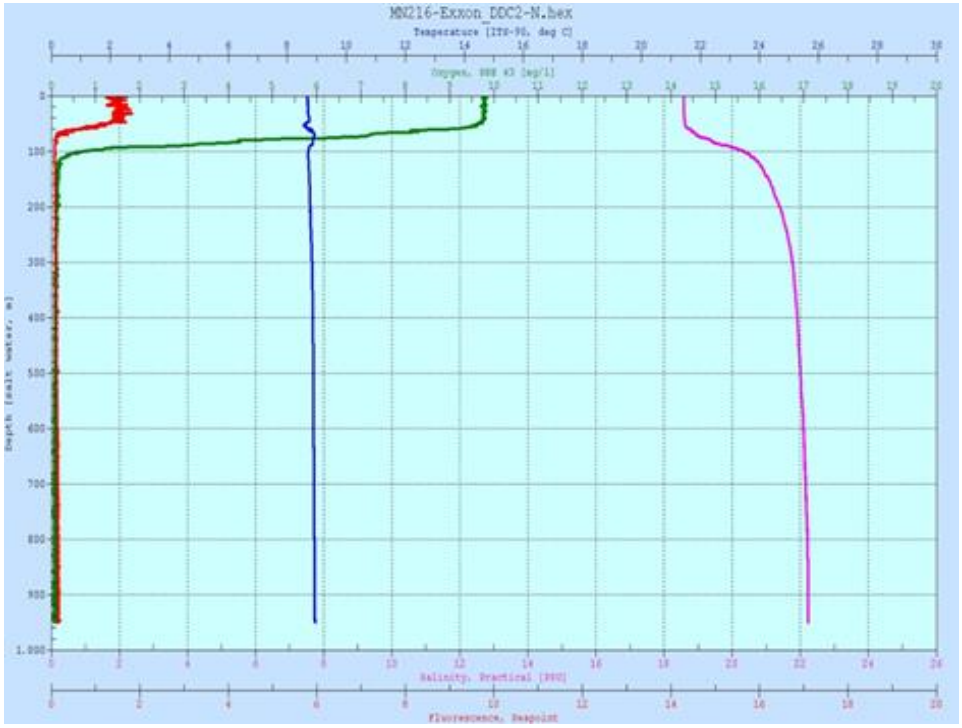


Figure 4.27 Domino 2 drilling centre: CTD measurements - evening profile, March 2021.

The results of the testing campaign conducted in March 2021 are presented below:

- Thermal characteristics of the water column were similar for all six collected profiles. At the sampling station, the production platform, surface water temperatures were approximately 8.7°C, and the temperature at the bottom of the water was around 8.7°C at

a depth of approximately 120 meters. The thermocline was not established due to the specific seasonal characteristics of the water bodies. The drilling centre Domino 2 station recorded surface water temperatures of approximately 8.7°C and a temperature at the bottom of the water of around 8.9°C at a depth of about 950 meters.

- Salinity profiles were similar for each of the six CTD modules in 2021, with values at the water's surface of approximately 18.5 PSU (Practical Salinity Units), increasing to about 20.1 PSU at a depth of 120 meters for profiles in the production platform area, and 22.2 PSU for profiles in the Domino 2 drilling centre area.

- pH values of the water column. In March 2021, based on measurements taken on water samples from the production platform area, the pH values ranged from 7.99 to 8.81, with a slight decrease at around 90 meters depth, simultaneously with the decline in oxygen values. At the drilling centre Domino 2 station, the pH values of the water column ranged from 7.93 to 8.64. These values are in line with general data for the Black Sea.

- Dissolved oxygen was close to saturation for the well-mixed upper layer, with concentrations ranging from approximately 10.4 mg/l at the surface to 0.2 mg/l at the bottom for the production platform station and from 9.7 mg/l at the surface to 0.0 mg/l at the bottom for the drilling centre Domino 2 station.

- Turbidity varied between 0 – 3 FTU (Formazin Turbidity Units) at the production platform (between 50- and 100-meters water depth) and at the Domino 2 drilling centre (between 860 and 950 meters water depth) between 0 and 4 FTU.

- Sulfide (S2-) concentrations varied between 7.650 and 10.550 mg S2-/l at water depths ranging from 860 to 950 meters. Sulfide concentrations decreased from morning to midday in March 2021 and then increased in the evening profiles, with a maximum value of 10.550 mg S2-/l recorded at a depth of 890 meters and a minimum value of 7.650 mg S2-/l at a depth of 860 meters. No detectable concentrations of S2- were observed in the shallower waters of the production platform.

- Chlorophyll-a, b, and c content in the water from the production platform and Domino 2 drilling centre were below the detection limit in March 2021

4.3.3 Data collection and investigation methods.

The method of reviewing scientific and technical data and information from documents, reports, and field studies conducted for the Neptun Deep project during the period 2018-2022 was applied.

Data regarding the existing surface and groundwater bodies in the terrestrial area of the Neptun Deep project were primarily sourced from the updated *Management Plan (2021) of the Danube River, Danube Delta, Dobrogea Hydrographic Basin, and Coastal Waters*[6].

Additionally, studies conducted by the project proponent for the assessment of the initial state and water quality were considered:

- Environmental Baseline Survey Report - GeoQuip Marine, 2018

[6] https://dobrogea-litoral.rowater.ro, accessed 25.04.2023

- *Surface water sampling within the coastal area of the Neptun Deep project*, conducted by Halcrow Romania (Jacobs) through Balint Analitika laboratories (subcontractor)
- Report on marine water samples and CTD tests for the offshore area of the Neptun Deep project - GeoEcoMar, 2021
- Report on the coastal marine water quality indicators from the samples collected in the field investigation program - Blumenfield, 2023

Field investigation methods involved the collection of surface water and marine water samples and their analysis, either in situ using multiparameter equipment (CTD, multiparameter probe) or ex-situ in specialized laboratories for environmental technical analyses.

For marine water sampling, Niskin bottles were used, and the collected water was stored in brown glass containers of 1l, 500ml, and 250ml, corresponding to laboratory analysis categories (nutrients, heavy metals, hydrocarbons, and other compounds). The samples were stored in mobile refrigerators at a temperature of 50°C and transported to the laboratory on the same day. Upon arrival at the laboratory, the samples were coded, and their condition was checked to ensure compliance with conservation requirements.

Chemical analyses were conducted following standard methods to determine the required chemical parameters. Where applicable, the obtained results were compared with legal references for the maximum values of coastal marine water quality indicators.

4.4 ENVIRONMENTAL FACTOR DESCRIPTION – AIR AND CLIMATE

4.4.1 Onshore Site

Currently, the onshore site of the project is used for agricultural purposes, and no industrial activities have been identified on the site or in the immediate vicinity. From this perspective, we can assert that there are no identified industrial sources of air pollution at the onshore project site. The main existing sources of air pollution in the project area include:

- Road and rail traffic, especially during the tourist season, through existing road infrastructure (DN39, communal road DC4, and local roads) and railway infrastructure (the Constanta - Mangalia railway line).
- Air traffic operations conducted at Tuzla Airport.

Approximately 5 km south of the project site's boundary, an existing non-hazardous waste landfill has been identified in the village of Schitu, Costinești commune, operated by SC Iridex Group. The main odour sources present in the Tuzla and Costinești areas include livestock farms and the existing non-hazardous waste landfill in Costinești. The distance between the project site and these sources is greater than 5 km.

4.4.2 Offshore Site

The main activities in the Black Sea area include maritime transportation, fishing, and oil and gas exploration and production operations. Currently, the main sources of air pollution include power generators and transportation means (both maritime and aerial) as well as flaring from existing offshore oil and gas installations (BSOG, Petrom SA).

The future production platform will be located offshore, approximately 160 km from the shore. There are no other operating/exploration platforms within a 50 km radius of the production platform.

Fishing is limited to shallower waters due to the capacity of the majority of vessels used. The Romanian fishing fleet operates up to 30-35 nautical miles (55-65 km) in the Black Sea or at a water depth of approximately 60 meters, as a consequence of vessel characteristics and their limited autonomy. Navigation routes crossing the production pipeline route consist of the following:

- Vessels navigating between the Ukrainian ports of Odessa, Chornomorsk (Illichivsk), Yuzhny, and Nikolaev and the Bosporus area.
- Vessels navigating between the Romanian ports of Constanta, Midia, and Galati and the Bosporus area.
- Vessels navigating between the Bulgarian ports of Varna and Burgas and the Romanian and Ukrainian ports.

4.4.3 Air Quality in the Project Site Area

There is no air quality monitoring network located within the onshore or offshore project sites. In Constanta County, there are seven continuous monitoring stations measuring nitrogen oxides (NOx), nitric oxide (NO), sulphur dioxide (SO2), nitrogen dioxide (NO2), carbon monoxide (CO), benzene, PM10, PM2.5 - suspended particulate matter, and ozone (O3). Suspended particulate matter samples are also collected and analysed for heavy metals (e.g., Pb, Cd, Ni, As). The location and characteristics of each station are detailed in Table No. 4.45.

Table 4.45 The network of automatic monitoring stations in Constanta County

European code	Station name	Station type	Site type	Pollutants monitored	City	Approximate distance to the onshore project site (km)
RO0131A	CT-1	Traffic	Urban	SO_2, NOx, NO, NO_2, CO, Benzene, PM_{10}, Heavy Metals *	Constanța	31,8
RO0132A	CT-2	Background	Urban	SO_2, NOx, NO, NO_2, CO, O_3, Benzene, $PM_{2.5}$	Constanța	31,2
RO0133A	CT-3	Background	Suburban	SO_2, NOx, NO, NO_2, CO, O_3, Benzene, PM_{10}, Heavy Metals *	Năvodari	52,5
RO0134A	CT-4	Traffic	Urban	SO_2, NOx, NO, NO_2, CO, Benzene, PM_{10}, Heavy Metals *	Mangalia	25
RO0135A	CT-5	Industrial	Urban	SO_2, NOx, NO, NO_2, CO, O_3, PM_{10}, Heavy Metals *	Constanța	27,7
RO0136A	CT-6	Industrial	Urban	SO_2, NOx, NO, NO_2, CO, O_3, Benzene	Năvodari	53,9
RO0137A	CT-7	Industrial	Urban	SO_2, NOx, NO, NO_2, CO, O_3, PM_{10}, Heavy Metals	Medgidia	60,8

Note: * Heavy metals (e.g., Pb, Cd, Ni, As) are analysed from the suspended particulate matter samples (PM10)

For an assessment of the air quality status in the onshore project area, as part of the data collection studies conducted by the project owner, air quality monitoring was carried out in the project vicinity on land (measurements taken on April 26, 2022, and May 26, 2022).

To measure the parameters: benzene, sulphur dioxide, nitrogen dioxide, and ozone, the accredited laboratory Bálint Analitika Kft installed Radiello tubes on poles. The Radiello tube sampling method is validated by ERLAP (European Reference Laboratory for Air Pollution).

The coordinates of the measurement points are presented in Table 4.46, and their locations relative to the project can be found in Figure 4.28.

Figure 4.28 Location of air gas sampling points in the area

The monitoring points were established considering the sensitive receptors in the vicinity of the project (i.e., residential areas in Tuzla and Costinești) and the prevailing wind direction (i.e., northwest). One of the selected positions (i.e., B1) was located within the boundary of the proposed NGMS (Submarine Power Cable).

Table 4.46 Coordinates of air quality monitoring points

ID Sampling point	Coordinates		Observations
	Latitude (degrees)	Longitude (degrees)	
B1	43.975703	28.640683	The NGMS zone, site boundary - Rural area approximately 300 m to the west of a lightly trafficked local road and a railway line. The tubes were installed on a metal fence, on the western side of the site.

ID Sampling point	Coordinates		Observations
	Latitude (degrees)	Longitude (degrees)	
R1	43.970453	28.651599	The residential area with a few houses. The tubes are installed on an electricity pole, approximately 80 meters from the lightly trafficked local road
R2	43.972800	28.655061	The project site boundary - residential area. The tubes are installed on a fence, approximately 35 meters from the access road.
R3	43.962026	28.641757	Costinești residential area - adjacent to the lightly trafficked suburban road (Henri Coandă Street). The road is asphalted. The tubes have been installed on an electricity pole.
R4	43.973657	28.621924	Rural, residential area; adjacent to the local road with low traffic, within a farm located off the national road DN39. The tubes have been installed on an electricity pole
R5	43.974566	28.618767	Residential area - Tuzla, adjacent to the lightly trafficked local road. The tubes have been installed on an electricity pole.
R6	43.991300	28.629486	Residential area - Tuzla, adjacent to the lightly trafficked local road. The tubes have been installed on an electricity pole
R7	43.992741	28.638744	Residential area - Tuzla, adjacent to the lightly trafficked local road. The tubes have been installed on an electricity pole

Table 4.47 The concentration of organic compounds in the air is expressed in µg/m3 at 20°C and 1031 mbar.

Parameter	B1-A	B1-B	R1-A	R1-B	R2-A	R2-B
Benzene	**0,23**	**0,23**	**0,24**	**0,24**	**0,26**	**0,25**
Toluene	0,26	0,25	0,21	0,23	0,24	0,21
Ethylbenzene	0,07	0,07	0,08	0,06	0,07	0,06
Xylenes	0,23	0,23	0,20	0,22	0,25	0,23
1-ethyl-3-methylbenzene	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
1 ethyl 4 methylbenzene	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
1,3,5 trimethylbenzene	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
1 ethyl 2 methylbenzene	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
Tert-butylbenzene + 1,2,4-trimethylbenzene	0,05	0,05	0,05	0,06	0,07	0,06
1,2,3-trimethylbenzene	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
Cyclohexane	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
Pentane (C5)	0,41	0,39	0,36	0,39	0,39	0,36
Hexane (C6)	0,80	0,81	0,85	0,91	0,96	1,02
Heptane (C7)	0,75	0,70	0,70	0,74	0,77	0,73
Octane (C8)	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
Aliphatic hydrocarbons C9-C17	6,51	6,81	7,14	7,63	6,90	7,50
Parameter	**R3-A**	**R3-B**	**R4-A**	**R4-B**	**R5-A**	**R5-B**
Benzene	**0,23**	**0,25**	**0,25**	**0,25**	**0,26**	**0,29**

Toluene	0,26	0,28	0,24	0,23	0,23	0,26
Ethylbenzene	0,07	0,07	0,08	0,06	0,07	0,06
Xylene	0,26	0,27	0,24	0,22	0,20	0,25
1-ethyl-3-methylbenzene	<0,05	0,06	<0,05	<0,05	0,05	0,05
1 ethyl 4 methylbenzene	<0,05	0,05	<0,05	<0,05	<0,05	<0,05
1,3,5 trimethylbenzene	<0,05	0,05	<0,05	<0,05	<0,05	<0,05
1 ethyl 2 methylbenzene	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
Tert-butylbenzene + 1,2,4-trimethylbenzene	0,06	0,06	0,06	0,05	0,07	0,08
1,2,3-trimethylbenzene	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
Cyclohexane	<0,05	0,06	<0,05	<0,05	0,05	0,05
Pentane (C5)	0,51	0,48	0,45	0,43	0,47	0,45
Hexane (C6)	0,93	0,85	0,81	0,77	0,77	0,81
Heptane (C7)	0,68	0,75	0,78	0,71	0,56	0,81
Octane (C8)	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
Aliphatic hydrocarbons C9-C17	7,76	7,48	6,65	6,40	6,29	5,78
Parameter	**R6-A**	**R6-B**	**R7-A**	**R7-B**	**QAQC-A**	**QAQC - B**
Benzene	**0,32**	**0,34**	**0,29**	**0,35**	**0,24**	**0,24**
Toluene	0,40	0,44	0,27	0,30	0,24	0,24
Ethylbenzene	0,11	0,12	0,08	0,10	0,07	0,06
Xylene	0,44	0,42	0,25	0,30	0,24	0,23
1-ethyl-3-methylbenzene	0,11	0,09	0,06	0,06	<0,05	<0,05
1 ethyl 4 methylbenzene	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
1,3,5 trimethylbenzene	0,07	0,07	<0,05	<0,05	<0,05	<0,05
1 ethyl 2 methylbenzene	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
Tert-butylbenzene + 1,2,4-trimethylbenzene	0,12	0,13	0,07	0,09	0,06	0,05
1,2,3-trimethylbenzene	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
Cyclohexane	0,06	0,05	0,06	0,05	<0,05	<0,05
Pentane (C5)	0,70	0,68	0,43	0,58	0,44	0,42
Hexane (C6)	0,91	0,96	0,76	0,96	0,78	0,79
Heptane (C7)	0,85	0,90	0,66	0,71	0,79	0,70
Octane (C8)	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05
Aliphatic hydrocarbons C9-C17	8,37	8,19	6,84	7,83	6,67	6,79

The limit value for the protection of human health for benzene, from Law 104/2011 on ambient air quality, is 5 µg/m3 for a calendar year, as shown in Table 4.48 below.

Table 4.48 The concentration of inorganic compounds in the air is expressed in µg/m3 at 20°C and 1031 mbar.

Parameter	**Limit values Law 104/2011**	**B1-A**	**B1-B**	**R1-A**	**R1-B**	**R2-A**	**R2-B**
Sulphur dioxide	124 µg/m^3 daily	1,89	1,78	2,03	1,97	1,94	2,10
Nitrogen dioxide	200 µg/m^3 hourly 40 µg/m^3 yearly	5,00	4,84	5,22	5,30	5,50	5,29
Ozone	120 µg/m^3 daily	84,56	82,18	78,01	88,37	80,69	75,03
Parameter		**R3-A**	**R3-B**	**R4-A**	**R4-B**	**R5-A**	**R5-B**
Sulphur dioxide	124 µg/m^3 daily	2,04	2,16	1,81	1,91	1,74	1,68

Nitrogen dioxide	200 µg/m^3 hourly 40 µg/m^3 yearly	5,17	5,09	5,45	5,57	5,15	5,03
Ozone	120 µg/m^3 daily	74,73	77,73	77,71	80,39	83,37	84,86
Parameter		**R6-A**	**R6-B**	**R7-A**	**R7-B**	**QAQC-A**	**QAQC - B**
Sulphur dioxide	124 µg/m^3 daily	2,42	2,51	2,58	2,51	1,93	1,85
Nitrogen dioxide	200 µg/m^3 hourly 40 µg/m^3 yearly	6,18	6,38	6,66	6,46	5,37	5,29
Ozone	120 µg/m^3 daily	79,50	82,18	77,12	82,77	82,77	78,31

The measurement of carbon monoxide concentration in the air was performed using a gas analyser for 2 hours at each monitoring point on May 26, 2022.

The concentration of PM2.5 and PM10 particulate matter was measured through 2-hour instrumental measurements using the DustTrakTM DRX Aerosol Monitor Model 8534 on May 27, 2022.

The coordinates of the measurement points are presented in Table 4.49.

Table 4.49 The coordinates of the measurement points for CO, PM2.5, and PM10 in ambient air.

ID Sampling point	Coordinates		Observations
	Latitude (degrees)	Longitude (degrees)	
B1	43.975331	28.643550	The NGMS zone, site boundary - Rural area approximately 20 meters to the northwest of a lightly trafficked local road and a railway line
R1	43.970451	28.651599	Residential area with few houses. Located approximately 80 meters from the lightly trafficked local road. Asphalt road.
R4	43.974857	28.622317	Rural, residential area; adjacent to the local road of low traffic, within a farm located off the national road DN39.
R5	43.998708	28.651810	Residential area - Tuzla, adjacent to the lightly trafficked local road.

The centralization of the obtained results is presented in Table 4.50 below:

Table 4.50 The concentration of CO in the ambient air at the site location

Sampling point	CO concentration (mg/m^3)	PM2.5 concentration (µg/m^3)	PM10 concentration (µg/m^3)
B1	0,132	18,9	19,6
R1	0,137	14,5	14,9
R4	0,130	18,9	19,8
R5	0,143	25,5	27,7
Limit values according to Law 104/2011	10 mg/m^3 (maximum daily average over an 8-hour period)	-	50 µg/m^3 (daily) 40 µg/m^3 (daily)

4.4.4 Climate

4.4.4.1 Climatic conditions of the onshore site

The climate of the project land site area is warm and temperate with hot summers (Cfa - Humid Subtropical Climate, Köppen climate class). It is also completely humid because the NGMS environment is coastal, adjacent to the Black Sea. Relative humidity therefore ranges between 64% and 85% in August and December, respectively, with little monthly variation. Predominant winds blow from the west and north, recording average monthly speeds between 4.3 and 5.1 m/s.

Weather stations near the project site in the land area are as follows: Tuzla Airport (2.7 km to the northwest), Mangalia (18.1 km to the south) and Constanța (26.7 km to the north). Weather station Tuzla Airport is very close to the seashore (3.4 km) and therefore could be considered coastal. The meteorological stations belong to the National Meteorological Administration (ANM) and the Romanian Civil Aeronautical Authority (CAAR). More information (name, coordinates, altitude, and operator/owner) about the nearest weather stations is shown in Table 4.51

Table 4.51 Meteorological stations located near the project site in the land area

No.	Weather station	WGS 84 Coordinates	Stereo 70 Coordinates	Quota altimetry (m)	Operator	No.	Weather station
		Longitude	Latitude	X(m)	Y(m)		
1	Constant	28.64638	44.21409	791478.81	308158.80	17.8	NMA
2	Mangalia	28.5874	43.8161	788726.77	263745.49	2.1	NMA
3	Tuzla Airport	28.6097	43.9842	789688.41	282495.19	49	CAA

The meteorological records for the nearest stations mentioned above (Tuzla Airport, Mangalia and Constanța) recorded in the period 2008 - 2021 are presented in Table 4.52. The data presented are monthly average, daily minimum and maximum temperature and relative humidity (RH), monthly average and daily maximum wind, and monthly average precipitation.

Table 4.52 Meteorological records for temperature (°C), relative humidity (%), wind speed (m/s) and precipitation (mm) for 3 of the closest coastal stations to the project land site, 2008- 20 21

Station	Month	Temperature (°C)			Relative humidity (%)		Wind speed (m/s)		Precipitation (mm)
		Monthly average	Min	MAX	Monthly average	Min	Average monthly	MAX	Average monthly
Constant	January	1.9	-17.6	17.4	84	33	2.6	16	56.36
	February	4.0	-14.5	22.7	82	30	2.3	12	35.57
	March	7.0	-11.5	22.3	76	10	2.2	10	41.36
	April	11.3	0.7	30.1	74	22	2.0	10	40.14
	May	17.1	7.1	31.7	74	20	1.9	9	57.36
	June	21.9	10.9	33.7	72	26	1.8	9	63.57
	July	24.1	14.4	33.6	68	26	1.7	7.0	62.00
	August	24.6	13.9	33.9	66	22	1.7	8	23.21
	September	20.2	5.6	32.9	68	2. 3	1.9	8	32.50
	October	14.1	2.1	27	77	26	2.0	11	63.71

Station	Month	Temperature (°C)			Relative humidity (%)		Wind speed (m/s)		Precipitation (mm)
		Monthly average	Min	MAX	Monthly average	Min	Average monthly	MAX	Average monthly
	November	9.5	-3.9	25.2	82	29	2.0	10	38.14
	December	4.4	-9.4	19.3	83	33	2.4	10	55.00
Mangalia	January	2.1	-19.1	17.4	87	36	3.3	17	54.64
	February	4.0	- 15.4	20.	87	30	3.3	14	29.86
	March	6.6	-11.9	23.6	84	19	3.3	15	30.93
	April	10.3	-0.3	29.7	84	26	3.3	13	26.29
	May	16.2	6.7	29.0	85	26	3.0	11	44.50
	June	21.2	9.7	33.1	84	32	2.9	10	67.86
	July	23.4	14.2	33.4	80	28	3.1	10	44.86
	August	24.1	13.5	34.7	74	22	3.4	10	26.93
	September	20.1	5.2	33.6	76	28	3.7	14	24.00
	October	14.5	1.4	26.0	84	27	3.6	15	70.71
	November	9.8	-6.8	23.5	89	32	3.3	15	35.43
	December	4.9	-9.9	18.3	88	36	3.2	15	42.21
Airport Tuzla	January	1.7	-17.0	16.0	84	31	5.0	21	N/A
	February	4.0	-12.0	20.0	81	27	5.1	16	N/A
	March	6.8	-13.0	20.0	76	18	5.0	12	N/A
	April	10.3	-3.0	24.0	74	2. 3	4.7	13	N/A
	May	16.5	4.0	31.0	75	22	4.5	12	N/A
	June	21.8	8.0	34.0	75	26	4.3	10	N/A
	July	23.8	13.0	36.0	69	4	4.3	15	N/A
	August	24.4	10.0	36.0	64	24	4.4	11	N/A
	September	20.2	4.0	31.0	66	24	4.7	13	N/A
	October	14.3	1.0	27.0	76	22	4.5	13	N/A
	November	8.8	-7.0	24.0	84	32	4.6	14	N/A
	December	4.1	-11.0	18.0	85	37	4.9	12	N/A

Note: N/A – not applicable, the weather station does not measure this parameter.

4.4.4.1.1 Temperature

As shown in Figure 4.29, the minimum values of the monthly mean temperature are recorded in January and the maximum in August at the 3 weather stations. The lowest/highest average monthly temperatures recorded at the meteorological stations are: 1.9/24.6 ^{0}C at Constanța, 2.1/24.1 ^{0}C at Mangalia and 1.7/24.4 ^{0}C at Tuzla Airport. It should be noted that the difference in minimum and maximum temperature for all months and locations is large enough to suggest an overall effective mixing of the boundary layer and thus a more efficient dispersion of pollutants.

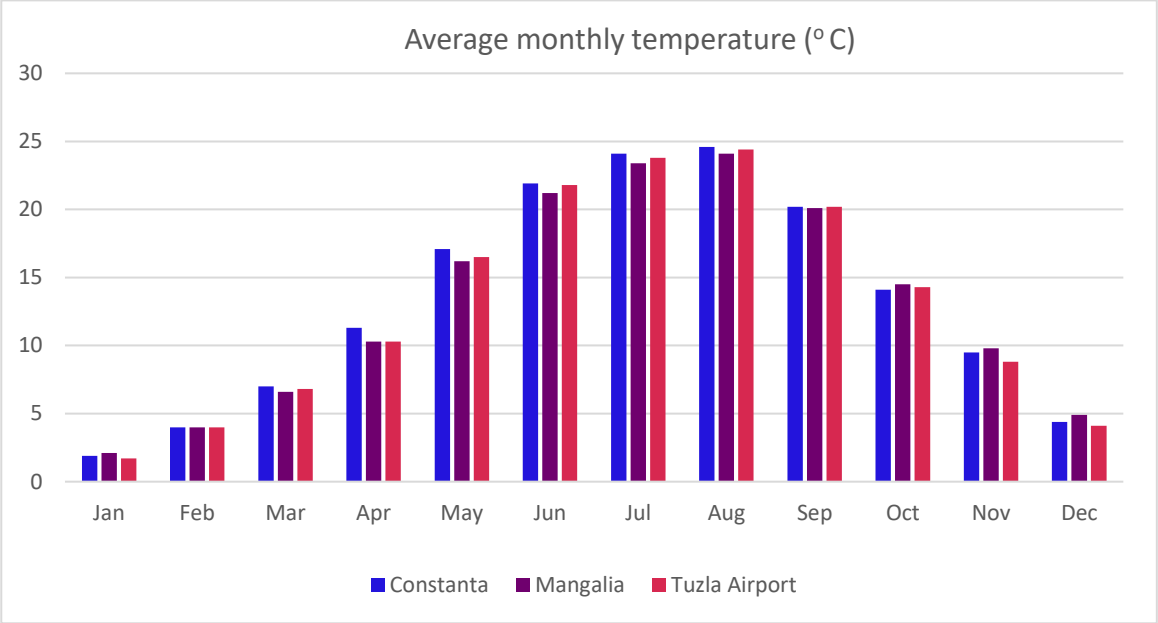


Figure 4.29 Average monthly temperature (° C) for the coastal weather stations Constanța, Mangalia and Tuzla, 2008-20 21

4.4.4.1.2 Relative humidity

As shown in Figure 4.30, the minimum monthly mean relative humidity values are recorded in August and the maximum in January for Constanța, the minimum in August and the maximum in November for Mangalia and the minimum in August and the maximum in December for Tuzla Airport. The average monthly relative humidity is 66/84% at Constanța, 74/89% at Mangalia and 64/85% at Tuzla Airport.

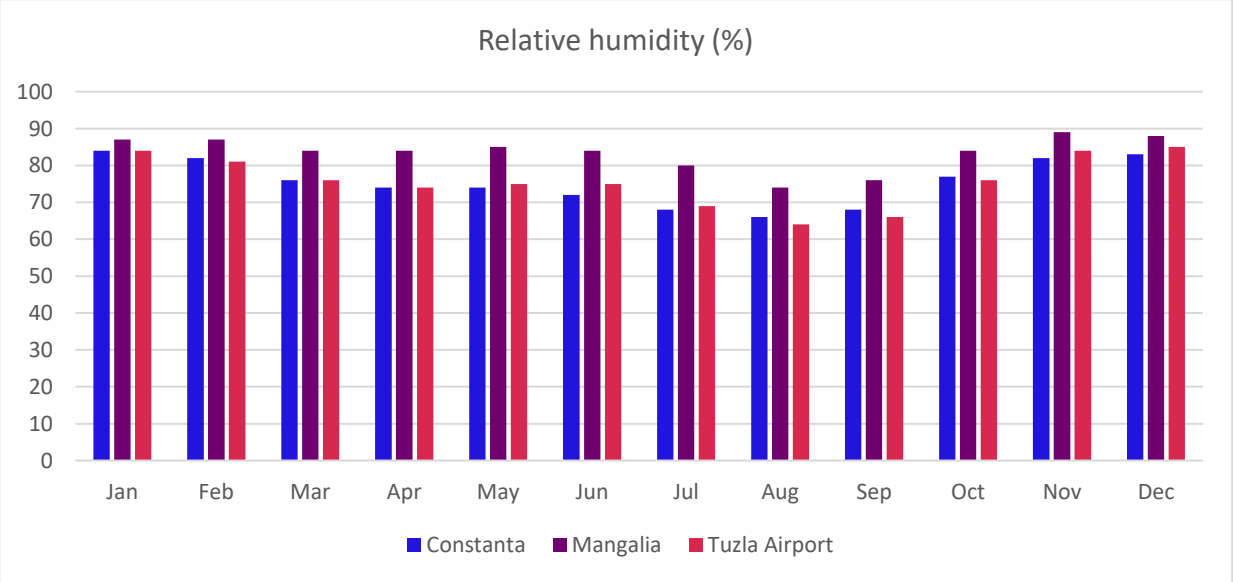


Figure 4.30 Monthly mean relative humidity (%) for the coastal weather stations Constanta, Mangalia and Tuzla, 2008-20 21

4.4.4.1.3 Precipitation

As shown in Figure 4.31, the wettest period of the year around the onshore project site is summer (May, June, July), October and January. The highest amount of precipitation during a month was recorded in October at the Constanța and Mangalia stations - 63.71 mm and 70.71 mm, respectively. The driest month in Constanta is August (23.21 mm), and in Mangalia September (24 mm). No precipitation data was available for Tuzla Airport station.

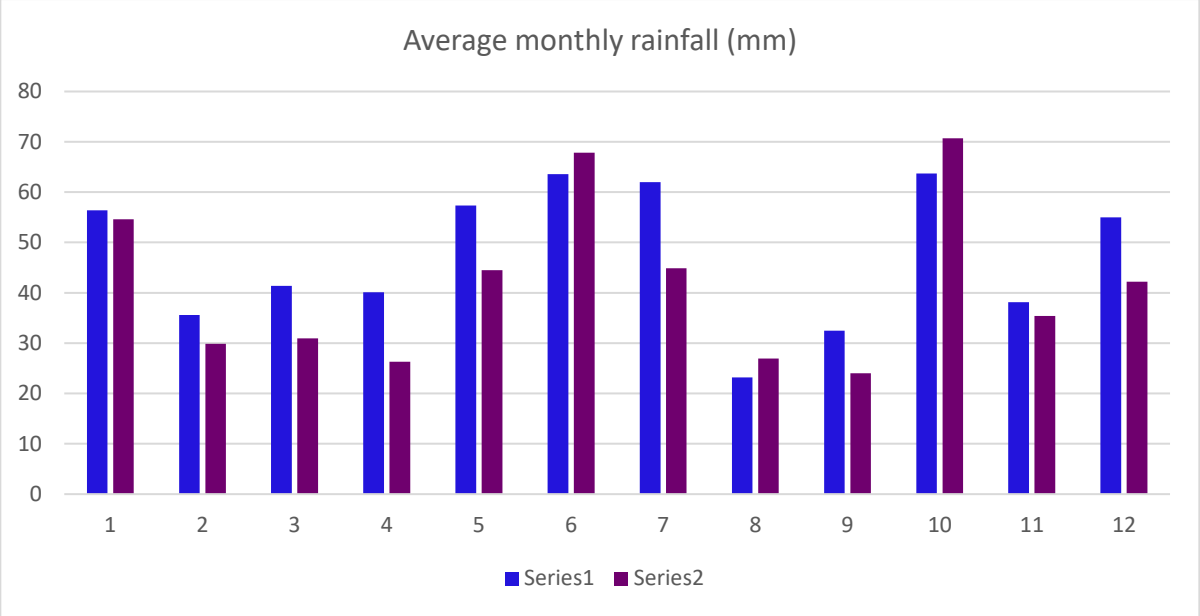


Figure 4.31 Average monthly precipitation (mm) for the coastal weather stations Constanța, Mangalia, 2008-20 2 1

4.4.4.1.4 The wind

As shown in Figure 4.32, the month with the highest average monthly wind speed is January for Constanta with a speed of 2.6 m/s, and September for Mangalia with a speed of 3.7 m/s. For Tuzla Airport, which is the closest station to the project site on land, the month with the highest mean daily and mean daily maximum wind speed is February with 5.1 m/s.

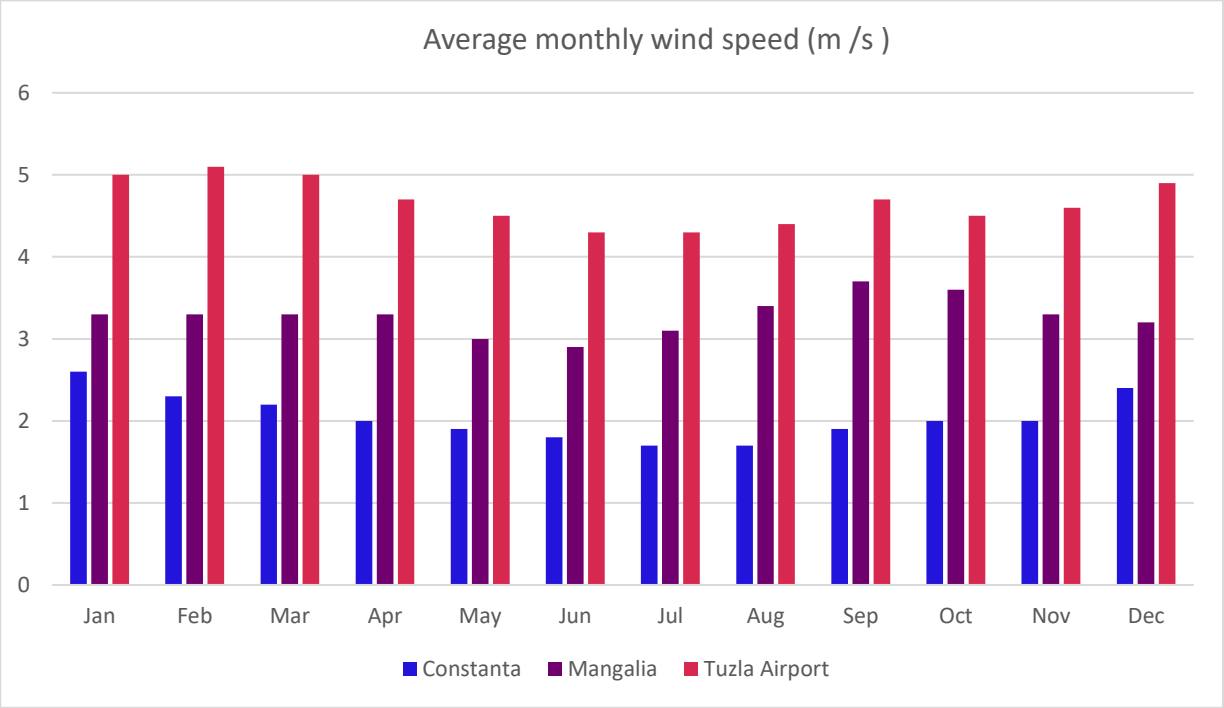


Figure 4.32 Average monthly wind speed (m/s) for coastal weather stations Constanta, Mangalia and Tuzla, 2008-2021

The prevailing winds in Constanța blow from the north and northeast. West and northwest winds have a minor frequency of occurrence. In Mangalia, although the strongest winds blow from the northeast and southeast, the prevailing winds are from the west and northwest. In the case of Tuzla Airport, the wind direction is variable, however the north-west and north-east winds seem to be more pronounced.

4.4.4.2 Climatic conditions of the sea site

A Black Sea metoceanic data study ("Black Sea Metoceanic Data for the Neptune Block Project - URC, TJ Moffett , F. Chen") to characterize metoceanic data in five regions located in the western Black Sea and to support the Neptune Block project.

Given that the Neptun Deep project spans a significant distance within the Black Sea, the metoceanic data collection areas were divided based on water depth into five regions and data were recorded for each region. The location of each region studied in is shown in figure 4.33.

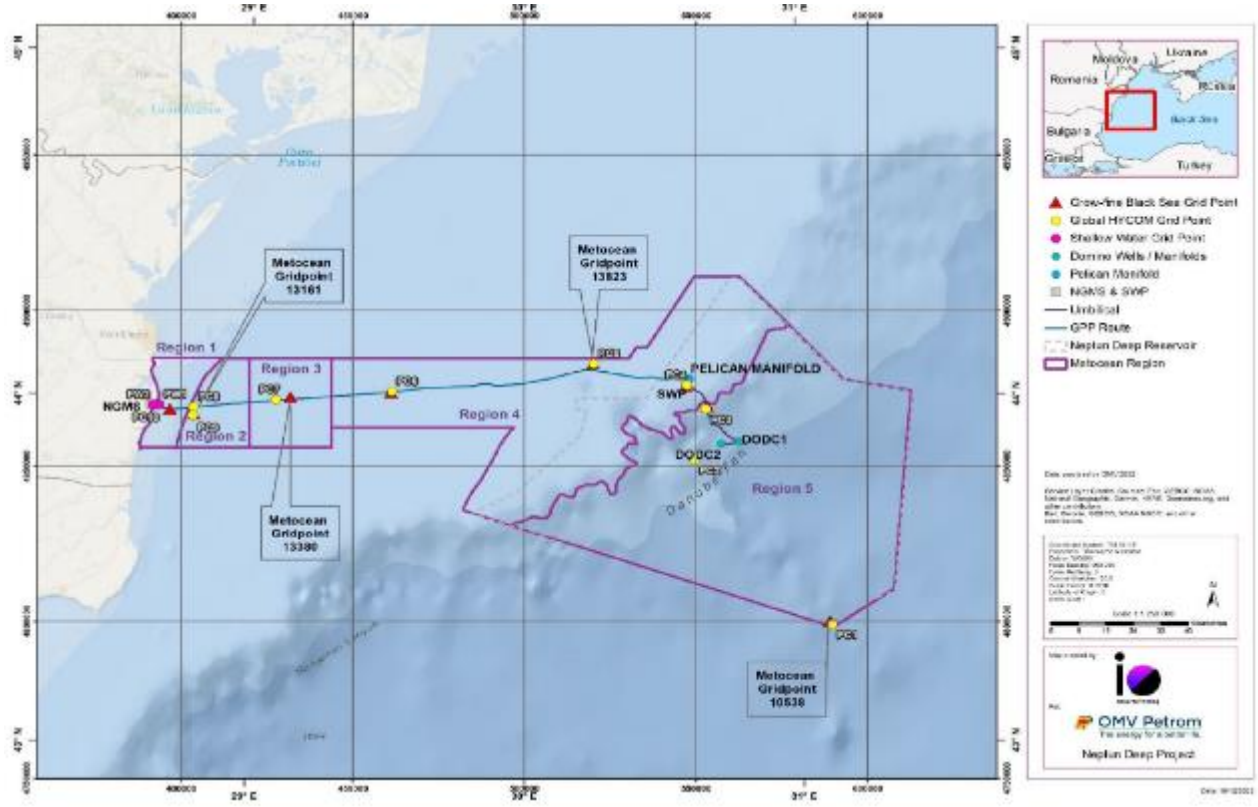


Figure 4.33 Metocean data collection regions

Metocean criteria also includes seasonal extreme wind and air temperature criteria. Data sources used to develop the extreme wind and air temperature criteria included:

- • Global Reanalysis of Black Sea Waves (GROW-FINE BS) retrospective for wind and waves by Oceanweather , Inc.; retrospective GROW-FINE-BS data were used to develop wave and wind criteria for regions 2–5;
- • Air temperature and visibility data based on historical measurements from the National Climatic Data Center (NCDC).

A summary of the meteorological criteria findings is presented below.

4.4.4.2.1 Extreme wind criteria

The prevailing offshore winds in the five regions are from the north and from the platform location (within region 4) are from the northeast. Table 6.53 shows the extreme wind speeds assessed in each region.

Table 4.53 Omnidirectional wind speeds

Region	Water depth (m)	Return period (years)	associate 1 hour wind speed (THX)	associate 10-minute wind speed (THX)	associate 1 minute wind speed (THX)	associate 3-seconds Wind speed (THX)	Department
1	10	1	20.6	22.3	24.5	27.4	North
		100	32.1	35.5	39.8	45.4	
2	40	1	20.6	22.3	24.5	27.4	North
		100	32.1	35.5	39.8	45.4	
3	45	1	21.6	23.4	25.8	28.9	North

Region	Water depth (m)	Return period (years)	associate 1 hour wind speed (THX)	associate 10-minute wind speed (THX)	associate 1 minute wind speed (THX)	associate 3-seconds Wind speed (THX)	Department
		100	30.8	34.0	38.0	43.3	
4	50-300	1	22.2	24.1	26.6	29.8	North East
		100	33.2	36.8	41.3	47.3	
5	300-500	1	22.0	23.9	26.3	29.5	northwest
		100	31.0	34.2	38.3	43.6	

4.4.5 Data collection and investigative methods

The method of reviewing scientific and technical data and information from the documents, reports and field studies carried out for the Neptun Deep project in the period 2018-2022 was applied.

The sources of information for the description of air quality were the following:

- Preliminary report on air quality for 2022, APM Constanta [7], accessed on 14.05.2023;

The field studies were carried out by the project owner during 2022, as follows:

- The results of the measurements carried out with a passive sampling system in the surrounding air, Neptun Deep Costinești-Tuzla, B á lint Analitika Laboratory Kft 22-530/46-105, April - June 2022;
- The results of carbon monoxide measurements in the surrounding air, Neptun Deep Costinești-Tuzla, B á lint Analitika Laboratory Kft 22-530/46-105, May 2022;
- The results of the measurements of PM2.5 and PM 10 in the surrounding air, Neptun Deep Costinești-Tuzla, Laboratory B á lint Analitika Kft 22-530/46-105, May 2022;

4.5 NOISE

4.5.1 The onshore site location

The proposed onshore site location is not situated in an area with significant sources of noise. The neighbouring areas are primarily rural and touristic, with main economic activities being agricultural activities, small shops, accommodation facilities, and restaurants. Many of the tourist facilities operate seasonally and temporarily, mainly during the summer season.

The main sources of noise in the project area are related to transportation infrastructure, including roads, railway, and an airport. The nearest major road to the onshore site location, with available noise maps according to Government Decision - HG no. 321/2005 (republished), is the National Road 39 (DN39), situated approximately 1.8 km away to the west of the NGMS site. The noise levels on this road vary from over 75 dB (A) at the road level to less than 35 dB (A) at a distance of approximately 400 m, as per the Strategic Noise Map for DN39 available on the CNAIR website.

[7] http://www.anpm.ro/documents/18093/33513629/Raport+preliminar+2022.pdf/558faf94-cacb-4f9b-bb71-a2b645245fc2 ,

The closest railway to the onshore site location is the Constanța - Mangalia railway section, which crosses the NGMS site, located at the eastern boundary of the NGMS site. Noise maps for this railway section are not required by the Environmental Noise Directive, and no noise measurements have been identified in publicly accessible sources. Unlike noise from busy roads, railway noise is not continuous, but rather characterized by distinct noise events associated with the passing of trains.

The nearest airport to the onshore site location, the Private Tuzla Airport (also known as Tuzla Aerodrome), is situated to the northwest of the NGMS site, approximately 2 km away. The private Tuzla Airport is a small charter aircraft airport covering an area of 36 hectares. Noise maps for this airport have not been drafted, and no noise measurements have been identified in publicly accessible sources.

Other important noise sources to be considered for characterizing the existing situation are industrial sources. No significant industrial noise sources have been identified in the vicinity of the onshore site location. The study area extends to approximately 4 km from the onshore site location, covering the areas of Tuzla and Costinești. As mentioned earlier, the neighbouring areas are mainly rural and touristic, with main economic activities being agricultural activities, small shops, accommodation facilities, and restaurants.

At a distance of approximately 5 km south of the onshore site location, in the Administrative Territorial Unit - UAT Costinești, the village of Schitu is a municipal waste landfill. According to the Site Report for this landfill, available on the APM Constanța website, the continuous equivalent A-weighted sound level, LAeq, measured at the northern boundary of the landfill near the main gate, recorded values of 60.2 dB (A) and 62.8 dB (A) in 2014 and 2015, respectively. Considering the significant distance between this facility and the onshore site location, it is unlikely that landfill activities would influence the ambient noise level at the onshore site location.

Significant economic activities generating noise are located in the cities of Mangalia and Constanța, which are situated at considerable distances from the onshore site location.

4.5.1.1 Sensitive noise zones in the onshore area of the project site.

According to Order no. 119/2014 approving the Norms for hygiene and public health regarding the living environment of the population, a protected territory is an area where exceeding the maximum permissible concentrations of physical, chemical, and biological pollutants in the environmental factors is not allowed; it includes residential areas, parks, nature reserves, balneo-climatic areas, recreation and leisure areas, social-cultural institutions, educational institutions, and medical institutions.

To identify the noise-sensitive zones in the vicinity of the onshore project site, in addition to field studies, various GIS resources were analysed, including satellite imagery, topographic maps, and vector datasets such as buildings and residential areas.

The approximate distances between the identified noise-sensitive zones and the project site boundary are presented in Table 4.54

Table 4.54 The nearest noise-sensitive receptors to the project site.

Type of noise-sensitive zone		Name	Approximate distance from the project site (km)	Applicable noise limits dB (A) [1]	
				Day (07:00 - 23:00)	Night (23:00 - 07:00)
Residential zones		Costinești	0,1	55 50[2]	45 40[2]
		Tuzla	1,6		
Hotel		Costinești	2,1		
School		Tuzla	2,7		
Church		Tuzla	2,7		
Protected natural area		Techirghiol Lake	5		
	1 According to Order No. 119/2014 regarding the limit criteria for noise. 2 The applicable noise limits that need to be correlated with the baseline measurements results, in cases where an objective will be located in an area near a protected territory where the background exterior noise before the construction of the objective does not exceed 50 dB (A) during the day and 40 dB (A) during the night.				

To characterize the existing noise levels in the project area (baseline conditions for existing noise levels on the project site, as well as the noise level at sensitive receptors in the area), measurements were carried out in accordance with European and national standards (2022).

The locations for noise level measurements were established within a radius of 2 km around the project site. The measurements of the baseline conditions included both measurements at the project site boundaries and in the vicinity of the closest sensitive receptors.

The coordinates of the noise measurement points are presented in Table 4.55, and the locations of the points in relation to the project area are shown in Figure 4.34 below.

Table 4.55 The coordinates of the noise measurement points

Measurement point ID (Figure 4.21)	Coordinates		Zone description
	WGS (X, Y)	Geographic (N, E)	
N1	X: 28.654658 Y: 43.973961	43°58'26.3"N 28°39'16.8"E	In the eastern part of the pipeline route, near the coastline: Distance to: ● NGMS Zone 875 m. ● National Road DN39: ~2820 m. ● Railway: ~845 m.
N2	X: 28.654814 Y: 43.972568	43°58'21.2”N 28°39'17.3"E	Tourist building, located in the pipeline route area (nearest receiver to the pipeline) Distance to: ● NGMS Zone 880 m. ● National Road DN39: ~2880 m. ● Railway: ~860 m.
N6	X: 28.651531 Y: 43.970494	43°58'13.8"N 28°39'05.5"E	Future residential and tourist area located south of the NGMS at approximately 640 m and south of the pipeline route at approximately 295 m). Distance to National Road DN39: ~2665 m. Distance to railway: ~595 m. Microphone in free-field position

Measurement point ID (Figure 4.21)	Coordinates		Zone description
	WGS (X, Y)	Geographic (N, E)	
N7	X: 28.639548 Y: 43.966818	43°58'00.5"N 28°38'22.4"E	Buildings - Residential area in the southern part of the NGMS at a distance of approximately 675 m. Distance to National Road DN39: ~2080 m. Distance to railway: ~23 m.
N8	X: 28.640671 Y: 43.963027	43°57'46.9"N 28°38'26.4"E	Residential area to the south of the NGMS site, at a distance of approximately 1085 m. This location would be representative for the residents of Costinești, the main existing inhabited area. Distance to National Road DN39: ~2100 m. Distance to railway: ~15 m.
N12	X: 28.638259 Y: 43.994002	43°59'38.4"N 28°38'17.7"E	Residential area to the north of the NGMS site, representative for the residents of Tuzla. Distance from NGMS (north): ~1880 m. Distance to National Road DN39: ~835 m. Distance to railway: ~340 m.

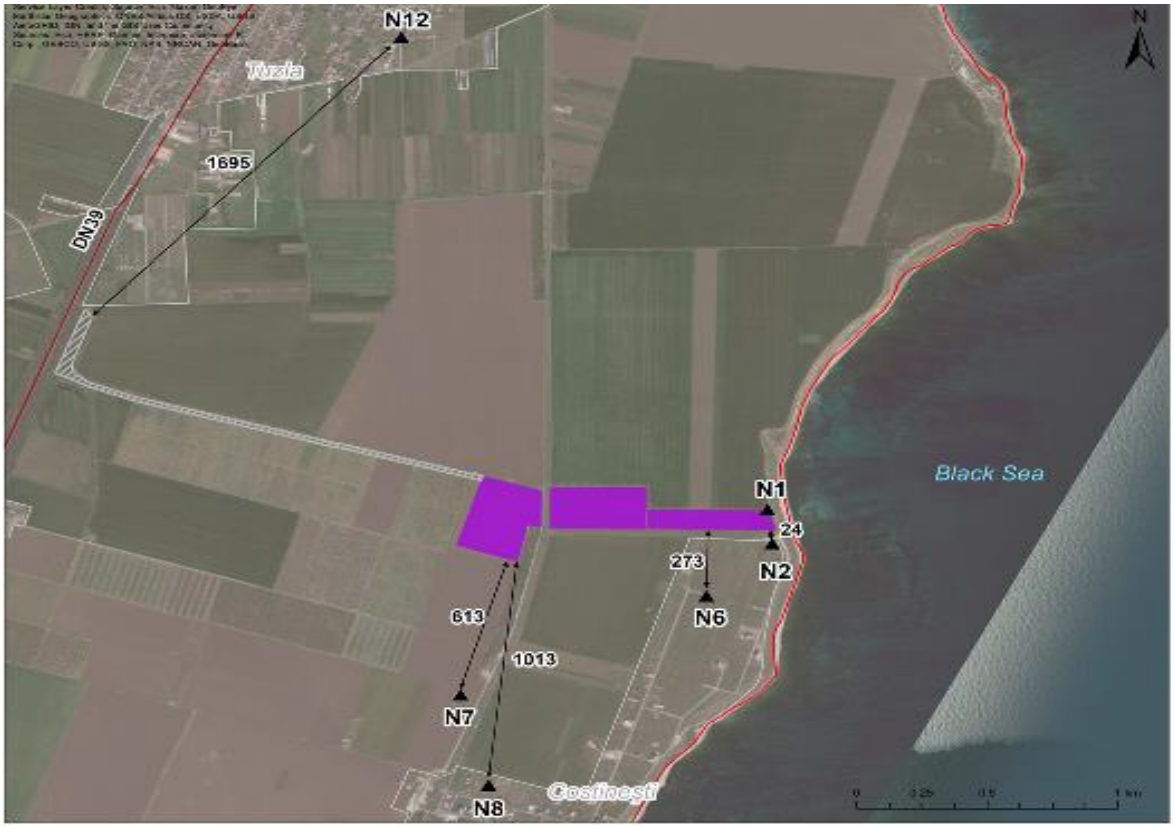


Figure 4.34 The positioning of the noise measurement points, 2022.

The measurement results showed that the majority of the measurement locations comply with the applicable noise limit values.

However, in a few locations, the measured noise levels exceeded the limit values, particularly at measurement point N12, where the acoustic pressure level was exceeded. The background noise levels in the area are mainly influenced by traffic on the national road DN39, as well as by railway

traffic. The results at the sensitive receivers were also influenced by domestic activities carried out in the respective areas (e.g., animal husbandry, construction activities).

Table 4.56 The measured acoustic pressure levels in the project area in 2022

Measurement point ID	Date and time of the start of measurements (DD.MM.YYYY: HH:MM:SS)	Duration (hours)	LAeq [dB (A)]		LA10 [dB (A)]		LA90 [dB (A)]		LAdn[8] [dB (A)]
			Day	Night	Day	Night	Day	Night	
N1	27.05.2022 / 12:03:58	24	41.6	35.9	43.3	36.6	35.3	31.3	44.5
N2	27.05.2022 / 11:56:38	24	40.8	33.8	39	34.8	32.4	28.7	43.1
N6	27.05.2022 / 12:03:58	24	44.7	41.1	42.5	37.2	31.6	27.9	48.7
N7	27.05.2022 / 12:03:58	24	45.7	39.2	43.3	38	26.6	28.3	48.2
N7*			44.3	38.5	42.5	37.2	25.9	27.8	48.1
N8	27.05.2022 / 12:03:58	24	45.6	41.3	44.4	40.3	25.7	22.8	50.5
N8*			43.3	39	44.1	37.5	25.7	22.8	49.1
N12	29.05.2022 / 17:48:57	24	55.1	60.4	52.9	52.8	32.8	26	63.2
N12*			49.7	46.2	52	47.7	32.4	25.9	53.7

According to Order no. 119/2014, in cases where a project is located in the vicinity of a protected area where the existing background noise does not exceed 50 dB (A) during the day and 40 dB (A) during the night, the maximum permitted levels will be 50 dB (A) during the day and 40 dB (A) during the night. Therefore, for sensitive receptors (residential areas) where the current background noise does not exceed 50 dB (A) during the day and 40 dB (A) during the night, the project activities will comply with the noise values in accordance with the current regulations during the construction and operation periods.

4.5.2 The offshore location of the project site

Regarding the offshore location of the project site, there is no existing network for monitoring the current levels of noise and vibrations. The main existing source of noise and vibrations in this area is represented by the traffic of transport and fishing vessels, primarily generated by the ships' equipment (e.g., power generators, pneumatic equipment, and cranes).

4.5.3 Data collection and investigation methods

For the development of **Section 4.5 - Noise**, the method of reviewing scientific and technical data and information from documents, reports, and field studies carried out for the Neptun Deep project during the period 2018-2022 was applied.

For collecting data related to noise, both office activities and field studies were utilized.

The office activities mainly involved:

- Identifying sources and data resources;
- Creating an integrated database;
- Documentation (literature review);

[8] LAdn (day-night noise indicator) - LAeq (weighted equivalent continuous sound pressure level) in 24 hours

- Requesting information from relevant institutions;
- Processing and analysing the collected information;
- Drafting reports.

Noise maps available for the project's area of interest were checked, and existing noise sources were identified.

Furthermore, to characterize the existing noise levels in the project area, noise measurements were conducted in the year 2022. The results of these measurements were mentioned within the content of the section.

4.6 MATERIAL GOODS

4.6.1 Material goods identified in the project area

Onshore project site (parcels owned by OMV Petrom) has been used for agricultural purposes, with no buildings present.

The onshore project site is surrounded by agricultural lands, and there are no industrial activities nearby. To the west of the proposed site, there is an orchard.

The onshore project site is currently crossed from north to south by the Constanța – Mangalia railway line, the DC4 local road, and other local roads (De277, De 259/4). The De269 local road is located at the eastern border of the onshore project site.

Field investigations were conducted in the Neptun Deep onshore project area to detect potential underground[9] utility networks. These investigations were carried out using a Radiodetection RD8100 induction detection device. Locations where the detector indicated possible pipes or cables were verified through open excavations up to the depth indicated by the device. The presence of underground utilities was confirmed through controlled excavations.

The conclusions of the investigations regarding potential underground utility networks are as follows:

- No underground utility networks were found on parcel S1, located to the west of the railway line, the proposed site for NGMS, CCR, and related facilities construction/installation.
- Two water drainage pipes (one with a diameter of 500 mm and one with a diameter of 250 mm) were identified on parcel S3, located to the east of the railway line, the proposed site for onshore production pipeline section and fibre optic cable installation, as well as the installation of a shut-off valve.
- An underground electric cable with a diameter of 100 mm was found on the left side of the Constanța – Mangalia railway line, along the De277 local road.

The presence of the two water pipes is confirmed by RAJA (the regional water supply and wastewater network operator) under Approval No. 11891/08.06.2021 issued for the Neptun Deep project. Furthermore, the Approval mentions the presence of a 250 mm diameter water

[9] Ramboll South East Europe, 2018 - Report on the buried objects detection Tuzla, prepared for ExxonMobil

distribution pipe located at 100 m east of the railway line, crossing parcel S3 (cadastral number 109659) from north to south.

According to the notification from RAJA submitted to OMV Petrom (letter No. 132924 dated 16.12.2019) and Approval No. 11891/08.06.2021 issued for the Neptun Deep project, the existing 500 mm diameter wastewater drainage pipe will be replaced with a new pipe that will be installed along the railway track.

Additionally, the irrigation water distribution pipes (cds 1 and cds1A) managed by the National Agency for Land Improvement (ANIF) – Branch of Land Improvement in Constanța, have been reported by ANIF as being present in the onshore project site area.

These irrigation pipes run parallel to the Constanța – Mangalia railway line and cross parcel S3 (cadastral number 109659) from south to north. Furthermore, the CDI-8 Biruință irrigation canal is located to the north, near the project site. The irrigation infrastructure mentioned above is part of the 1340 Carasu – Biruință Irrigation Scheme, managed by ANIF – Constanța Branch.

No sources of freshwater (e.g., water supply wells) have been identified on the onshore project site.

The proposed offshore gas production pipeline route crosses some potential cables, as identified in the route study conducted for the selection of the production pipeline route and as indicated in the pipeline alignment sheets.

4.6.2 Data collection and investigation methods

For the development of **Section 4.6 - Material Goods**, the method of reviewing scientific and technical data and information from documents, reports, along with field studies carried out for the Neptun Deep project during the period 2018-2022, was applied.

The sources of information for describing the material goods (specialized literature, reports, and field studies) were as follows:

- Address from the Dobrogea Coastal Basin Administration with registration number 22692/O.A./16.01.2019;
- Approval No. 1189/39242 dated 08.06.2021 issued by RAJA S.A. Constanta for the Neptun Deep project;
- Technical approval A7/15.03.2022 issued for the Neptun Deep project by the National Agency for Land Improvement (ANIF) - Constanta Branch

Field studies conducted by the project owner:

- Report on the buried objects detection in Tuzla - east side of the railroad, prepared by Ramboll Southeast Europe, May 2018;
- Report on the buried objects detection in Tuzla, prepared by Ramboll Southeast Europe, August 2018;
- Onshore Groundwater Baseline Study - Jacobs (Halcrow Romania), 2019;

4.7 DESCRIPTION OF CULTURAL HERITAGE

The description of the archaeological elements was conducted based on desk studies and archaeological field surveys carried out both on land and at sea.

4.7.1 Archaeological and historical sites in the onshore area of the project site.

According to the Order of the Minister of Culture and Cults no. 2314/2004 approving the *List of historical monuments and the National Archaeological Repertory (RAN),* the following elements of cultural heritage have been identified within a 5 km radius from the onshore project site:

Table 4.57 Existing archaeological sites in the project area.

LMI code	Name	Type	Historical dating	Location
CT-I-s-B-02769	The archaeological site of Tuzla - Lighthouse /Stratonis	Settlement	Prehistory, Roman-Byzantine period, Latène / 5th-6th centuries, 3rd century BC	**Tuzla, commune, Constanta County** 50-150 m south of Tuzla lighthouse, on the seaside, approximately 2 km east of the village of Tuzla.
CT-I-s-B-02772	The archaeological site of Tuzla 1	Military settlement	Roman period, Prehistory	**Tuzla, commune, Constanta County** on the peninsula located west of Tuzla Mare Gulf, on the southwestern shore of Lake Techirghiol, approximately 4 km west of the village of Tuzla.
CT-I-s-B-02771	The archaeological site of Tuzla 2	Settlement	Roman period, Latène/ 2nd-3rd centuries	**Tuzla, commune, Constanta County** between "Tuzla Mică" and "Tuzla Mare" gulfs
CT-I-s-B-02770	Roman settlement at Tuzla	Settlement	Roman period / 3rd-4th centuries	**Tuzla, commune, Constanta County** west of the locality and approximately 1 km south of Lake Techirghiol.
CT-I-s-B-02638	Archaeological site at Costineşti - Parthenopolis	Settlement; Necropolis	Roman period, Hellenistic period / 4th century BC - 6th century AD	**Costineşti, commune, Constanta County** about 250 m north of Pescărie, on the eroded shoreline.
CT-I-s-B-02639	Hellenistic settlement at Costineşti	Settlement	Hellenistic period / 4th century BC	**Costineşti, commune, Constanta County** 2 km northeast of the intersection between the national road Constanţa - Mangalia and the road to Costineşti, 200 m from the power point.
CT-I-s-B-02640	Archaeological site at Costineşti	Settlement	Neolithic, Roman period	**Costineşti, commune, Constanta County** north of the camp, on the small promontory between the sea and the lake.

The onshore location is at the following distances from the cultural heritage elements:

- Archaeological site at Tuzla - Lighthouse/Stratonis: 1.9 km

- Archaeological site at Tuzla 1/Archaeological site at Tuzla 2/Roman settlement at Tuzla: 2.9 km
- Latene settlement at Costinești: 2.2 km
- Archaeological site at Costinești – Parthenopolis: 1.14 km
- Hellenistic settlement at Costinești: 2.4 km
- Archaeological site at Costinești: 2.2 km

In Figure 4.35, the archaeological sites and burial mounds identified in the vicinity are positioned in relation to the onshore project site.

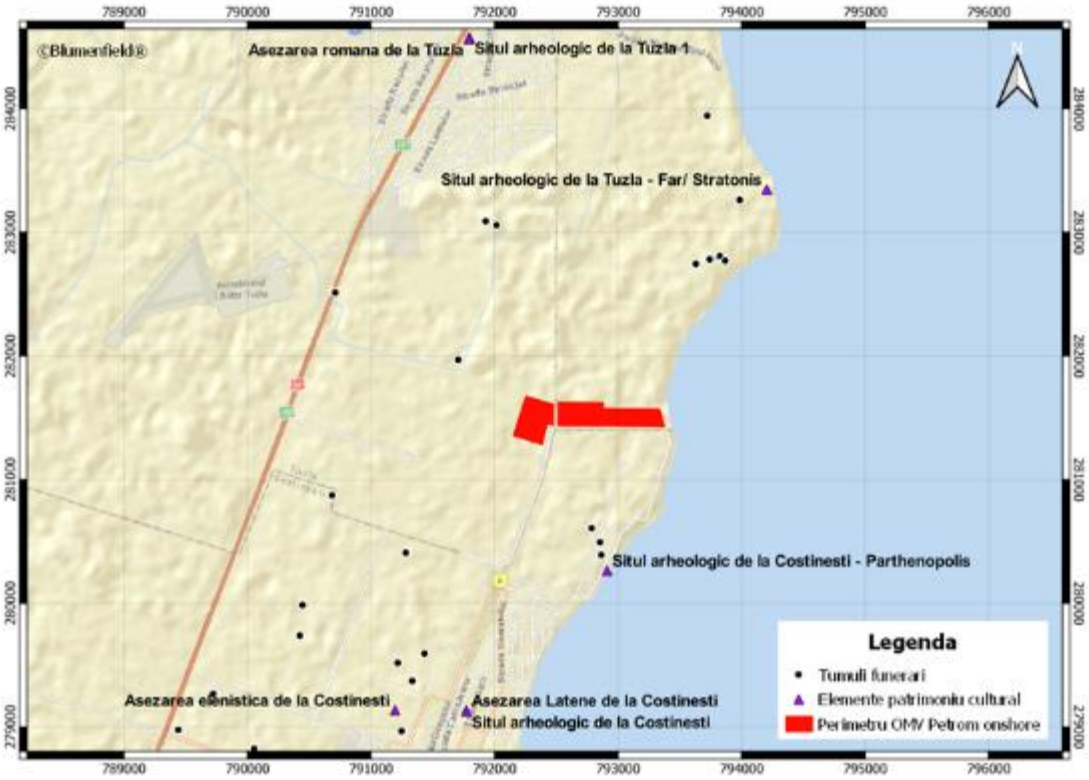


Figure 4.35 Archaeological sites identified in the project area

An intrusive archaeological diagnostic study was conducted in the southeastern area of the outlying territory of Tuzla commune, near the administrative boundary of Costinești commune, between the Black Sea coastline, DN 39 (National Road 39), and the Constanța – Mangalia railway, covering an area of 25 hectares[10].

The results of the study did not lead to the identification of any archaeological complexes. The closest archaeological site is represented by Tuzla Sud - Movila Costinescu - a group of tumuli, located approximately 500 meters away from the northwest corner of the project site.

The investigations were carried out by archaeologists in the proposed site locations for the NGMS (shore approach) and CCR (onshore gas treatment facilities), as well as along the route of the gas production pipeline. The locations of the investigation sections are presented in Figure 4.36 below.

[10] C. Băjenaru, R. Petcu, C. Nopcea, 2018, Archaeological Diagnostic Report, Extravilan area, Tuzla commune, Constanța county.

Figure 4.36 The location of the studied site and the identified archaeological sites[11]

4.7.2 Archaeological investigations in the project's offshore location.

The offshore location of the project is partially situated in the archaeological protection zone of the Romanian coastal plateau of the Black Sea (CT-l-s-A-02561 *'Romanian Black Sea Coast Continental Shelf'*).

In 2020, archaeologists from the National Museum of History and Archaeology Constanta (MINAC) conducted a non-intrusive field evaluation of an area covering 383 km² on the Continental Shelf of the Romanian Black Sea Coast (Romanian Exclusive Economic Zone of the Black Sea) with the purpose of identifying submerged archaeological sites in the Neptun Deep project area.

A total of 152 contacts were investigated, and their locations in relation to the project components can be found in Figure 4.37.

[11] The National History and Archaeology Museum Constanța (MINAC), Archaeological Diagnostic Report, 2018

Figure 4.37 The location of the 152 contacts along the Neptun Deep project route, (source: Archaeological Diagnostic Report)

The conclusions of the study conducted by the MINAC[12] marine archaeologists are as follows:

The analysis of the 152 points discovered within the investigated perimeter has led to the identification of 25 targets proposed for visualization. Among these, 4 have been documented as shipwrecks of historical and archaeological significance, receiving a protection area of 50 meters according to Law no. 256/2018, art.8

Another 4 points, located at great depths and currently not feasible for visualization due to technical limitations, have also been proposed for protection under the law. These last four targets - contacts 0088, 0095, 0116, 0211 - will benefit from a protection area until they can be visualized.

The remaining 17 points, initially considered of archaeological interest, were found during visualization to fall within the biogenic, geological, or modern anthropic sphere (e.g., the wreck of the vessel Mitera Zafira).

Contact 0003 - a wooden structure shipwreck situated at a depth of 32 meters known as Nicholas - will receive a protection area since it has reached 100 years since its sinking. Based on sonogram measurements, it is approximately 66 meters in length and 7.5 meters in width. The limit of the protection area is approximately 575 meters from the pipeline.

Contact 0114 - a shipwreck located at a depth of 50 meters with a well-preserved wooden structure observed during visualization. Sonogram measurements indicate a length of 22.5 meters and a width of approximately 8.8 meters. The main dating element is an Admiralty-type anchor, suggesting a possible dating to the 19th century. However, without additional dating elements and given the current stage of research, a precise dating cannot be determined. The limit of the protection area is approximately 720 meters from the pipeline.

Contact 0004 - a shipwreck situated at a depth of 116 meters with a well-preserved wooden structure observed during visualization. Sonogram measurements indicate a length of approximately 16 meters and a width of 5 meters. Two dating elements were captured on video - a vessel on a wooden structure (possibly a deck or lifeboat) and the palm of an anchor protruding

[12] C. Dobrinescu, V. Bodolică, MINAC, 2021, Archaeological Diagnostic Report - Non-intrusive Land Assessment.

from the mud around the wreck. Similar to the previous case, a precise dating cannot be determined, but an estimated dating is suggested for the 18th to 19th centuries. The limit of the protection area is approximately 1100 meters from the pipeline.

Contact 0087 - a wooden shipwreck located at a depth of 115 meters, buried deeper in sand and mud as observed in the footage. Sonogram measurements indicate a length of 11.5 meters and a width of approximately 3 meters. It appears to be quite well-preserved, but clear dating elements are lacking. At this moment, based on its relative proximity to wreck 0004 (approximately 3 miles), it is speculated that there might be a connection between the two ships, potentially sinking at the same time. Thus, a broad dating proposal is made for the 18th to 19th centuries. The limit of the protection area is approximately 1100 meters from the pipeline.

As a result of the non-intrusive archaeological diagnostic study and after following the procedures provided by O.nr.2630/2018 - *regarding the completion of methodological norms for the classification and inventory of historical monuments approved by O.nr. 2260/2008* - an area of 383 square kilometres corresponding to the project site has been approved for declassification from the national archaeological heritage. Some safety zones will still be maintained, as stated in Archaeological Discharge Certificate no. 60/2022 issued by the County Directorate for Culture in Constanta.

4.7.3 Data collection and methods for conducting investigations

For the development of Section 4.7 - Cultural Heritage, the method of reviewing scientific and technical data and information from documents, reports, and field studies carried out for the Neptun Deep project during the period 2018-2022 was applied.

The sources of information for identifying and describing the cultural heritage (specialized literature, reports, and field studies) were as follows:

- Order of the Minister of Culture and Cults no. 2314/2004 regarding the approval of the List of Historical Monuments;
- National Archaeological Repertory, http://ran.cimec.ro/;
- Archaeological Diagnostic Report for the Neptun Deep project, Extravilan com. Tuzla, jud. Constanța, C. Băjenaru, R. Petcu, C. Nopcea, 2018.
- Archaeological Diagnostic Report (Non-intrusive field evaluation) for the Neptun Deep project, C. Dobrinescu, V. Bodolică.

4.8 THE NATURAL OR URBAN LANDSCAPE OF THE AREA

The landscape in the project area is characteristic of a plain region, primarily occupied by agricultural land and a coastal (beach) landscape with high landscape value.

The landscape along the proposed pipeline route is generally considered to have low importance and medium sensitivity to changes during project execution. This is due to the overall quality of the existing landscape, considering the flat topography that allows visibility from a distance. The main human recipients of this landscape are residents from the surrounding areas.

The only attractive landscape area is the Black Sea shore. The proposed works will undercrosss this area, but the landscape will not suffer modifications.

The landscape in the offshore area of the project is of a marine/maritime type, as the project is located 160 km from the shoreline.

Below are images from vantage points around the project site to give a real idea of the visibility of the site. The location of the visual points are shown below

Figure 4.38 Viewpoints where photos were taken

Figure 4.39 Visual point no. 1

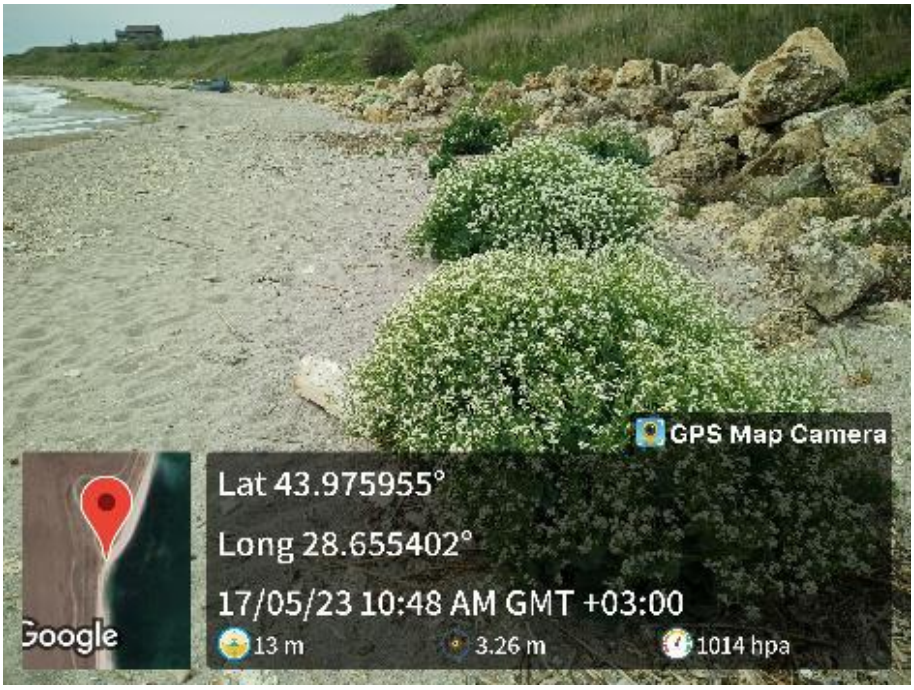


Figure 4.40 Visual point no. 2

Figure 4.41 Visual point no. 3

Figure 4.42 View from the railway to the sea

The project will introduce artificial elements that will change the character of the area and therefore the overall appearance of the landscape. Upon completion of the construction, perimeter trees and shrubs will be planted to create a green curtain around the NGMS and CCR and thus mitigate the visual impact

As mentioned, in the area there are houses in the vicinity and the trend is to develop the housing area, so the visual impact will affect receptors and will not directly affect the economic activities that are related to landscape characteristics such as tourism and recreational activities.

The only attractive area from the point of view of the landscape is the Black Sea coast. The proposed works will undercut this area so the landscape will not undergo changes.

Distances are especially difficult to appreciate when looking out to sea. Due to weather conditions there are different levels of visibility. Even in apparently clear summer conditions the atmosphere can obscure distant objects. In fog, their color and clarity are altered and this can confuse observers.

The horizon is the limit to which our vision reaches. The actual distance to the horizon line increases with viewer height and decreases at lower elevations and with decreasing atmospheric clarity. On a clear day viewed from the beach, the horizon will be at a distance of about 6 km. Viewed from a height of 60 m the horizon will be up to a distance of about 32 km and from the top of a 1,000 m mountain the horizon will be at a distance of about 113 km. However, the horizon is always perceived as very far away.

4.8.1 Data collection and methods for conducting investigations

For the development of **Section 4.8 - Natural and Urban Landscape of the Area,** the method of reviewing scientific and technical data and information from documents, reports, and field studies carried out for the Neptun Deep project during the period 2018-2022 was applied.

4.9 CONDITIONS: DEMOGRAPHIC, SOCIAL, SOCIO-ECONOMIC

The proposed location for the construction/installation of the onshore facilities of the Neptun Deep Project is situated in the southern area of the administrative territory of Tuzla commune, Constanța County, close to the northern border of the administrative territory of Costinești commune.

The administrative unit Tuzla is part of the Constanța Metropolitan Area, a voluntary administrative entity established for the uniform socio-economic development of its component localities.

The urban agglomeration of the Constanța Metropolitan Area includes localities located within a maximum of 35 km from the city of Constanța and is composed of 16 administrative territorial units, namely: the city of Constanța, 5 towns (Năvodari, Ovidiu, Murfatlar, Techirghiol, and Eforie), and 10 communes (Agigea, Cumpăna, Valu lui Traian, Poarta Albă, Lumina, Corbu, Mihail Kogălniceanu, Tuzla, 23 August, and Costinești), including their associated villages.

4.9.1 Demographic conditions

Within the Constanța Metropolitan Area, the city of Constanța together with its neighbouring localities houses a permanent population of 491,692 inhabitants (64% of the total population of the county), concentrated on only 30% of the county's territory. Additionally, during the spa and tourist season, there is an average floating population and tourists exceeding 1,000,000 people. The majority of the population resides in urban areas (404,655 inhabitants, out of which 316,263 in the city of Constanța and 88,392 in the other cities within the Constanța Metropolitan Area), while the remaining population of 87,037 inhabitants is concentrated in rural areas.

According to the Statistical Yearbook of Constanța County-2022, the number of residents with domicile in Tuzla and Costinești communes is presented in Table 4.58.

Table 4.58 Population number in the years 2020,2021, 2022

	Costinești			**Tuzla**		
	2020	**2021**	**2022**	**2020**	**2021**	**2022**
Total	**3345**	**3388**	**3392**	**7245**	**7229**	**7171**
Masculine	1638	1661	1667	3527	3496	3476
Feminine	1707	1727	1725	3718	3733	3695

There is a tendency of population growth in Costinești by approximately 1% in 2022 compared to 2021, and a decrease in Tuzla by 1% in 2022 compared to the year 2021.

The number of people who established their residence in the year 2021[13] was as follows:

- 74 individuals in Costinești commune;
- 36 individuals in Tuzla commune.

The number of people who established their domicile (including international migration) in the year 2021 was as follows:

- 104 individuals in Costinești commune;

[13] Data source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table, accessed 19.06.2023

- 121 individuals in Tuzla commune.

A total of 6 permanent immigrants were registered in Tuzla in the year 2022.

4.9.2 Social conditions

4.9.2.1 Education

The number of school-age population by education levels in 2021[14] was as follows:

Table 4.59 The number of school-age population in the year 2021

	Year	Total no.	Kindergarten	Elementary school	Middle school	Teaching staff
Tuzla commune	2020	610	112	264	234	
	2021	607	111	254	242	6 kindergarten 31 elementary +middle
Costinești commune	2020	277	71	114	92	
	2021	288	77	108	103	4 kindergarten 19 elementary+ middle

In both Tuzla and Costinești communes, there is only one primary and middle school each.

Regarding the number of enrolled children, it was observed that in the year 2021, there was an increase in the total number in Costinești and a slight decrease in Tuzla.

4.9.2.2 Healthcare facilities

In the year 2020 and 2021, the following healthcare units and medical personnel were registered in the communes of Tuzla and Costinești.

Table 4.60 Healthcare facilities and medical personnel

Localities	Year	Family medical clinic	Family doctors	Pharmacies	Pharmacists	Dental clinics	Dentists	Health environmental staff
Tuzla	2020	5	5	6	6	6	6	20
	2021	5	5	6	6	8	6	20
Costinești	2020	2	2	3	4	0	0	5
	2021	1	1	3	4	0	0	4

The healthcare facilities remain at the same number.

4.9.2.3 Land fund

The land fund area in 2014 was as follows:

[14] Data source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table, accessed 19.06.2023

Table 4.61 The land fund area[15]

The land fund category	Costinești (ha)	Tuzla (ha)
Total, of which:	2028	4895
Agricultural	1643	4142
Arable land	1636	3754
Pasture	-	250
Vineyards and vine nurseries	7	9
Orchards	-	129
Non-agricultural land	385	753
Forests and other forest vegetation	46	3
Occupied by water bodies	7	52
Occupied by constructions	199	445
Roads and railways	117	119
Degraded and unproductive lands	6	36

4.9.2.4 Turism

In the year 2022, the number and categories of tourist accommodation facilities registered are as follows:

Table 4.62 Tourist accommodation facilities

Tourist accommodation facilities	Costinești (no)	Tuzla (no)
Total, of which	**140**	**-**
Hotels	17	-
Hostels	12	-
Motels	4	-
Tourist villas	31	-
Bungalows	74	-
Camping	13	-
Student and pre-schooler camps	3	-
Tourist guesthouses	2	-
Agro tourism guesthouses	4	-

No tourist units have been identified in Tuzla.

4.9.2.5 Employees

Data regarding the number of registered employed individuals is presented in Table 4.61 below:

Table 4.63 The number of employees in the year 2021, 2022

Settlement	2019	2020	2021
Costinești	495	432	403
Tuzla	403	409	485

[15] Source de date: TEMPO Online, http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table

In the case of employees, there is a trend of an increasing number of employees in Tuzla and a decrease in Costinești.

4.9.2.6 Non-employees

At the level of Constanța County, the number of registered unemployed individuals and the unemployment rate during the period 2010 - 2021[16] is represented in the graph below:

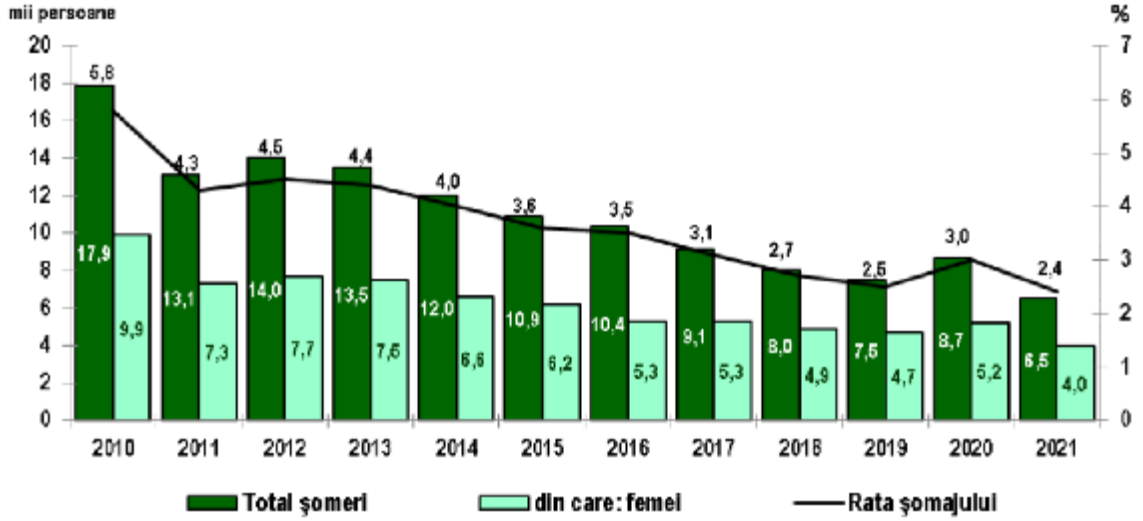


Figure 4.43 The number of registered unemployed individuals in Constanța County from 2010 to 2021.

According to the data recorded at the National Institute of Statistics (INSS), the evolution of unemployment in the communes of Tuzla and Costinești is as follows:

Table 4.64 The number of registered unemployed individuals[17]

Settlement	2021	2022	April 2023
Tuzla	109	115	67
Costinești	1	0	0

As observed from Table 4.62 above, Costinești commune does not register any unemployed individuals in April 2023, in comparison to Tuzla commune. Moreover, the unemployment trend in Costinești commune is towards zero in the last 3 years, compared to the neighbouring commune.

4.9.3 Data collection and methods for conducting investigations

For the development of **Section 4.9 - Demographic, Social, and Socio-economic Conditions**, the method of reviewing scientific and technical data and information from documents, reports, and field studies carried out for the Neptun Deep project during the period 2018-2022 was applied, as follows Social baseline Demographics and school information, Neptun Deep EIA Project, Jacobs, 2018;

[16] Data source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table, accessed 19.06.2023
[17] Data source: TEMPO Online, http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table

- Social baseline Demographics and school information, Neptun Deep EIA Project, Jacobs, 2018;
- Socio-economic Environment baseline, Neptun Deep EIA Project, Jacobs, 2019;
- Community Health and Safety Report, Neptun Deep EIA Project, Jacobs, 2019;
- Community Venues, Parks, Recreation Facilities, Neptun Deep EIA Project, Jacobs, 2019;
- Cultural resources, Neptun Deep EIA Project, Jacobs, 2019;
- Housing and Land Use, Neptun Deep EIA Project, Jacobs, 2019
- Additionally, a series of data were collected from public information sources, namely:
- The websites of the local public authorities: Costineti and Tuzla;
- The website of the National Institute of Statistics.

4.10 BIODIVERSITY

The Neptun Deep project will be developed in two types of ecosystems - marine (the Black Sea) and terrestrial (Constanța County).

4.10.1 The location of the project in relation to protected natural areas.

The onshore facilities of the project are not located within any internationally, community, and/or nationally designated protected natural areas (including natural reserves, special protection areas for birds - SPA, sites of community importance - SCI, special areas of conservation - SAC, RAMSAR sites, areas of avifaunistic importance - AAI).

The nearest Natura 2000 protected areas to the onshore project site (surfaces S1, S3, and S4 owned by the project beneficiaries) are represented by ROSPA0076 Marea Neagră and ROSAC0273 Marine area at Cape Tuzla, located approximately 60 m east from the easternmost point of the onshore project site.

The closest part of the project site to these two Natura 2000 sites is represented by the land associated with the installation of the underground production pipeline. Other Natura 2000 sites are located more than 3 km away from the onshore project site (figure 4.44).

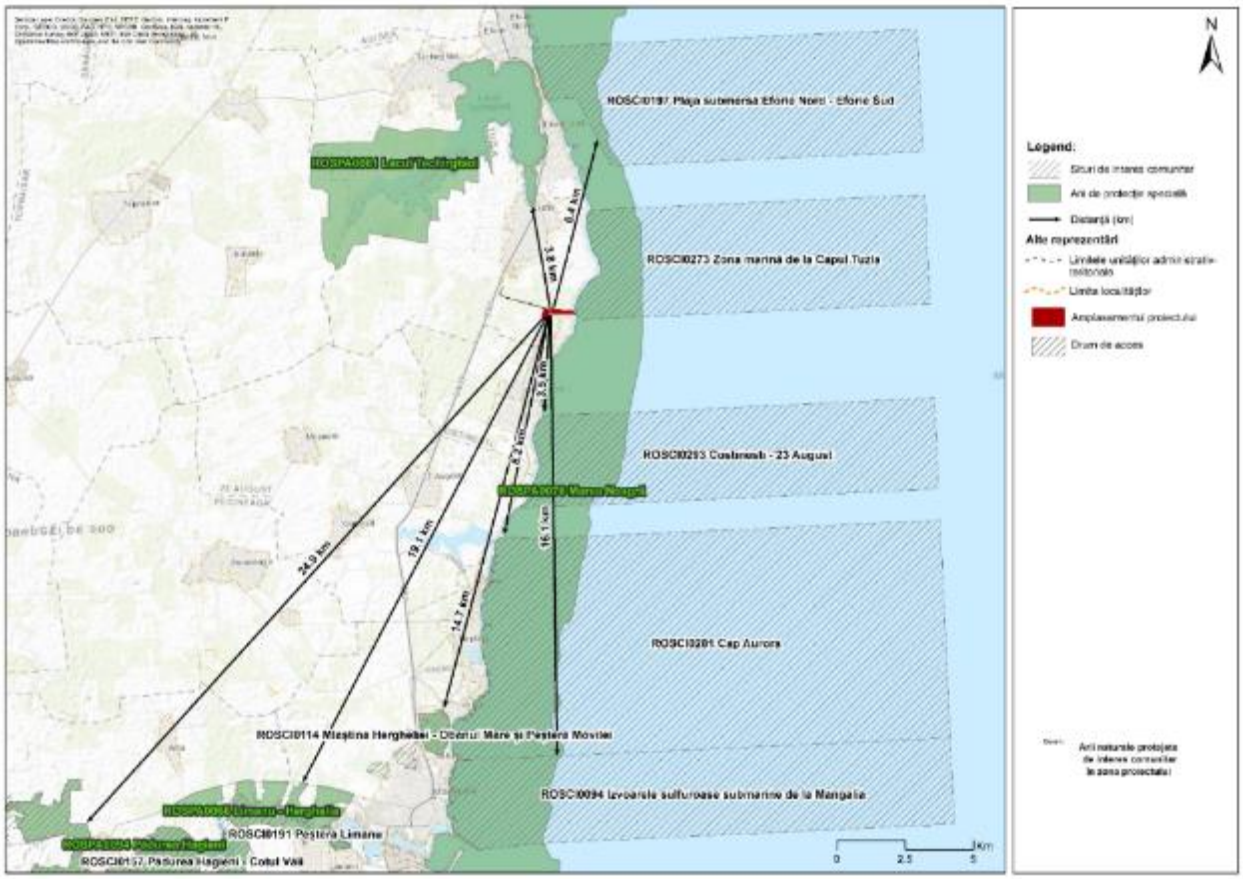


Figure 4.44 The location of the land site of the project in relation to sites in the Natura 2000 network

The nearest Ramsar site to the onshore project site (surfaces S1, S3, and S4 owned by the project beneficiaries) is RORMS0005 Techirghiol Lake (National code: RO1610), which overlaps with the Techirghiol Lake natural reserve (RONPA0937). It is located approximately 5.2 km away from the northwest corner of the project site (figure 4.45).

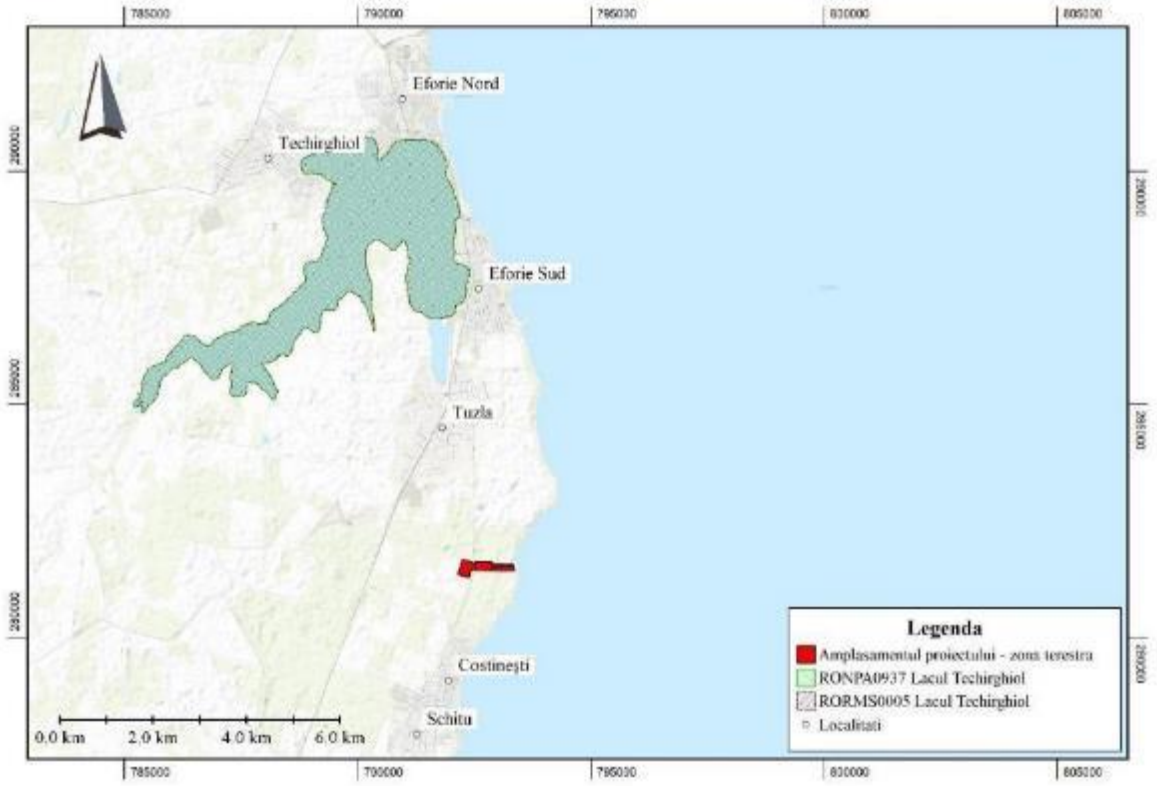


Figure 4.45 The location of the onshore project site in relation to nationally protected natural areas (natural reserve) and internationally protected areas (RAMSAR site).

The facilities at sea are also not located within nationally protected natural areas (natural reserves) or internationally protected areas (World Heritage sites, RAMSAR sites, Biosphere Reserves, ecologically or biodiversity significant marine protected areas - EBSA), but they partially overlap with two areas protected at the community level (SPA, SAC). (figure 4.46).

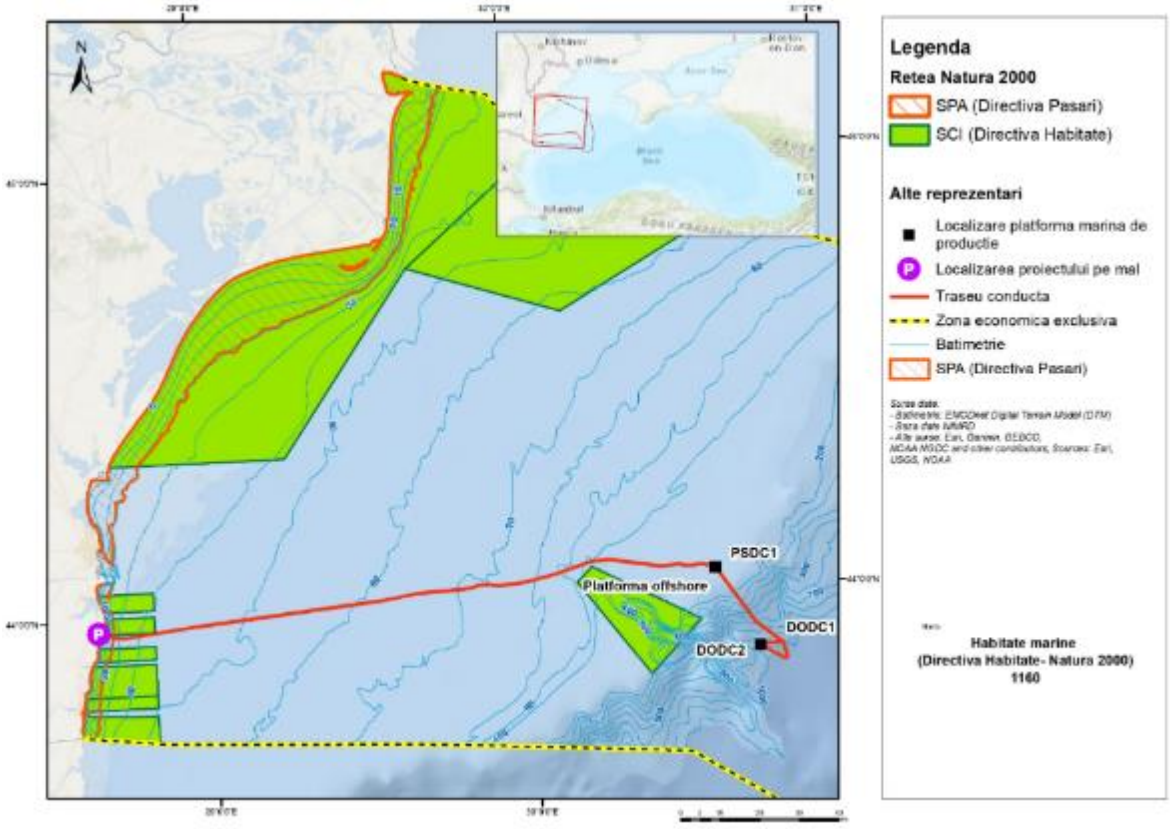


Figure 4.46 Community-level protected natural areas (Natura 2000 sites) in the project area - marine zone.

The nearest Natura 2000 protected natural areas to the offshore facilities of the project are represented by:

- ROSPA0076 Marea Neagră, which is crossed by the gas production pipeline and the fibre optic cable for approximately 2.53 km;
- ROSAC0273 Zona marina de la Capul Tuzla, which is crossed by the gas production pipeline and the fibre optic cable in its southwest corner for approximately 586 m;
- ROSCI0311 Canionul Viteaz, located at approximately 1.3 km from the gas production pipeline route;
- ROSCI0293 Costinești - 23 August, located at approximately 2.3 km from the gas production pipeline route.

Figures 4.47 and 4.48 below show the project elements positioned in relation to the Natura 2000 protected areas mentioned above.

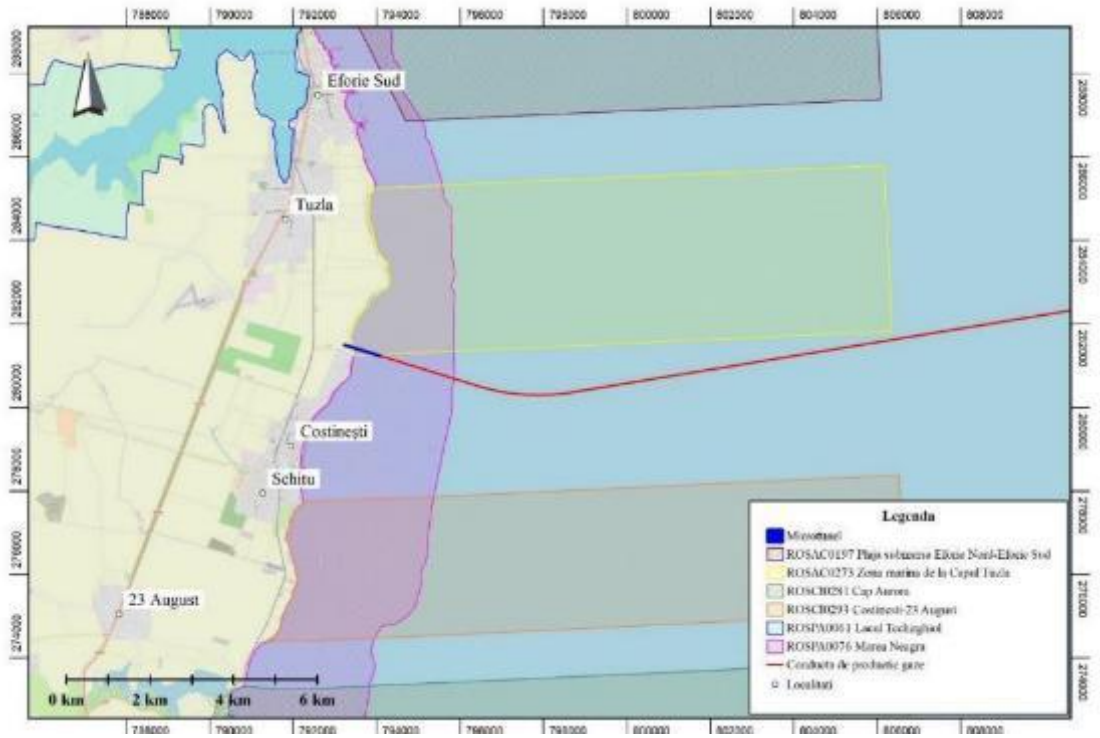


Figure 4.47 Community-level protected natural areas (Natura 2000 sites) near the shore that overlap or are in the vicinity of the project - marine zone.

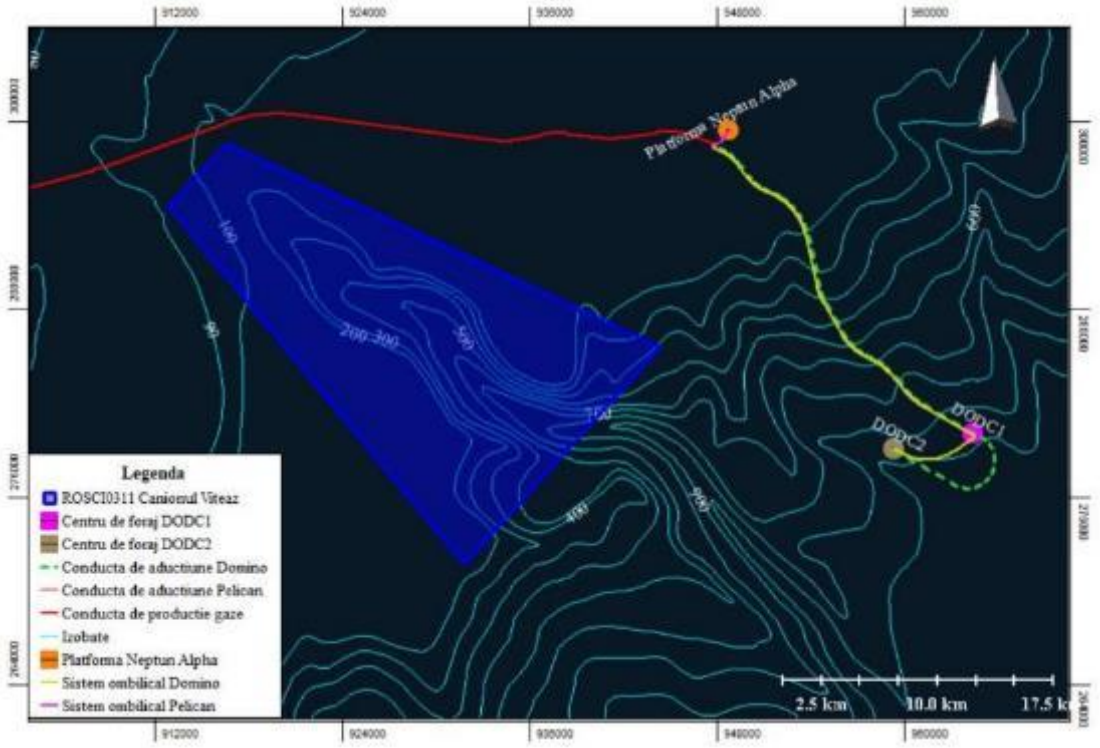


Figure 4.48 Community-level protected natural areas (Natura 2000 sites) in the offshore area of the Black Sea that are in the vicinity of the project - marine zone.

4.10.2 Description of protected natural areas and their characteristics

Given the project's location, we provide below the description of the community-level protected natural areas - ROSPA0076 Marea Neagră and ROSAC0273 Zona marină de la Capul Tuzla, relevant to the analysis of the potential impact of this project on biodiversity components.

The information and data presented below are based on:

- Data provided in the updated standard forms of the Natura 2000 sites (updated for ROSPA in November 2019 and for ROSCI in September 2021),
- Information included in the Management Plans of the respective sites,
- Specific conservation objectives defined for both sites.

(i) ROSAC0273 Zona marină de la Capul Tuzla

The Natura 2000 site ROSAC0273 Zona marină de la Capul Tuzla is located in the marine zone of the project and is crossed by the gas production pipeline and the fibre optic cable for approximately 586 m.

Zona marina de la Capul Tuzla was declared a Site of Community Importance (SCI) with the code ROSCI0273 through the Order of the Minister of Environment and Forestry no. 1964/2007 regarding the establishment of the protected natural area regime for the Sites of Community Importance, as an integral part of the European ecological network Natura 2000 in Romania, in accordance with Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, and in accordance with the Commission Decision of 12 December 2008 adopting, pursuant to Council Directive 92/43/EEC, the initial list of sites of Community importance for the biogeographical region of the Black Sea.

Following the adoption of Decision No. 685 of May 25, 2022, regarding the establishment of the protected natural area regime and the declaration of the special areas of conservation as an integral part of the European ecological network Natura 2000 in Romania, ROSACI0273 Zona marină de la Capul Tuzla was declared a special area of conservation (SAC), becoming ROSAC0273 Zona marină de la Capul Tuzla.

The site is located in the marine zone of the Black Sea and was initially declared in 2007 and confirmed as SCI in 2009, covering an area of 1,738 ha. It is situated equidistantly (20 km) from the municipalities of Constanța and Mangalia. Along the coastline, the site borders Costinești administrative territorial unit to the north and Tuzla administrative territorial unit to the south (both in Constanța county).

The surface area of the site was extended by Order no. 46/2016 of the Minister of Environment, Waters, and Forests, regarding the protected natural areas regime and the establishment of Sites of Community Importance within the European ecological network Natura 2000 in Romania. The surface area of ROSCI0273 increased from 1,738 ha to 4,946.8 ha. The general coordinates of the site are: Longitude 28.0059555 and Latitude 43.0057916.

The biogeographical region in which the site is located is the Black Sea (Pontic), with 100% overlap.

The Natura 2000 site ROSAC0273 Zona marină de la Capul Tuzla entirely overlaps with the Natura 2000 site ROSPA0076 Marea Neagră.

In the Cape Tuzla area, the rocky reef seabed extends the most into the deep and has the most varied and rugged relief in the Romanian sector of the Black Sea. Therefore, it hosts the most diverse range of microhabitats of this type and, consequently, a highly diverse aquatic fauna and flora. The area is not yet significantly affected by anthropic impacts and is not suitable for navigation due to the highly rugged submarine relief.

Types of habitats and protected species of conservation interest present in the site, according to the data provided in the Natura 2000 Standard Form (updated in December 2020), are presented in Table 4.65, Table 4.66, and Table 4.67 below:

Table 4.65 Types of habitats present in the ROSAC0273 Zona marină de la Capul Tuzla site and the site's evaluation concerning them.

Types of habitats					Evaluation			
Code	Habitat name	Surface area (ha)	Caves (nr.)	Data quality	A/B/C/D	A/B/C		
					Rep.	Supr. rel.	Conserv. status	Global eval.
1110	Submerged sandbanks at shallow depths	450	-	low	B	C	B	B
1140	Exposed sand and mudflats at low tide	2	-	low	B	C	B	B
1170	Reefs	1285	-	low	A	A	A	A
8330	Partially or fully submerged marine caves	0,7	7	low	C	A	B	B

Legend:
Rep. (Representativeness): A: excellent representativeness, B: good representativeness, C: significant representativeness; D: non-significant presence
Supr.rel. (Relative area): A: 100 ≥ p > 15%; B: 15 ≥ p > 2%; C: 2 ≥ p > 0%
Status Conserv. (Conservation status): A: excellent conservation; B: good conservation; C: medium or reduced conservation
Eval. globală (Overall evaluation): A: excellent value; B: good value; C: considerable value

Table 4.66 Species listed in Article 4 of Directive 2009/147/EC, species listed in Annex II to Directive 92/43/EEC, and the evaluation of the ROSAC 0273 Capul Tuzla Marine Area site regarding them.

Species			Population						Evaluation			
Group	Code	Scientific name	Type	Size		MU	Categ.	Data quality	A/B/C/D	A/B/C		
				Min	Max.		C/R/V/P		Rep.	Supr. rel.	Conser. Status	Global eval.
M	1351	*Phocoena phocoena*	P	5	20	i	P	G	B	C	B	B
M	1349	*Tursiops truncatus*	P	5	20	i	P	G	B	C	B	B
F	4125	*Alosa immaculata*	P	100	1000	i	C		A	A	A	A
F	4127	*Alosa tanaica*	P		1000	i	P		C	A	B	B

Legend:
Group: M - mammals, F - fish
Type: P - permanent
Unit of measure: i - individuals

Population size/density is indicated by (C) - common species; (R) - rare species; (V) - very rare species; (P) - presence of the species (if data about a population are completely missing).
Population (Site Population): A: 100 >/= p > 15%; B: 15 >/= p > 2%; C: 2 >/= p > 0%; D: insignificant population.
Conservation (Conserv.): A: excellent conservation; B: good conservation; C: medium or reduced conservation.
Isolation: A: (almost) isolated population; B: non-isolated population, but at the limit of the distribution range; C: non-isolated population with an extended range of distribution.
Global: A: excellent value; B: good value; C: considerable value.

Table 4.67 Other important species of flora and fauna mentioned for the ROSAC0273 Zona marină de la Capul Tuzla site.

Species			Population	Motivation					
Group	Code	Scientific name	Categ.	Annex		Other categories			
			C/R/V/P	IV	V	A	B	C	D
M	1350	*Delphinus delphi*	C	X				X	
F	5040	*Acipenser gueldenstaedtii*	C	X				X	
F	2488	*Acipenser stellatus*	C	X				X	
F		*Aidablennius sphynx*	C						X
F		*Belone belone belone*	C						X
F		*Callionymus risso*	C						X
F		*Chelidonichthys lucerna*	C						X
F		*Coryphoblennius galerita*	C						X
F		*Hippocampus guttulatus*	C					X	
F	2489	*Huso huso*	C	X				X	
F		*Liza ramada*	C						X
F		*Mesogobius batrachocephalus*	C						X
F		*Mullus barbatus ponticus*	C						X
F		*Neogobius ratan*	C						
F		*Nerophis ophidion*	P						X
F		*Salaria pavo*	C						X
F		*Sarda sarda*	P						X
F		*Scomber scombrus*	P						X
F		*Scorpaena porcus*	C						X
F		*Solea nasuta*	C						X
F		*Spicara smaris*	P						X
F		*Symphodus ocellatus*	C						X
F		*Symphodus tinca*	C						X
F		*Syngnathus tenuirostris*	C						X
F		*Syngnathus typhle*	C						X
F		*Trachinus draco*	C						X
F		*Uranoscopus scaber*	P						X
I		*Carcinus aestuarii*	P						X
I		*Clibanarius erythropus*	P						X
I		*Diogenes pugilator*	C						X
I		*Dysidea fragilis*	C						X
I		*Eriphia verrucosa*	C						X
I		*Gastrana fragilis*	P						X
I		*Halichondria panicea*	C						X
I		*Hemimysis anomala*	P						X
I		*Hemimysis serrata*	P						X

Species			Population	Motivation					
Group	Code	Scientific name	Categ.	Annex		Other categories			
			C/R/V/P	IV	V	A	B	C	D
I		*Mytilus galloprovincialis*	C						X
I		*Pachygrapsus marmoratus*	C						X
I	2581	*Pholas dactylus*	P						X
I		*Pilumnus hirtellus*	C						X
I		*Tricolia pullus*	P						X
I		*Upogebia pusilla*	C						X
I		*Xantho poressa*	C						X
P		*Corallina officinalis*	P						X
P		*Cystoseira barbata*	P						X

Legend:
Group: M - mammals, F - fish, I - invertebrates, P - plants
Population: The size/density of the population is indicated by (C) - common species, (R) - rare species, or (V) - very rare species. If data about a population are completely missing, only the presence of the species is indicated (P).
Reason categories: IV, V: Annexes to the Habitats Directive, A - National Red Lists, B - Endemic, C - International Conventions (including Bern Convention, Bonn Convention, and Convention on Biological Diversity), D - Other reasons.

The general characteristics of the site *ROSAC0273 Zona marină de la Capul Tuzla*, according to the standard form, consist of habitat classes listed in table 4.68, which also presents their coverage at the site level.

Table 4.68 Habitat classes identified at the level of ROSPA0076

Code	Habitat classes	Coverage (%)
N01	Marine zones, maritime islands	99,81
N12	Cultivated land (arable land)	0,15
Total coverage		99,96

Other characteristics of the site, important from a descriptive point of view, are as follows: high cliffs with direct access to the sea, Capul Tuzla continues with a rocky submarine promontory. The marine habitats for which the site was designated are of special importance: reefs, sandbanks permanently covered by a shallow layer of seawater, sandy and marshy areas uncovered by seawater at low tide.

In the Standard Data Form of the site *ROSAC0273 Zona marină de la Capul Tuzla*, threats, pressures, or activities with an impact on this site have been identified, presented in the tables 4.69 and 4.70 below:

Table 4.69 The most significant impacts and activities with a major effect on the site

Negative impact				
Intens.	**Code**	**Threats and pressures**	**Poluation (Code)**	**Within site/outside site**
H	E03	Descărcări	N	I

Table 4.70 Cele mai importante impacturi și activități cu efect mediu/mic asupra sitului

Negative impact				
Intens.	**Code**	**Threats and pressures**	**Poluation (Code)**	**Within site/outside site**
L	F02.01	Passive professional fishing	N	I
L	F02.03	Recreational fishing	N	I
L	F03.02	Fauna collection / harvesting.	N	I
L	G01.01	Water sports	N	I

Legend:
The intensity of their influence on the site using the following categories: H - high influence, M - medium influence, L - low influence; Pollution: N - nitrogen input, P - phosphorus/phosphate input, A - acidification, T - toxic chemical substances, O - organic toxic substances, X - mixed pollution; I - inside, O - outside, B - both.

The form of ownership of the areas included in the ROSAC0273 Zona marină de la Capul Tuzla site is 100% public ownership of the state.

The site has an approved Management Plan through Order No. 1.433/2016 of the Minister of Environment, Waters, and Forests, approving the Management Plan and the Regulations of the Natura 2000 site ROSCI0273 Zona marina de la Capul Tuzla.

Through the **Management Plan**, objectives and measures necessary for achieving and maintaining a favourable conservation status of protected habitats and species have been identified within the Natura 2000 site ROSAC0273 Zona marina de la Capul Tuzla. Besides these, the protection and conservation of the marine landscape have also been considered within the site, in accordance with the provisions of Government Emergency Order No. 57/2007 on the regime of protected natural areas, the conservation of natural habitats, flora, and wild fauna, approved with modifications and completions through Law No. 49/2011, with subsequent modifications and completions.

The conservation objectives and measures can be found in both the Management Plan approved by the Minister of Environment mentioned in the previous paragraph and in Decision No. 490/06.10.2021 of the National Environmental Guard.

The **site's management** is ensured by the National Agency for Protected Natural Areas (A.N.A.N.P.) - as the competent authority responsible for the administration of natural areas in the national Natura 2000 network, according to Annex 2 to Decision No. 681 of 28.10.2019 regarding the takeover of management by the National Agency for Protected Natural Areas of unattributed protected natural areas or those whose administration contracts, conventions/custody contracts have ceased, as well as those assigned for administration or custody - unattributed protected natural areas or those whose administration contracts, conventions/custody contracts have ceased.

(ii) ROSPA0076 Marea Neagră

The Special Protection Area *ROSPA0076 Marea Neagră* is located in the marine zone of the project, and the site is traversed by the natural gas production pipeline and the fibre optic cable route for a length of 2.53 km.

ROSPA0076 Marea Neagră is a site of Community interest, according to Council Directive 2009/147/EC (Birds Directive), and it was declared a special protection area for avifauna at the

national level through Government Decision No. 1284/2007 on the declaration of avifauna protected areas as an integral part of the European ecological network Natura 2000 in Romania.

The Natura 2000 site ROSPA0076 Marea Neagră borders the administrative territories of two counties, namely Tulcea and Constanta. The degree of overlap of the site with the local administrative units (LAUs) in the area is 0% (**the site does not overlap with the terrestrial area).**

ROSPA0076 is located along the Black Sea, with some interruptions in port areas (where economic, industrial, and transportation activities take place). The site extends eastward from the coastline to the 22-meter isobath in the open sea.

The site covers an area of 149,143.9 ha, and its coordinates (according to the information in the Standard Form) are Latitude: N 45044'59" and Longitude: E 2805'13". The site is located in the biogeographical region of the Black Sea (100% inclusion).

ROSPA0076 Marea Neagră has connections with other Natura 2000 sites in terms of partial overlap with them, including ROSCI0065 Danube Delta - terrestrial zone, ROSCI0066 Delta Dunării - marine zone, ROSCI0237 Methane-generating marine structures - Sf. Gheorghe, ROSCI0197 Submerged Beach Eforie Nord - Eforie Sud, ROSAC0273 Zona marină de la Capul Tuzla, ROSCI0293 Costinești - 23 August, ROSCI0281 Cap Aurora, ROSCI0094 Submarine Sulphurous Springs at Mangalia, and ROSCI0269 Vama Veche - 2 Mai.

This site hosts significant populations of protected bird species (Table 4.71). The site is important only during bird migration and wintering. During the migration period, the site hosts more than 20,000 individuals of waterfowl.

Table 4.71 Species listed in Article 4 of Directive 2009/147/EC, species listed in Annex II of Directive 92/43/EEC, and the site evaluation in this regard

(Information from the updated Standard Form of the site in September 2019).

Group	Code	Scientific name	Population				Site			
			Type	Size		Categ.	A/B/C/D	A/B/C		
				Min. (indiv.)	Max. (indiv.)	C/R/V/P	Pop.	Conserv.	Izolation	Global
B	A050	*Anas penelope*	C	1.200	1.500	V	B	B	C	C
B	A053	*Anas platyrhynchos*	W	7.000	9.000	V	B	B	C	A
B	A051	*Anas strepera*	W	340	410	R	C	B	C	A
B	A059	*Aythya ferina*	W	18.000	20.000	C	A	B	C	B
B	A061	*Aythya fuligula*	W	6.300	7.450	R	A	B	C	A
B	A396	*Branta ruficollis*	C	200	300	P	C	B	C	A
B	A067	*Bucephala clangula*	W	1.500	3.000	C	A	B	C	B
B	A196	*Chlidonias hybridus*	C	4.000	5.000		B	B	C	b
B	A197	*Chlidonias niger*	C	120	140	P	C	B	C	C
B	A038	*Cygnus cygnus*	W	1.000	1.500		B	B	C	B
B	A125	*Fulica atra*	W	25.000	40.000	R	C	B	C	B
B	A002	*Gavia arctica*	W	250	300		A	B	C	C
B	A001	*Gavia stellata*	W	100	200		A	B	C	C
B	A189	*Gelochelidon nilotica*	C	320	350	C	A	A	C	B

Group	Code	Scientific name	Population				Site			
			Type	Size		Categ.	A/B/C/D	A/B/C		
				Min. (indiv.)	Max. (indiv.)	C/R/V/P	Pop.	Conserv.	Izolation	Global
B	A459	*Larus cachinnans*	C	25.000	30.000	C	A	B	C	B
B	A182	*Larus canus*	C	12.000	15.000	C	A	B	C	B
B	A183	*Larus fuscus*	C	200	400	C	C	B	C	C
B	A180	*Larus genei*	C	1.000	1.500		B	C	B	B
B	A176	*Larus melanocephalus*	C	12.000	15.000		A	B	B	A
B	A177	*Larus minutus*	C	10.000	12.000	R	A	B	C	B
B	A179	*Larus ridibundus*	C	20.000	50.000	C	B	B	C	C
B	A156	*Limosa limosa*	C	2.000	5.000	C	C	B	C	B
B	A068	*Mergus albellus*	W	1.000	1.500		A	B	C	A
B	A070	*Mergus merganser*	W	120	180	C	B	B	C	B
B	A069	*Mergus serrator*	C	230	340	C	C	B	C	C
B	A020	*Pelecanus crispus*	C	70	120	R	C	B	C	C
B	A017	*Phalacrocorax carbo*	W	10.000	27.000	R	B	B	C	B
B	A170	*Phalaropus lobatus*	C	700	1.200	V	C	B	C	C
B	A005	*Podiceps cristatus*	C	4.500	6.000	C	C	B	C	C
B	A006	*Podiceps grisegena*	C	500	1.000	C	A	B	B	C
B	A008	*Podiceps nigricollis*	W	2.000	20.000	R	A	B	C	A
B	A464	*Puffinus yelkouan*	C	1.000	17.000	R	A	B	A	A
B	A195	*Sterna albifrons*	C	300	500	C	B	B	C	B
B	A190	*Sterna caspia*	C	500	1.000		A	B	C	B
B	A193	*Sterna hirundo*	C	8.000	10.000		A	B	C	B
B	A191	*Sterna sandvicensis*	C	5.200	6.000	R	A	B	C	B
B	A004	*Tachybaptus ruficollis*	C	1.200	1.500	C	B	B	C	B

Legend:
Group: B - birds
Population type: P - permanent, R - breeding, C - concentration, W - wintering
The population size/density is indicated by (C) - common species; (R) - rare species; (V) - very rare species; (P) - presence of the species (if data on population size is completely missing).
Population (Site Population): A: 100 >/= p > 15%; B: 15 >/= p > 2%; C: 2 >/= p > 0%; D: insignificant population.
Conservation (Conserv.): A: excellent conservation; B: good conservation; C: moderate or low conservation.
Isolation: A: (almost) isolated population; B: non-isolated population, but at the edge of the distribution area; C: non-isolated population with an extended range.
Global: A: excellent value; B: good value; C: considerable value.

The general characteristics of the ROSPA0076 Marea Neagră site, according to the standard form, consist of habitat classes and their coverage at the site level. The site is located on the continental shelf of the Black Sea, which naturally results in the predominant proportion of the habitat class N01 - Marine areas, maritime islands.

Table 4.72 Habitat classes identified at the ROSPA0076 level

Code	Habitat classes	Coverage (%)
N01	Marine zones, maritime islands	96,96
N02	Estuaries, lagoons	2,18
N04	Sandy beaches	0,40
N07	Marshes, peatlands	0,15
N23	Other artificial areas (settlements, mines...)	0,11
Total coverage		99,80

Other characteristics of the ROSPA0076 Marea Neagră site, important from a descriptive point of view, are given by the physico-chemical and biological peculiarities of the Black Sea, which confer a unique character to the Natura 2000 site.

In **the Management Plan of the ROSPA0076 Marea Neagră site**, no abiotic conservation elements of interest were identified.

At the site level, there are 18 species listed in Annex I of Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Birds Directive), which are strictly protected. These species are as follows: *Branta ruficollis, Chlidonias hybridus, Chlidonias niger, Cygnus cygnus, Gavia arctica, Gavia stellata, Gelochelidon nilotica, Larus genei, Larus melanocephalus, Larus minutus, Mergus albellus, Pelecanus crispus, Phalaropus lobatus, Puffinus yelkouan, Sterna albifrons, Sterna caspia, Sterna hirundo, Sterna sandvicensis.* Other species with regular migration not mentioned in Annex I of the Birds Directive are listed in the site's species list: *Podiceps nigricollis, Phalacrocorax carbo, Aythya fuligula, Fulica atra, Anas penelope, Anas platyrhynchos, Anas strepera, Larus fuscus, Larus ridibundus, Mergus merganser, Mergus serrator, Podiceps cristatus, Aythya ferina, Bucephala clangula, Larus cachinnans, Larus canus, Podiceps grisegena, Tachybaptus ruficollis, Limosa limosa*.

All these bird species were the basis for declaring the ROSPA0076 Marea Neagră Natura 2000 site and have found suitable habitats within the site for feeding, resting, and sheltering.

Threats, pressures, or activities with an impact on the site, differentiated by the intensity of the impact, are presented in the tables 4.73 and 4.74 below:

Table 4.73 The most significant impacts and activities with a high effect on the site

Negative impacts				
Intens.	**Code**	**Threats and pressures**	**Pollution (Code)**	**Within site/outside site**
H	D 03.01	Port area	N	I
H	D03.02	Navigation	N	I
H	E01	Urbanized areas Human settlements (human dwellings)	N	O
H	F03.02	Fauna taking / capturing (terrestrial)	N	I
H	G02	Sports and recreational complexes	N	O
H	G04.01	Military manoeuvres	N	O
H	K01.01	Erosion	N	O

Table 4.74 The most significant impacts and activities with a major effect on the site

Negative impacts				
Intens.	**Code**	**Threats and pressures**	**Pollution (Code)**	**Within site/outside site**
M	D 01.02	Drumuri, autostrăzi	N	O

Legend:
The intensity of their influence on the site using the following categories: H - High influence, M - Medium influence, L - Low influence; Pollution: N - Nitrogen input, P - Phosphorus/phosphate input, A - Acidification, T - Toxic chemical substances, O - Organic toxic substances, X - Mixed pollution; Location: I - Inside the site, O - Outside the site, B - Both inside and outside the site.

The **ownership form** of the areas included in the ROSPA0076 Marea Neagră site is 100% state public property.

The site has an approved **Management Plan** through the Order of the Minister of Environment, Waters, and Forests no. 1.197/2016 regarding the approval of the Management Plan and the Regulations of the Natura 2000 site ROSPA0076 Marea Neagră.

The **conservation objectives and measures** are included in both the Management Plan approved by the Minister of Environment and the Decision of ANANP no. 535/05.11.2020 (attached to this study).

The **site's management** is ensured by the National Agency for Protected Natural Areas (A.N.A.N.P.) - as the competent authority responsible for managing the natural areas within the national Natura 2000 network, in accordance with Annex 2 to DECISION no. 681 of 28.10.2019 concerning the takeover for administration by the National Agency for Protected Natural Areas of the unattributed protected natural areas or those whose administration contracts, conventions/custody contracts have expired, as well as those assigned for administration or custody - the unattributed protected natural areas or those whose administration contracts, conventions/custody contracts have expired.

4.10.3 Description of the current state of biodiversity.

4.10.3.1 Terrestrial zone

The flora, vegetation, and habitats of the terrestrial zone at the site.

For the initial establishment of the presence and distribution of vegetation communities on and near the project site, the main spatial data source used was the CORINE Land Cover (CLC) 2018 dataset. Land use classes forming the vegetation cover were selected for description, using the most recent CLC nomenclature (Kosztra et al., 2019). On the project site and its vicinity, the following land use classes were identified:

- 122 Road and rail networks and associated land (highways and railways, including associated facilities such as stations, platforms, embankments, linear green spaces smaller than 100 m);
- 142 Sports and recreational facilities (areas used for sports, recreation, and leisure activities. This class includes camping grounds, sports fields, recreational parks, golf courses, racecourses, as well as designated parks not surrounded by urban areas);

- 211 Non-irrigated arable land (parcels of land cultivated under rainfed agricultural conditions for non-permanent crops harvested annually, typically within a crop rotation system. This class also includes sporadically irrigated land with non-permanent devices);
- 222 Fruit trees and berry plantations (cultivated plots planted with fruit trees and shrubs, intended for fruit production, including nuts, with the planting pattern consisting of either single or mixed fruit species, both in association with permanent grassland areas).

The CLC 2018 dataset did not indicate any natural or semi-natural areas on the project site and its vicinity.

Field activities for the inventory of flora and habitats were conducted monthly as part of the Neptun Deep project by contractors of the project holder. Vegetation was analysed in all appropriate seasons: late summer (August - September 2018), autumn (September - October 2018), early spring (March - April 2019), spring (April - May 2019, May 2023), and summer (June - July 2019). The vegetation analysis used the longitudinal transect method supplemented with phytocoenological surveys (Cristea et al., 2004). This method involved identifying observed plant species and vegetation communities along a line whose length was determined based on habitat complexity. In some cases, transects were performed at the edges of areas of interest (e.g., active agricultural lands) where spontaneous vegetation occurred. In other cases, transects were conducted both at the edges and inside a study area (e.g., abandoned agricultural lands). For each survey, the abundance-dominance index (AD) of each species was recorded, along with other relevant data.

For the taxonomic identification of plant species, the most recent publications on plant identification in Romania were used (Ciocârlan, 2009, Sârbu et al., 2013), as well as references on the flora of Romania (Flora României, Săvulescu et al., 1952-1976, vol. I-XIII). The identified phytotaxa were grouped according to the current systematic classification included in the synoptic works on vegetation in Romania (Sanda et al., 2008).

Vegetation was classified into 9 zones corresponding to different land use classes, differentiated by the defining vegetation communities. These zones are:

- Zone 1 - SH1 (Protection Belt 1): forest and shrub belt area located near the European road E87 (national road DN39);
- Zone 2 - IC (Irrigation Canal): the irrigation canal located along the future access road to the project site;
- Zone 3 - PO (Orchard): the peach orchard located south of the irrigation canal, along the future access road;
- Zone 4 - STSA (Small Trees and Shrubs Along the Railway): the area with small trees and shrubs located along the railway line;
- Zone 5 - AL (Agricultural Lands): lands covered by oilseed and cereal crops located north of the irrigation canal, on the future site of NGMS/CCR, and also in other areas near the project site;
- Zone 6 - PCA (Pipeline Corridor Area): the area between the railway and agricultural road (dirt road) located near the terraced area on the seafront. This zone includes agricultural land but was delineated and investigated separately due to the different vegetation composition developed due to the long period without cultivation.
- Zone 7 - SH2 (Protection Belt 2): the area with trees near the future NGMS site;

- Zone 8 - SA (Sand Zone): the sandy area along the seashore (beach);
- Zone 9 - TA (Terraced Area on the Seashore): the terraced area along the shoreline.

These zones are shown in figure 4.49 below and described further.

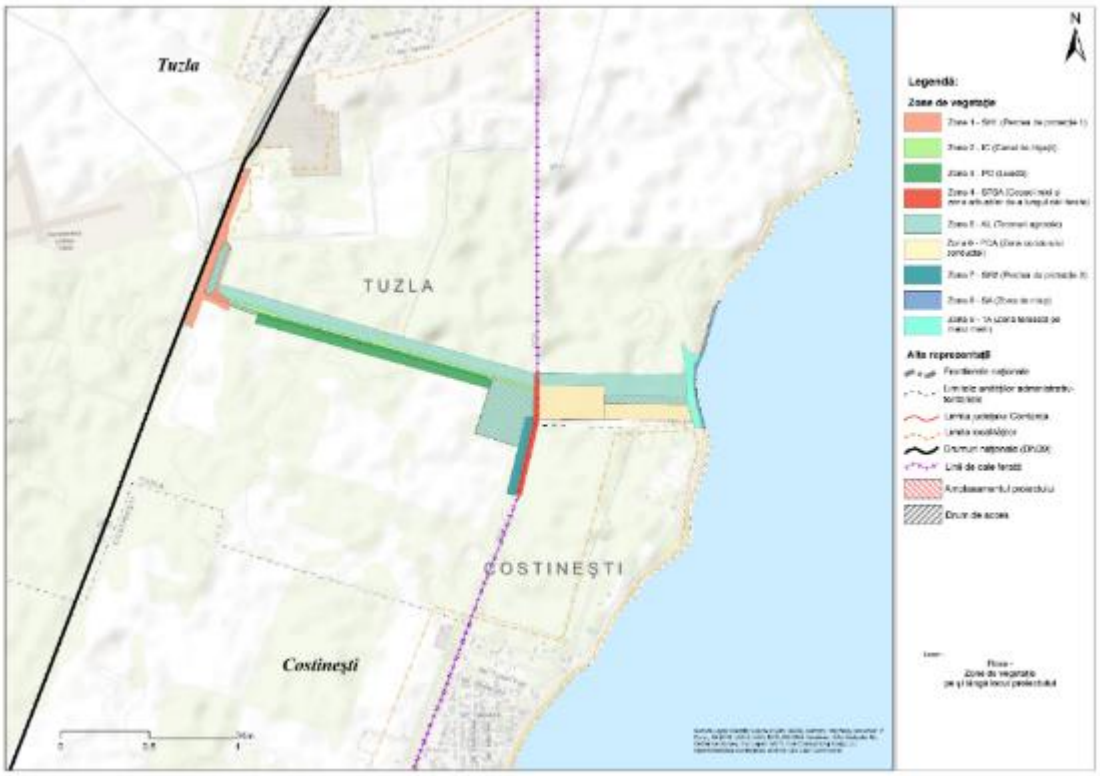


Figure 4.49 Vegetation areas on and near the land site of the project, analysed in the field study

1 SH1 (Tree Protection curtain 1)

The SH1 area is mainly composed of tree and shrub species such as Robinia pseudoacacia, Acer negundo, Acer campestre, Acer platanoides, Acer pseudoplatanus, Gleditsia triacanthos, Fraxinus angustifolia, Morus nigra, Quercus robur, Crataegus monogyna, Juglans regia, Ligustrum vulgare, Prunus cerasifera, and Prunus spinosa.

The herbaceous layer varies according to the season. Therefore, prevernal flora observations have led to the identification of ephemeral species such as Ranunculus ficaria and Muscari neglectum. The vernal aspect of the flora has been characterized by species such as Conium maculatum, Veronica hederifolia, Cradaria draba (observed at the edge of the protective curtain), Euphorbia sp., Asperugo procumbens, Valerianella locusta, Lamium purpureum, and Allium sp. During the summer season, the herbaceous layer was less developed due to the canopy of the trees. The species with the highest frequency of occurrence were Sambucus ebulus and Conium maculatum.

Near the SH1 area, there is a woody vegetation zone, composed of species such as Malus domestica, Prunus cerasifera, Juglans regia, Rosa canina, Crataegus monogyna, and Elaeagnus angustifolia.

2 IC (Irrigation Canal)

In the IC area, the most frequent species identified were *Prunus cerasifera* and *Crataegus monogyna,* with rare occurrences of *Cerasus avium* and *Prunus persica* species. Regarding the herbaceous layer, the species with the highest coverage were *Cardaria draba*, *Artemisia absinthium, Bromus sterilis, Euphorbia agraria, E. seguieriana, Rumex stenophyllus, Ballota nigra, Conium maculatum, Rubus caesius, Calamagrostis epigejos, and Sorghum halepense*.

The plant association *Lepidietum drabae* (Timár 1950) was identified on the irrigation canal and its vicinity. It is a specific association found on embankments, along roads, near households, and on abandoned lands (Sanda et al., 2008). Along the irrigation canal, the association *Artemisietum absinthii* Todor et al. 1971 is well-developed, especially near the orchard, indicating a rich organic substrate. The plant community *Setario pumilae-Sorghetum halepensii* Ștefan et Oprea 1997 was also identified at the edge of the IC area, and it is commonly found on cultivated lands.

Balloto nigrae-Malvetum sylvestris (Gutte 1966), a ruderal association that thrives in areas rich in organic content, was identified at the beginning of the irrigation canal, between the railway and the orchard in the northern part of the future NGMS (Site of Restoration and Mitigation). The association *Balloto nigrae-Malvetum sylvestris* is characteristic of habitat R8703 Anthropogenic communities with *Agropyron repens, Arctium lappa, Artemisia annua,* and *Ballota nigra* (national classification) corresponding to 87.2 Ruderal communities (Palearctic classification), having a low conservation value and not requiring conservation measures.

3 PO (Orchard)

The herbaceous layer in the peach orchard (PO) consists of ruderal species. During the summer season, there was an observed dominance of *Aleppo grass - Sorghum halepense* (with high coverage). Rarely, species such as *Fumaria vaillantii, Tribulus terrestris, Tragopogon dubius, and Vicia narbonensis* were observed. In the prevernal season, the species *Ornithogalum refractum* was observed. On the orchard fence, *Cynanchum acutum* developed, with a significant coverage. The plant community *Setario pumilae - Sorghetum halepensi* Ștefan et Oprea 1997 was identified in the area, along the entire edge of the orchard.

4 STSA (The zone of small trees and shrubs along the railway)

The vegetation with shrubs along the railway is not continuous but mainly occurs in the form of fragmented zones, with relatively compact vegetation in only some places. The species recorded with the highest frequency are *Crataegus monogyna, Rosa canina, and Elaeagnus angustifolia*..

Figure 4.50 Aspect of the study area crossed by the railway (photo source: Blumenfield, May 2023)

4 AL (Agricultural land)

The agricultural lands have favoured the development of arable and ruderal plants, which are typical for cultivated fields or anthropized areas. The majority of the identified species are annuals with rapid growth and flowering, (such as *Atriplex patula, Fumaria vaillantii, Chenopodium album, Polygonum aviculare, Heliotropium europaeus, Xanthium italicum, X. strumarium, and Asperugo procumbens).*

The agricultural lands located in the northern part of the irrigation canal have been cultivated with sunflower (*Helianthus annuus*), corn (*Zea mays*), and wheat (*Triticum sp*.). On the NGMS/CCR site, the arable land was cultivated with wheat. On the abandoned agricultural land, near the sunflower cultivation area that will be bypassed by the access road, the plant association *Conietum maculati* (I. Pop 1968) has been identified.

Figure 4.51 The narrow area with hemlock (Association *Conietum maculati*), bordered by agricultural plots

(photo source: Blumenfield, May 2023)

At the edge of the agricultural fields (as well as in the area along the pipeline corridor), the invasive species *Erigeron canadensis* and *Xanthium italicum* were observed. These species have a high potential for spreading in the area.

6 PCA (The pipeline corridor)

In the pipeline corridor area (PCA), the agricultural land has not been cultivated for a longer period of time. The vegetation composition consisted of ruderal and segetal species. Some of them are invasive, such as *Erigeron canadensis* (this species had a significant coverage). On the future pipeline site, near the terrace area along the seashore, the phytocoenosis is changing. The number of individuals from spontaneous species has increased. *Bromus tectorum, Descurainia sophia, Sisymbrium loeselii, Senecio vernalis, Papaver rhoeas, Anagallis arvensis, Echium vulgare, Centaurea diffusa, Stachys annua, Reseda lutea, Carduus thoermeri, Medicago rigidula, Dactylis glomerata, Sinapis arvensis, and Sonchus oleraceus* have been observed.

The plant community *Setario pumilae-Sorghetum halepensi* Ştefan et Oprea 1997 identified in this area indicates the previously cultivated character of the zone. Furthermore, the *Setario pumilae-Sorghetum halepensi* association occupies a significant area along this corridor. In the spring of 2023, the largest area on the uncultivated land is covered by the characteristic plant association *Descurainio-Brometum tectori* Burduja et al. 1969 ined. Apud Horeanu 1975.

7 SH2 (Protective forest belt 2)

The protective forest belt is located near the future site of the NGMS (Site of Restoration and Mitigation) and is represented by a plantation of various tree and plant species. These species include *Robinia pseudoacacia, Laburnum anagyroides, Sambucus nigra, Juglans regia, Prunus cerasus, Elaeagnus angustifolia, Rosa canina, Gleditsia triacanthos, Prunus cerasifera, and Crataegus monogyna. Additionally, species such as Ajuga chamaepytis, Vicia narbonensis, Poa pratensis, Geum urbanum, Gallium humifusum, and Sclerochloa dura* have also been identified at the edge of the zone, along with *Tragopogon dubius, Conium maculatum, Taraxacum officinale, and Agrimonia eupatoria*.

8 TA (The terraced zone on the seaside)

In the terraced (TA) or landscaped cliff zone, mostly ruderal plant species with low conservation value have been observed, such as *Cynodon dactylon, Elymus repens, Artemisia absinthium, Medicago minima, Lycopsis arvensis ssp. orientalis, Cardaria draba, Buglossoides arvensis, Anthemis austriaca, Carthamus lanatus, Bromus tectorum, Bromus hordeaceus, Phragmites australis, Geranium dissectum, Cynanchum acutum, Viola arvensis, Potentilla argentea, Sonchus oleraceus, Plantago lanceolata, Vicia villosa, Galium aparine, Galium humifusum, Centaurea diffusa, Sambucus ebulus, Conium maculatum, Echium italicum, Fumaria vaillantii, Euphorbia helioscopia, Vicia narbonensis, Convolvulus arvensis, and Lolium perenne.*

Figure 4.52 The coastal cliff in the study area perimeter

At the base of the coastal cliff and in the area of the slope protection, species of conservation interest have been identified, such as *Ecballium elaterium* and *Scolymus hispanicus*.

Figure 4.53 Ecbalium elaterium (photo source: Blumenfield, may 2023)

The habitat has a moderate conservation value. The mentioned species do not form distinct plant communities; only a few individuals were observed during field activities. Other characteristic species of this habitat type were *Centaurea diffusa, Echium italicum, Galium humifusum, Convolvulus arvensis, and Lolium perenne*.

Regarding *Cardaria draba*, it recorded a high coverage in this area, forming the Lepidietum drabae Timár 1950 association (Syn.: *Capsello-Cardarietum drabae* Resmerita and Roman 1975). Another species with a significant coverage was Phragmites australis. As for the shrubs in this area, isolated specimens of the species *Eleagnus angustifolia, Prunus spinosa, and Rosa canina* were observed.

8 SA (Sand zone)

In the sand zone (SA), on a narrow strip of approximately 2-5m, communities of psammophilous plants belonging to the class *CAKILETEA MARITIMAE* were observed, represented by important taxa such as *Cakile maritima subsp. euxina, Crambe maritima, Eryngyum maritimum, Argusia (Tourneforntia) sibirica, and Polygonum maritimum.* Additionally, species such as *Salsola kali subsp. ruthenica*, which forms plant communities with the aforementioned species, and the

subendemic species *Leymus racemosus* subsp. *sabulosus* were also observed. These communities are specific to the habitat of Community interest **1210 Annual vegetation along the shore**, which corresponds to the habitat **R1601 Pontic West communities with Cakile maritima ssp. euxina and Argusia sibirica** (national classification). The identified plant communities do not have a high coverage, being subjected to both limiting natural factors (coastal erosion) and anthropic factors (especially tourism and grazing).

These important taxa have a high potential for expansion. For example, the species *Argusia sibirica* was observed at the base of the cliff, near the access road, between the stones of the slope protection, and on the sand, occupying small areas. Other important species such as *Eryngium maritimum, Salsola kali subsp. ruthenica, and Crambe maritima* were frequent on the seaside, forming the association *Argusietum (Tournefortietum)* sibiricae Popescu et Sanda 1975, characteristic of the Natura 2000 habitat type 1210.

Leymus racemosus subsp. sabulosus was observed only in two locations on the seaside. In the first location (28.655278 N, 43.974098 E), most characteristic species of the habitat 1210 were found, including *Polygonum maritimum*. In the second location (28.657363 N, 43.979278 E), which is further away from the project site, along with characteristic species of habitat 1210, the subspontaneous species *Bassia scoparia (Kochia scoparia)* was identified.

Only 3 individuals of *Cakile maritima* were observed on the seaside in October 2018. According to *Sârbu et al*. (2013) and *Ciocârlan (*2009), the optimal period for this species is June to September. During field activities in June and July 2019, this species was not observed anymore.

In this area, a single association was observed, consisting of important taxa in terms of conservation (*Eryngium maritimum, Argusia sibirica, Crambe maritima, Salsola kali subsp. ruthenica, Leymus racemosus subsp. sabulosus, Polygonum maritimum*) (figure 4.54).

Figure 4.54 Aspect of the vegetation on the seaside, with characteristic species of the habitat type 1210.

In the terrestrial area of the project, at the base of the cliff and on the beach, 9 plant species listed in the Red Book of Vascular Plants of Romania (Dihoru and Negrean, 2009) have been identified, listed below:

Table 4.75 Plant species from the Red Book identified in the project area and their sozological category

No.	Scientific Name	Red European List	The Red Book of Vascular Plants of Romania
1	*Argusia sibirica*	-	CR

No.	Scientific Name	Red European List	The Red Book of Vascular Plants of Romania
2	*Polygonum maritimum*	-	VU
5	*Cakile maritima subsp.euxina*	-	EN
6	*Crambe maritima*	-	EN
7	*Eryngium maritimum*	-	VU
8	*Scolymus hispanicus*	-	VU
9	*Vicia narbonensis**	-	VU

Category IUCN: **VU** – vulnerable; **LC** – low risc; **EN** – endangered; **CR** – critically endangered

** Vicia narbonensis has been observed in several types of habitats: on the cliff, in the orchard area, and in the protective forest belt.*

Leymus sabulosus is a species of national interest, being listed in Annex 4b of Government Order 57/2007 with subsequent amendments and additions, being the only plant taxon with protected status in the terrestrial area of the project.

Invertebrates

The general region of Dobrogea has been the subject of several investigations concerning invertebrate fauna. Regarding protected species, 25 species listed in the annexes of the Habitat Directive occur in Dobrogea, namely: two dragonflies - *Coenagrion ornatum, Ophiogomphus cecilia (Odonata); one bush-cricket - Saga pedo; two grasshoppers - Paracaloptenus caloptenoides, Stenobothrus eurasius (Orthoptera); seven beetles - Bolbelasmus unicornis, Cerambyx cerdo, Lucanus cervus, Morimus funereus, Osmoderma eremita, Pilemia tigrina, Rosalia alpina (Coleoptera); and thirteen butterflies - Apatura metis, Arytrura musculus, Callimorpha quadripunctaria, Catopta trips, Eriogaster catax, Euphydryas maturna, Hyles hippophaes, Lycaena dispar, Maculinea arion, Pseudophilotes bavius, Parnassius mnemosyne, Proserpinus proserpina, and Zerynthia polyxena (Lepidoptera).* However, after reviewing the relevant literature, the conclusion is that none of these species has been reported in the Tuzla - Costinești areas.

Field studies utilized both active and passive monitoring methods. Active methods involved selecting and delineating visual transects that were periodically checked during the study period. Passive methods involved capturing live animals, followed by identification and release. The field research methods used were in accordance with the "Guidelines for Monitoring Invertebrate Species of Community Interest in Romania" (Iorgu, 2015)

In total, 123 invertebrate species were observed during the field studies: two mantis species, twenty-one orthopterans, two dragonfly species, twelve ant species, forty-four beetle species, twenty-one butterfly species, twenty moth species, and one centipede. The complete list of species identified during the field studies is presented in Table 4.73.

Table 4.76 The list of invertebrate species identified during the field studies.

Class	Order	Family	Species
	Mantodea	Mantidae	*Ameles heldreichi* *Mantis religiosa*
	Orthoptera	Tettigoniidae	*Tylopsis lilifolia*

Class	Order	Family	Species
Insects			*Phaneroptera nana* *Conocephalus fuscus* *Tettigonia viridissima* *Decticus albifrons* *Decticus verrucivorus* *Platycleis affinis* *Platycleis veyseli* *Rhacocleis germanica*
	Odonata	Libellulidae	*Sympecma fusca* *Sympetrum meridionale*
	Hymenoptera	Formicidae	*Camponotus aethiops* *Camponotus vagus* *Cataglyphis aenescens* *Formica cunicularia* *Lasius (Chtonolasius) sp.* *Lasius (Lasius) sp.* *Lasius alienus* *Messor sp.* *Myrmica sp.* *Plagiolepis pygmaea* *Solenopsis cf fugax* *Tetramorium cf caespitum*
	Coleoptera	Carabidae	*Amara sp.* *Brachinus sp.* *Calathus sp.* *Calomera littoralis* *Carabus auronitens* *Carabus coriaceus* *Carterus sp.* *Ditomus clypeatus* *Harpalus sp.* *Ophonus sp.* *Pseudoophonus cf rufipes* *Stenolophus discophorus*
		Scarabeidae	*Anomala sp.* *Aphodius sp.* *Copris lunaris* *Onthophagus amyntas* *Oxythyrea funesta* *Pentodon idiota* *Rhizotrogus aequinoctialis*
		Coccinelidae	*Coccinela septempunctata* *Harmonia axyridis* *Psyllobora vigintiduopunctata*
		Chrysomelidae	*Chrysolina sanguinolenta* *Crepidodera sp.* *Cryptocephalus cf. sericeus* *Donacia sp.*
		Tenebrionidae	*Omophlus sp.*

Class	Order	Family	Species
Insects			*Opatrum sabulosum* *Pedinus sp.* *Podonta sp.*
		Staphylinidae	*Paederus sp.* *Quedius sp.*
		Brentidae	*Apion sp.*
		Elateridae	*Ampedus sp.*
		Mordellidae	*Mordella sp.*
		Cerambycidae	*Chlorophorus varius*
		Histeridae	*Hister quadrimaculatus*
		Curculionidae	*Larinus sp.* *Lixus sp.* *Sphenophorus sp.* *Tanymecus sp.*
		Meloidae	*Mylabris variabilis*
		Silphidae	*Nicrophorus sp.*
		Cantharidae	*Rhagonycha fulva*
	Lepidoptera	Nymphalidae	*Aglais io* *Aglais urticae* *Coenonympha pamphilus* *Lasiommata megera* *Vanessa atalanta* *Vanessa cardui* *Melitaea cinxia* *Melitaea phoebe*
		Papilionidae	*Papilio machaon*
		Pieridae	*Anthocharis cardamines* *Colias cf croceus* *Gonepteryx rhamni* *Pieris napi* *Pieris rapae* *Pontia edusa*
		Lycaenidae	*Lampides boeticus* *Lycaena phlaeas* *Lycaena thersamon* *Plebejus argus* *Polyommatus icarus*
		Geometridae	*Charissa sp.* *Chlorissa viridata* *Crocallis elinguaria* *Ematurga atomaria* *Lythria purpuraria* *Phaiogramma etruscaria* *Timandra comae*
Insects		Noctuidae	*Acontia trabealis* *Heliothis nubigera* *Mamestra brassicae* *Noctua pronuba* *Prodotis stolida* *Protoschinia scutosa*

Class	Order	Family	Species
		Sphingidae	*Macroglossum stellatarum*
		Crambidae	*Nomophila noctuella* *Pyrausta aurata*
		Erebidae	*Aedia funesta* *Euclidia glyphica*
		Tortricidae	*Epiblema scutulana*
		Notodontidae	*Dicranura ulmi*
Chilopoda	Scolopendromorpha	Scolopendridae	*Scolopendra cingulata*

Figure 4.55 Lampides boeticus

Figure 4.56 Lycaena phlaeas

Figure 4.57 Chorthippus brunneus

Figure 4.58 Omocestus rufipes

Figure 4.59 Oxythyrea funesta

Figure 4.60 Carabus auronitens

Amphibians and reptiles from the terrestrial area of the project

According to Cogalniceanu et al. (2014) research, Romania's amphibian fauna includes 19 native species from the orders Anura and Urodela. In the Dobruja region, 12 species are found as per Cogalniceanu et al. (2013): *Triturus dobrogicus, Lissotriton vulgaris, Bombina bombina, Pelobates fuscus, Pelobates syriacus, Bufo bufo, Bufotes viridis, Hyla arborea, Rana dalmatina, Pelophylax lessonae, Pelophylax esculentus, and Pelophylax ridibundus.*

The only species identified on the project site and its vicinity was *Bufotes viridis* (Annex 4A of Government Order 57/2007). A total of 25 observations were made during the field activities.

Most observations were recorded near the protective forest belt next to the NGMS and on the road from the NGMS to the shore. Observations were also made near the project site, especially close to the seaside and neighbouring agricultural fields. It should be noted that these observations are relevant for the project, as species of *Bufo* genus can have a relatively high mobility, with some sources mentioning a maximum range of 2.5 hectares (for *Bufo bufo*, a related species to *Bufotes viridis) (*Daversa et al., 2012).

According to the relevant literature, there are a total of 23 reptile species in Romania. Out of these, 20 species can be found in the Dobruja region. They are: *Emys orbicularis, Testudo graeca, Anguis fragilis, Eremias arguta, Lacerta agilis, Darevskia praticola, Lacerta trilineata, Lacerta viridis, Podarcis muralis, Podarcis tauricus, Ablepharus kitaibelii, Eryx jaculus, Coronella austriaca, Zamenis longissimus, Elaphe sauromates, Dolichophis caspius, Natrix natrix, Natrix tessellate, Vipera ammodytes, and Vipera ursinii ssp. moldavica (*Cogalniceanu et al., 2013).

Through direct observations of individuals or signs, the field activities confirmed the presence of species *Lacerta viridis, Dolichophis caspius, and Testudo graeca* on the project site or in its vicinity.

Twenty-seven observations were made for *Lacerta viridis* on the project site or its vicinity. It should be noted that some observations made during different months could refer to the same individuals. Additionally, there was an observation in May, probably of *Lacerta viridis*, but it was not confirmed. Most observations were made in the canal next to the NGMS, especially near the forest area along the national road. This area, characterized by herbaceous vegetation and shrubs, is ideal for this species.

One individual of the *Dolichophis caspius* species was observed in the southern area of the project site, near the orchard, towards Costinești. The individual was spotted about 1.2 km south of the NGMS site, hiding under a rock.

Only one *Testudo graeca* carapace was identified in the project area, in the forested area along the national road. Although favorable habitat areas for the species exist nearby the project site, no living individuals were identified during the field activities. The carapace could have been dropped by a predator bird or brought from another location by humans, but caution is recommended during construction, as the species may find suitable habitat zones within the project area.

Figure 4.61 Lacerta viridis

Figure 4.62 *Testudo graeca* (shell fragments)

Table 4.77 The sozological status and protection status of the reptile species identified on the site and in the vicinity

Species	The Habitats Directive	G.E.O 57/2007	The European Red List (IUCN)
Testudo graeca	Annex II, IV	Annex 3, 4A	VU
Dolichophis (Coluber) caspius	Annex IV	Annex 4A, 4B	LC
Lacerta viridis	Annex IV	Annex 4A	LC
Bufotes (Bufo) viridis	Annex IV	Annex 4A	LC

Note:
IUCN Category: **VU** - Vulnerable; **LC** - Least Concern;
Government Order 57/2007: **ANNEX 3** - Species of plants and animals whose conservation requires the designation of special conservation areas and special protection areas for avifauna; **ANNEX 4 A** - SPECIES OF COMMUNITY INTEREST - Species of animals and plants that require strict protection; **ANNEX 4 B** - SPECIES OF NATIONAL INTEREST - Species of animals and plants that require strict protection.
Directive 92/43/EEC: **Annex II** - Species of animals and plants of community importance whose conservation requires the designation of special conservation areas; **Annex IV** - Species of animals and plants of community importance in need of strict protection; **Annex V** - Species of animals and plants of community importance whose removal and exploitation may be subject to administrative measures.

Avifauna in the project area

On and in the vicinity of the project site, the bird community is represented by both terrestrial (diurnal and nocturnal) and aquatic species, including sedentary and migratory species (summer visitors, winter visitors, passage species), some of which are of community and/or national interest.

Field observations for each typology involve specific and dedicated methods that can provide adequate information to characterize the degree of presence and use of the land, distribution, population size, and understand the availability of the project area as a feeding/reproduction/nesting/migration site for each group.

Three methods were used for conducting field activities: *the longitudinal transect method, to obtain data on species that use the project area* (resident species, summer visitors, winter visitors), *the fixed point method,* mainly for migratory species, and the *transect method with the use of boats*, applied for species in passage at the ROSPA0076 Marea Neagră site.

During the bird monitoring activities on and near the project site, carried out from August 2018 to July 2019, a total of 117 bird species were identified, and from March to June 2023, 113 bird species were recorded, out of which 36 species were not mentioned in the previous monitoring reports (table no. 4.75).

Unlike the initial monitoring period (August 2018 - July 2019) which mainly focused on bird species in the terrestrial area of the project, the observations from March to June 2023 were mainly concentrated within the protected natural area ROSPA0076 Marea Neagră.

The following table also provides information on the protection status (Government Order 57/2007 and Birds Directive) and the conservation status categories of the bird species observed on and near the project site, following the MMAP Order No. 2.015/2022 approving the National Red List of bird species in Romania, using IUCN criteria.

Table 4.78 List of bird species identified during field activities (August 2018 - July 2023) on the project site and in its vicinity and information on conservation status

No.	Scientific Name	Phenology	Categories of Endangerment (O.2.015/2022)	Protection status (Annex GEO 57/2007)	Birds Directive	The Bern Convention	The Bonn Convention
1.	*Accipiter nisus*	C	LC			III	II
2.	*Actitis hypoleucos*	C	LC	4B		II	II
3.	*Acrocephalus palustris*	C	LC			II	
4.	*Alauda arvensis*	C	NT	5C	IIB	III	
		P	LC				
5.	*Alcedo atthis*	C	LC	3	I	II	
6.	*Anas acuta*	I	NE	5C, 5E	IIA; IIIB	III	II
7.	*Anas platyrhynchos*	C	LC	5C, 5D	IIA; IIIA	III	II
		I	NE				
8.	*Anser albifrons*	P	NE	5C, 5E	IIB	III	II
		I	NE				
9.	*Anthus campestris*	C	LC	3	I	II	
10.	*Anthus pratensis*	C	NE			II	II
11.	*Anthus trivialis*	C	NT			II	II
12.	*Apus apus*	C	LC			III	
13.	*Apus pallidus*	C	NT			II	
14.	*Ardea alba*	C	LC	3	I	II	II
		P	NE				
		I	NE				
15.	*Ardea cinerea*	C	LC			III	
16.	*Ardea purpurea*	C	LC	3	I	II	II
		P	NE				
17.	*Ardeola ralloides*	C	LC	3	I	II	
		P	NE				
18.	*Asio otus*	C	LC			II	
19.	*Athene noctua*	C	LC	4B		II	
20.	*Branta ruficollis*	P	NE	3	I	II	I;II
		I	VU				
21.	*Buteo buteo*	C	LC			III	II
22.	*Buteo rufinus*	C	LC	3	I	III	II
23.	*Calidris alpina*	P	NE	3		II	II
24.	*Calidris ferruginea*	P	NE			II	II

No.	Scientific Name	Phenology	Categories of Endangerment (O.2.015/2022)	Protection status (Annex GEO 57/2007)	Birds Directive	The Bern Convention	The Bonn Convention
25.	*Calidris minuta*	P	NE			II	II
26.	*Calidris pugnax*	P	NE		I; IIB	III	II
27.	*Carduelis carduelis*	C	LC	4B		II	
28.	*Cecropis daurica*	C	LC				
29.	*Charadrius dubius*	C	LC			II	II
30.	*Chlidonias hybrida*	C	LC	3	I	II	
		P	NE				
31.	*Chlidonias leucopterus*	C	VU			II	II
32.	*Chlidonias niger*	C	VU	3	I	II	II
		P	NE				
33.	*Chloris chloris*	C	LC	4B		II	
34.	*Chroicocephalus genei*	C	RE	3	I	II	II
		P	NE				
35.	*Chroicocephalus ridibundus*	C	LC		IIB	III	
		P	NE				
36.	*Ciconia ciconia*	C	LC	3	I	II	II
		P	NE				
37.	*Circus aeruginosus*	C	LC	3	I	III	II
38.	*Circus macrourus*	C	RE	3	I	III	II
		P	NE				
39.	*Circus pygargus*	C	VU	3	I	III	II
40.	*Clanga pomarina*	B	NT	3	I	III	II
41.	*Coloeus monedula*	C	LC	5C	IIB		
42.	*Columba palumbus*	C	LC	5C, 5D	IIA; IIIA		
43.	*Coracias garrulus*	C	LC	3	I	II	I; II
44.	*Corvus cornix*	-	-	5C	IIB	III	
45.	*Corvus frugilegus*	C	LC	5C	IIB		
46.	*Coturnix coturnix*	C	LC	5C	IIB	III	II
47.	*Cuculus canorus*	C	LC			III	
48.	*Cyanistes caeruleus*	C	LC			II	
49.	*Cygnus olor*	C	LC		IIB	III	II
		P	NE				
50.	*Delichon urbicum*	C	LC			II	
51.	*Dendrocopos syriacus*	C	LC	3	I	II	
52.	*Egretta garzetta*	C	LC	3	I	II	
		P	NE				
53.	*Emberiza calandra*	C	LC	4		III	
54.	*Emberiza citrinella*	C	LC			II	
55.	*Emberiza hortulana*	C	LC	3	I	III	
56.	*Emberiza melanocephala*	C	LC	4B		II	
57.	*Emberiza schoeniclus*	C	LC			II	
58.	*Erithacus rubecula*	C	LC	4B		II	II
59.	*Falco subbuteo*	C	LC	4B		II	II
60.	*Falco tinnunculus*	C	LC	4B		II	II
61.	*Falco vespertinus*	C	VU	3	I	II	I/II
		P	NE				
62.	*Ficedula albicollis*	C	LC	3	I	II	II
63.	*Ficedula parva*	C	LC	3	I	II	II
64.	*Fringilla coelebs*	C	LC			III	

No.	Scientific Name	Phenology	Categories of Endangerment (O.2.015/2022)	Protection status (Annex GEO 57/2007)	Birds Directive	The Bern Convention	The Bonn Convention
65.	*Fringilla montifringilla*	-	-			III	
66.	*Fulica atra*	C	NT	5C, 5E	IIA; IIIB	III	
		I	LC				
67.	*Galerida cristata*	B	LC			III	
68.	*Gallinago gallinago*	C	VU	5C, 5E	IIA; IIIB	III	II
		P	NE				
69.	*Gavia arctica*	C	NE	3	I	II	II
70.	*Gelochelidon nilotica*	C	CR	3	I	II	II
		P	NE				
71.	*Haematopus ostralegus*	C	VU		IIB	III	II
72.	*Himantopus himantopus*	B	LC	3	I	II	II
		P	NE				
73.	*Hirundo rustica*	C	NT			II	
74.	*Hydroprogne caspia*	C	RE	3	I	II	II
		P	NE				
75.	*Hydrocoloeus minutus*	C	NE	3	I	II	
76.	*Ichthyaetus melanocephalus*	C	CR	3	I	II	II
		P	NE				
77.	*Iduna pallida*	C	LC			II	II
78.	*Jynx torquilla*	C	LC	4B		II	
79.	*Lanius collurio*	C	LC	3	I	II	
80.	*Lanius minor*	C	VU	3	I	II	
81.	*Lanius senator*	C	LC			II	
82.	*Larus canus*	C	NE		IIB	III	
		P	NE				
83.	*Larus fuscus fuscus*		-		IIB		
84.	*Larus michahellis*	C	LC			III	
85.	*Linaria cannabina*	C	VU	4B		III	
86.	*Luscinia luscinia*	C	LC			II	II
87.	*Luscinia megarhynchos*	C	LC			II	II
88.	*Mareca penelope*	P	NE	5C, 5E	IIA; IIIB	III	II
		I	NE				
89.	*Mareca strepera*	C	LC	5C	IIA	III	II
		P	NE				
		I	NE				
90.	*Melanocorypha calandra*	C	EN	3	I	II	
91.	*Mergus merganser*	B	LC		IIB	III	II
		W	NE				
92.	*Merops apiaster*	C	LC	4B		II	II
93.	*Microcarbo pygmaeus*	C	LC	3	I	II	II
		P	NE				
		I	NE				
94.	*Milvus migrans*	C	CR	3	I	III	II
95.	*Motacilla alba*	C	LC	4B		II	
96.	*Motacilla flava*	C	LC	4B		II	
97.	*Muscicapa striata*	C	LC	4B		II	II
98.	*Netta rufina*	C	LC		IIB	III	II
		I	NE				
99.	*Nycticorax nycticorax*	C	LC	3	I	II	

No.	Scientific Name	Phenology	Categories of Endangerment (O.2.015/2022)	Protection status (Annex GEO 57/2007)	Birds Directive	The Bern Convention	The Bonn Convention
100.	*Oenanthe isabellina*	C	LC			II	II
101.	*Oenanthe oenanthe*	C	LC			II	II
102.	*Oenanthe pleschanka*	C	LC	3	I	II	II
103.	*Oriolus oriolus*	C	LC	4B		II	
104.	*Pandion haliaetus*	P	NE	3	I	III	II
105.	*Parus major*	C	LC			II	
106.	*Passer domesticus*	C	LC				
107.	*Passer hispaniolensis*	C	LC	4B		III	
108.	*Passer montanus*	C	LC			III	
109.	*Pelecanus crispus*	B	VU	3	I	II	I;II
		P	NE				
110.	*Pelecanus onocrotalus*	C	VU	3	I	II	I;II
		P	NE				
		I	NE				
111.	*Perdix perdix*	C	LC	5C, 5D	IIA; IIIA	III	
112.	*Phalacrocorax (Gulosus) aristotelis*	C	NE				
113.	*Phalacrocorax carbo*	C	LC			III	
		P	NE				
		I	NE				
114.	*Phasianus colchicus*	C	NA	5C, 5D	IIA; IIIA	III	
115.	*Phoenicurus ochruros*	C	LC	4B		II	II
116.	*Phoenicurus phoenicurus*	C	LC	4B		II	II
117.	*Phylloscopus collybita*	C	LC	4B		II	II
118.	*Phylloscopus sibilatrix*	C	LC	4B		II	II
119.	*Phylloscopus trochilus*	C	LC	4B		II	II
120.	*Pica pica*	C	LC	5C	IIB		
121.	*Platalea leucorodia*	C	NT	3	I	II	II
		P	NE				
		I	NE				
122.	*Plegadis falcinellus*	C	NT	3	I	II	II
		P	NE				
123.	*Pluvialis apricaria*	P	NE	3, 5E	I, IIB, IIIB	III	II
124.	*Pluvialis squatarola*	-	-		II	III	II
125.	*Podiceps cristatus*	C	LC			III	
126.	*Podiceps nigricollis*	C	NT			II; III	
		P	NE				
		I	NE				
127.	*Puffinus yelkouan*	P	NE		I	II	
128.	*Recurvirostra avosetta*	C	LC	3	I	II	II
		P	NE				
129.	*Riparia riparia*	C	LC			II	
130.	*Saxicola rubetra*	C	NT			II	II
131.	*Spatula querquedula*	C	LC				
132.	*Sterna hirundo*	C	LC	3	I	II	II
		P	NE				
133.	*Sternula albifrons*	C	NT	3	I	II	II
		P	NE				

No.	Scientific Name	Phenology	Categories of Endangerment (O.2.015/2022)	Protection status (Annex GEO 57/2007)	Birds Directive	The Bern Convention	The Bonn Convention
134.	*Streptopelia decaocto*	C	LC	5C	IIB	III	
135.	*Streptopelia turtur*	C	LC	5C	IIB	III	
136.	*Sturnus vulgaris*	C	LC	5C	IIB		
137.	*Sylvia atricapilla*	C	LC			II	II
138.	*Sylvia borin*	C	LC			II	II
139.	*Sylvia communis*	C	LC			II	II
140.	*Sylvia curruca*	C	LC			II	II
141.	*Tadorna ferruginea*	C	LC	3	I	II	II
142.	*Tadorna tadorna*	C	LC			II	
		I	NE				
143.	*Thalasseus sandvicensis*	C	VU	3	I	II	II
		P	NE				
144.	*Tringa erythropus*	P	NE		IIB	III	II
145.	*Tringa ochropus*	-	-			II	II
146.	*Tringa totanus*	C	NT		IIB	III	II
		P	NE				
147.	*Troglodytes troglodytes*	C	LC			II	
148.	*Turdus merula*	C	LC		IIB	III	
149.	*Turdus philomelos*	C	LC	5C	IIB	III	
150.	*Turdus pilaris*	C	LC	5C	IIB	III	
151.	*Turdus viscivorus*	C	LC	5C	IIB	III	
152.	*Upupa epops*	C	LC	4B		II	
153.	*Vanellus vanellus*	C	VU		IIB	III	II

Note:

Phenological status: Phenology (official, according to reporting for Article 12 of the Birds Directive) for which the assessment was made: B - breeding, W - wintering, P - passage;

Final category LR (List of Red-listed bird species in Romania): RE - regionally extinct; CR/PE - Critically Endangered / Possibly extinct; CR - Critically Endangered; EN - Endangered; VU - Vulnerable; NT - Near Threatened; LC - Least Concern; NE - Not Evaluated; NA - Not Applicable;

Government Order No. 57/2007 with subsequent amendments and completions: 3 - Annex 3 Species of plants and animals whose conservation requires the designation of special conservation areas and special avifaunal protection areas, 4A - Annex 4A - Species of Community Interest, Species of animals and plants requiring strict protection, 4B - Annex 4B - Species of national interest, Species of animals and plants requiring strict protection, 5A - Annex 5A - Species of Community Interest, Species of plants and animals of Community Interest, except for bird species, the removal from nature and exploitation of which are subject to management measures, 5B - Annex 5B - Species of national interest, the removal from nature and exploitation of which are subject to management measures, 5C - Annex 5C - Species of Community Interest, whose hunting is allowed, 5D - Annex 5D - Bird species of Community Interest, whose commercialization is allowed, 5E - Annex 5E - Bird species of Community Interest, whose commercialization is allowed under special conditions.

Birds Directive (Directive 2009/147/EC on the conservation of wild birds): I - Annex I Species subject to special conservation measures; IIA - Annex IIA Species that can be hunted in the geographical maritime and terrestrial area where the directive applies; IIB - Annex IIB Species that can be hunted only in the member states for which they are indicated.

Berna Convention (Convention on the Conservation of European Wildlife and Natural Habitats): II - Annex II Strictly protected fauna species; III - Annex III Protected fauna species.

Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals): I - Annex I Endangered migratory species; II - Annex II Migratory species protected by agreements.

Figure 4.63 Phalacrocorax carbo

Figure 4.64 *Puffinus yelkouan* în pasaj

Figure 4.65 Ichthyaetus melanocephalus

Figure 4.66 Sterna hirundo

The most important shelter and nesting area identified in the project area is the shipwreck near Costinești. Species such as Great Cormorants (*Phalacrocorax carbo),* European Shags (*Phalacrocorax aristotelis),* and Yellow-legged Gulls (*Larus michahellis)* use the shipwreck for nesting. Over a hundred pairs of Great Cormorants nest on the shipwreck along with several pairs of European Shags (approximately 4-5 pairs) and a large number of Yellow-legged Gulls. Additionally, Yellow-legged Gulls also nest on residential buildings in Costinești.

Another nesting area is represented by a portion of the high loess cliff, located north of the analysed project, which hosts a colony of European Bee-eaters (*Merops apiaster*).

The most important resting and feeding habitats for waterbirds are found in the shallow waters near the shore. In the period of April-May, several fish species migrate close to the shore, including for reproduction and feeding. Thus, fish-eating birds are frequently observed feeding in such habitats and resting nearby on sandy beaches.

Various species of gulls have been observed resting on agricultural lands in the study area, and during agricultural activities, they feed on invertebrates and small mammals on freshly plowed fields alongside corvid species.

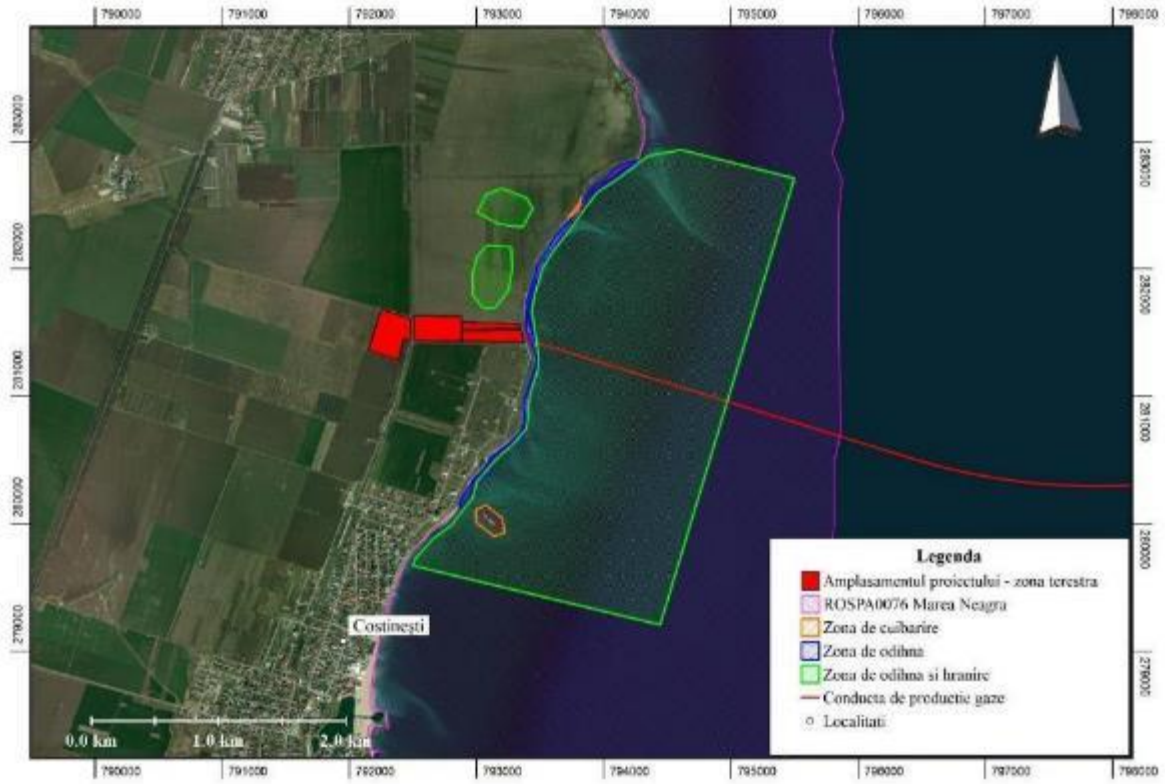


Figure 4.67 The main locations of resting, feeding, and nesting areas of the avifauna in the project area are as follows:

Mammals from the terrestrial area of the project

Monthly field activities for mammal species were carried out during the period of August 2018 to July 2019 and March to July 2023. Individually observed animals and any signs of their presence, such as excrements, tracks, or burrows, were photographed, and their coordinates were recorded using a GPS receiver. Another method utilized during field investigations was *camera trapping* for video recorderg. Additionally, in a limited number of trips in 2019, trapping methods were applied.

A total of 15 terrestrial mammal species were identified through direct observation and/or indirect signs of their presence within the project area and its vicinity (Table 4.76). Two of the identified species (*Spermophilus citellus and Lutra lutra)* are species of community interest.

The European otter (*Lutra lutra*) was not visually identified, but its footprints were observed on the beach. The otter is a species known for its high mobility, and its feeding territory extends beyond typical lacustrine habitats, often being spotted in search of food and shelter in natural or anthropogenic coastal habitats (e.g., harbors, dikes). There have been reports of dead otter specimens north of Capul Tuzla and on the beaches of Costinești and Eforie resorts.

The European souslik (*Spermophilus citellus*) utilizes the talus of the cliff for shelter, feeding, and reproduction, where no construction works are planned for the project. The species has a limited distribution in the study area, only found in the mentioned habitat, and has an unfavorable conservation status.

The best habitats for mammals are represented by patches of natural vegetation in the vicinity of the project and the project area itself, as well as the agricultural fields surrounding it, especially for rodents. The irrigation channels along the project area and the orchard have been identified

as shelters for *Meles meles, Vulpes vulpes, and Canis aureus*. Numerous burrows of rodents and species belonging to the order Eulipotyphla were also identified in the vicinity of the project area.

Table 4.79 List of mammal species identified during field investigations inside and in the vicinity of the project site

No.	Order	Scientific Name	Popular Name	Habitats Directive	G.E.O 57/2007	European Red List (IUCN)
1.	Eulipotyphla	*Erinaceus roumanicus*	Northern white-breasted hedgehog			LC
2.		*Crocidura leucodon*	Bicolored shrew			LC
3.		*Sorex araneus*	Common shrew			LC
4.		*Talpa europaea*	European Mole			LC
5.	Rodentia	*Mus musculus*	House mouse			LC
6.		*Mus spicilegus*	Steppe mouse			LC
7.		*Rattus norvegicus*	Brown Rat			LC*
8.		*Apodemus sylvaticus*	Wood mouse			LC
9.		*Microtus arvalis*	Common Vole			LC
10.		*Spermophilus citellus*	European ground squirrel	Annex II, IV	Annex 3,4A	EN
11.	Lagomorpha	*Lepus europaeus*	European Hare		Annex 5B	LC
12.	Carnivora	*Vulpes vulpes*	Red Fox		Annex 5B	LC
13.		*Meles meles*	European Badger		Annex 5B	LC
14.		*Canis aureus*	Golden Jackal	Annex V	Annex 5A	LC
15.		*Lutra lutra*	Eurasian Otter	Annex II,IV	Annex 3,4A	NT

Note:

IUCN Categories: **LC** - Least Concern; **EN** - Endangered; **NT** - Near Threatened.

G.E.O 57/2007: **Annex 3** - Species of plants and animals whose conservation requires the designation of special conservation areas and special avifaunistic protection areas; **Annex 4 A** - SPECIES OF COMMUNITY INTEREST - Species of animals and plants requiring strict protection; **Annex 4 B** - SPECIES OF NATIONAL INTEREST - Species of animals and plants requiring strict protection; An**nex 5 A** - SPECIES OF COMMUNITY INTEREST - Species of plants and animals of community interest, with the exception of bird species, the harvesting from nature and exploitation of which are subject to management measures; Annex 5 B - SPECIES OF NATIONAL INTEREST - Species of animals of national interest, the harvesting from nature and exploitation of which are subject to management measures.

Directive 92/43/EEC: **Annex II** - Species of animals and plants of community interest whose conservation requires the designation of special conservation areas; **Annex IV** - Species of animals and plants of community interest in need of strict protection; **Annex V** - Species of animals and plants of community interest, the capture and exploitation of which may be subject to administrative measures.

* In the absence of a regional European IUCN assessment, the global IUCN assessment has been applied to the species *Rattus norvegicus.*

Chiropterofauna

Regarding chiropterofauna, it can be stated that the habitats on the site and in the immediate vicinity do not offer a variety of suitable locations for establishing maternity colonies. The nearby wooded areas do not provide favourable habitats for establishing bat colonies since mature trees are either absent or present in very small numbers.

No bats were identified in the forests in the area. Anthropogenic shelters are the closest potential locations for colonies of migratory bats that hunt in the open spaces of the site. Bat commuting areas extend up to 15 - 20 km²/night, but this area is measured as potential optimal habitat for the species around the shelters. The closest distance from the project to a bat shelter of national importance is 20.8 km (Limanu Cave, located near the village of Limanu). This may represent a sufficiently large distance for rare species, such as *Miniopterus schreibersii*, not to reach the project area during feeding, commuting, or migration. The species exhibits regional migratory behavior, but colonies in the southern Dobrogea area are only present here during the summer and usually migrate to Bulgarian karst for hibernation.

Bat species are generally challenging to observe through traditional methods. Field activity focused on identifying bats on the site and in its vicinity through ultrasonic transects (using ultrasonic detectors and active searches in potential shelter areas). The transects were conducted during the periods of spring, maternity, feeding, and reproduction, on clear nights, starting 30 minutes before sunset and continuing until 1 AM when bat activity decreases significantly due to their feeding behaviour.

The species identified on-site were predominantly represented by *Pipistrellus nathusii/kuhlii*. Distinguishing between *P. nathusii* and *P. kuhlii* cannot be reliably achieved solely through ultrasonic use, which is why these two species are treated as a group. There is a higher probability that the identified species is P. nathusii, given that the ecology of the species and habitat preferences align more with the habitat requirements present in the project area. Individuals from the *Nyctalus genus* were more abundant in the months of August and September, indicating potential migration activities in the study area.

Table 4.80 List of species in the study area and their conservation status and zoological category.

No.	Scientific name	Popular Name	Number of bioacoustic observations - project area*	Habitats Directive	OUG57/2007	European Red List (IUCN)
1	*Nyctalus leisleri*	Leisler's bat	3	Annex IV	Annex 4A	LC
2	*Nyctalus noctula*	Common noctule	19	Annex IV	Annex 4A	LC
3	*Pipistrellus nathusii/kuhlii*	Nathusius' /Kuhl's pipistrelle	282	Annex IV	Annex 4A	LC
4	*Pipistrellus pipistrellus*	Common pipistrelle	1	Annex IV	Annex 4A	LC**

Note:
IUCN Category: **LC** - Least Concern;
Government Order 57/2007: **Annex 3** - Species of plants and animals whose conservation requires the designation of special conservation areas and special avifauna protection areas; **Annex 4 A** - SPECIES OF COMMUNITY INTEREST - Species of animals and plants requiring strict protection; **Annex 4 B** - SPECIES OF NATIONAL INTEREST - Species of animals and plants requiring strict protection; **Annex 5 A** - SPECIES OF COMMUNITY INTEREST - Species of plants and

animals of community interest, except for bird species, which are subject to management measures; **Annex 5 B** - SPECIES OF NATIONAL INTEREST - Species of animals of national interest, subject to management measures.
Directive 92/43/EEC: **Annex II** - Species of animals and plants of community importance whose conservation requires the designation of special conservation areas; **Annex IV** - Species of animals and plants of community importance in need of strict protection; **Annex V** - Species of animals and plants of community importance whose capture and exploitation may be subject to administrative measures.
Directive 92/43/EEC: **Annex IV** - Species of animals and plants of community importance in need of strict protection.
*Bioacoustic observations cannot be treated as individual counts and are generically marked as 1 individual per recorderg. The number of bioacoustic observations on the project site and in its vicinity were specifically conducted for this project, while other observations in the study area were collected from previous projects and other databases and do not contain information about the project site.
** In the absence of a regional European IUCN assessment, the global IUCN assessment has been applied to the species Pipistrellus pipistrellus.

4.10.3.2 Marine area

The data regarding marine biodiversity present in the proposed area for the offshore facilities of the Neptun Deep project have been collected since 2013 during various stages of exploration and prospecting in the Neptun concession area, Black Sea.

Starting from 2018, a series of studies and sea expeditions were conducted to inventory the presence of marine fauna species and habitats in the project's area of interest. References regarding these studies can be found in the following sections.

The most recent data was collected as part of the program conducted in May - June 2023 by **Blumenfield**® experts. The study focused on both planktonic and benthic communities, as well as marine habitats in the coastal area influenced by the project, including the ROSAC0273Zona marina de la Capul Tuzla and the project site area adjacent to the protected natural area.

The investigation methods are described in **Section 4.10.4 - Data Collection and Investigation Methods.**

The explored zone's length was approximately 13.2 km, from 0 to the 60m isobath (Figure 4.68).

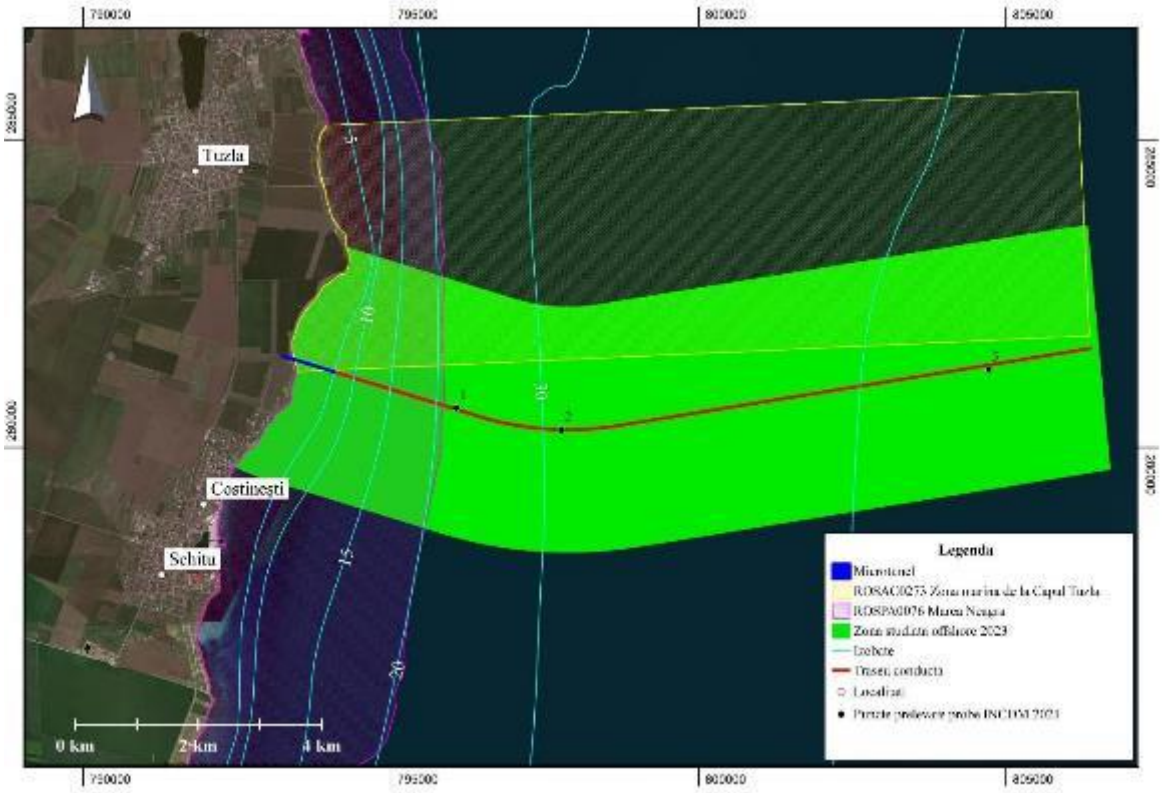


Figure 4.68 The study area for the 2023 monitoring program conducted by Blumenfield®

Phytoplankton

To update the data and information regarding phytoplankton communities in the project area, marine water samples were collected and filtered using a net to study the qualitative and quantitative aspects of phytoplankton.

A total of 10 samples were collected from the designated study area, and the estimates and reporting of results for quantitative analysis were done per litre (1000ml). The identification of some taxonomic groups was carried out up to the species level, while for others, it was only possible up to the genus level.

The qualitative structure of the phytoplankton community in the analysed samples corresponds to the data available in the specialized literature, being typical for the time intervals (warm season/cold season) and the surface horizon of the sea.

Diatoms are dominant in terms of species number, and dinoflagellates, another important component of marine phytoplankton, were also highly represented in the analysed samples. They are more abundant in warm waters but can also be numerous in temperate and cold seas, especially during summer and autumn.

Characterizing phytoplankton in a specific region can be challenging, as it can exhibit significant variations in abundance, depending on factors such as light radiation, nutrient content, and predation by phytoplanktonivores.

Throughout the annual cycle, phytoplankton can undergo periodic changes in its composition, characterized by a succession of species, depending on various factors (season, depth, etc.).

Physical-chemical factors have a major influence on phytoplankton species, sometimes acting as limiting factors.

Following the observations, 18 phytoplankton taxa were identified, distributed across groups as follows: 14 taxa from the *Bacillariophyta group* (Diatomeae), 3 taxa from the *Dinophyta group* (Peridineae), and one species from the Chrysophyta group.

The qualitative structure of the phytoplankton community in the analysed samples from the current sampling corresponds to the data available in the specialized literature, being typical for the time interval (May, cold season), and the surface horizon of the sea.

Diatoms dominate in terms of species number, with the highest number of individuals belonging to centric diatoms: *Rhizosolenia (*present in all samples), *Chaetoceros, Diyillum*; alongside them are pennate diatoms: *Diatoma, Navicula, Pinnularia* (present in most samples).

Dinoflagellates, also an important component of marine phytoplankton, were frequent in several samples: *Ceratium fusus, Ceratium tripos, Peridinium*; generally, their biodiversity is higher in warm waters, but they can also be numerous in temperate and cold seas, especially during summer and autumn.

Among the golden algae, a single species, *Dictyocha speculum*, was identified, belonging to the group of marine silicoflagellates characterized by the presence of an internal siliceous skeleton. They are stenohaline algae of very small size, falling into the category of nanoplankton.

Table 4.81 The qualitative structure of the phytoplankton

Nr.	Taxon	Sample PM1 FPK 2.05.2023	Sample P7 FPK 2.05.2023	Sample P8 FPK 3.05.2023	P21 FPK 3.05.2023	Sample PM1 FPK 3.05.2023	Sample T 5.1 FPK 10.05.2023	Sample T 3.1 FPK 10.05.2023	Sample T 4.1 FPK 10.05.2023	Sample T 3.5 FPK 10.05.2023	Sample T 6.5 FPK 10.05.2023	Sample T 7.4 FPK 11.05.2023	Sample T 1.1 FPK 11.05.2023
	Bacillariophyta Link (Diatomeae)												
1.	*Achnantes longipes*					+				+	+		
2.	*Chaetoceros compressus*			+			+	+		+	+	+	+
3.	*Cocconeis pediculus*	+	+									+	
4	*Coscinodiscus*						+			+		+	+
5.	*Cymbella* sp.	+	+	+			+	+	+				
6.	*Diatoma* sp.	+	+										
7.	*Diploneis* sp.	+	+										
8.	*Dityllum brighwellii*			+			+			+	+		+
9.	*Licmophora* sp.	+				+						+	
10.	*Melosira moniliformis*					+					+	+	+
11.	*Navicula* sp.	+	+				+	+					
12.	*Nitzschia* sp.			+									
13.	*Pinnularia* sp.	+	+	+		+	+	+	+	+			+
14.	*Rhizosolenia*	+	+	+	+	+	+	+	+	+	+	+	+
	Dinophyta Link (Peridineae)												
1.	*Peridinium granii*	+		+	+	+			+	+	+	+	+
2.	*Ceratium fusus*	-					+				+		

Nr.	Taxon	Sample PM1 FPK 2.05.2023	Sample P7 FPK 2.05.2023	Sample P8 FPK 3.05.2023	P21 FPK 3.05.2023	Sample PM1 FPK 3.05.2023	Sample T 5.1 FPK 10.05.2023	Sample T 3.1 FPK 10.05.2023	Sample T 4.1 FPK 10.05.2023	Sample T 3.5 FPK 10.05.2023	Sample T 6.5 FPK 10.05.2023	Sample T 7.4 FPK 11.05.2023	Sample T 1.1 FPK 11.05.2023
3.	*Ceratium tripos*	-	-		+	+		+	+		+	+	
	Chrysophya Link												
1.	*Dictyoha speculum*		+										

Microscopic images of phytoplankton species identified from the project area are presented in the following figures:

Figure 4.69 Achnantes longipes (original photo)

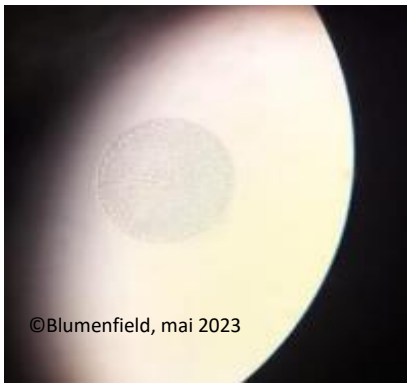


Figure 4.70 *Coscinodiscus* sp. (original photo)

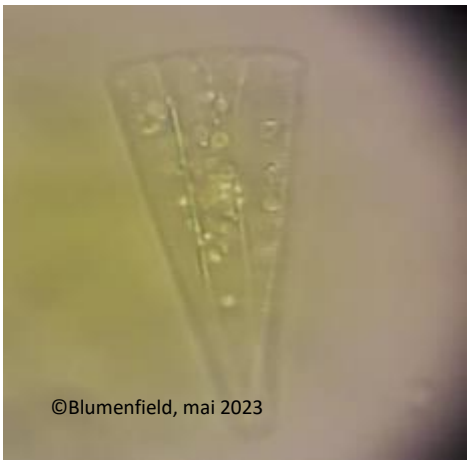


Figure 4.71 *Licmophora* sp. (original photo)

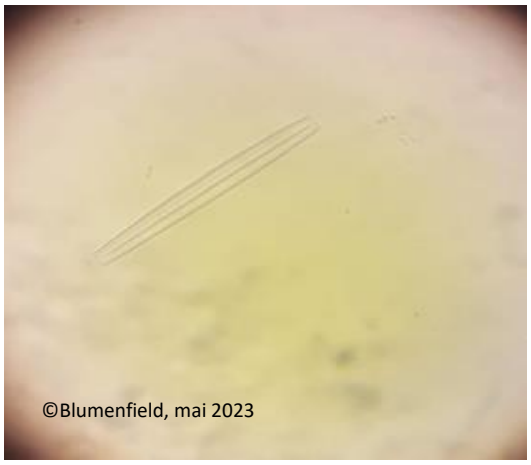


Figure 4.72 *Pinnularia* sp. (original photo)

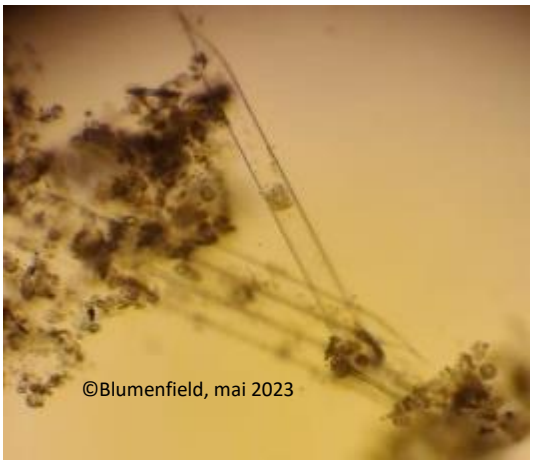


Figure 4.73 *Rhizosolenia* sp (original photo)

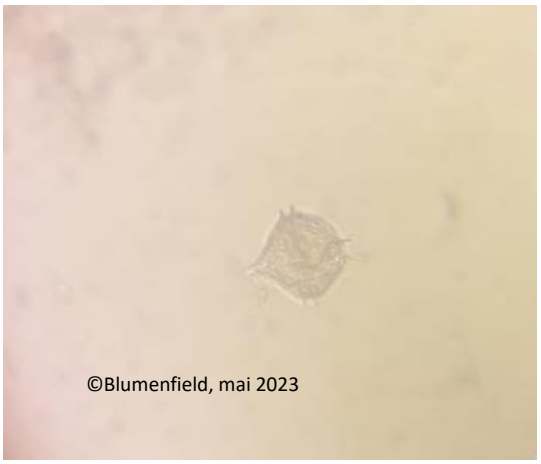
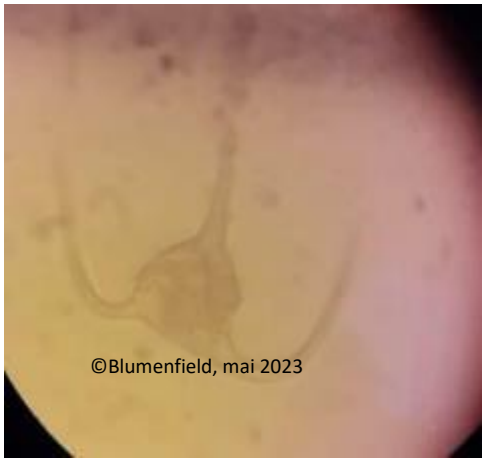


Figure 4.74 *Peridinium granii (*original photo)

a



b

Figure 4.75 a și b *Ceratium tripos (*original photo)

Quantitative aspects of phytoplankton

- Average density and biomass of diatoms in the analysed samples

As a primary trophic level element, diatoms play an essential role and are particularly important in aquatic ecosystems. The presence and quantity of diatoms largely influence the production of direct consumers and, therefore, the productivity of each aquatic basin

Rhizosolenia is a genus with approximately 35 species, featuring conical valves, usually asymmetric, with a sharp or massive apical extension, sometimes ending in a hair. Cells can live isolated or form more or less compact chains. Most of the 35 species of this genus are marine planktonic, and five species have been identified in the Black Sea, among which Rhizosolenia calcar-avis is a constant presence in phytoplankton, showing quantitative variations from year to year and can undergo massive developments during warm periods.

Rhizosolenia calcar-avis has been identified in all analysed samples, which can be explained by it being one of the most abundant species in the Black Sea's plankton. It is often mentioned in specialized literature as having exceptionally high densities, especially during warm seasons. Due to its elongated and sharp cell shape, particularly during significant developments under certain

environmental conditions, its colonies can form dense mats that may negatively affect zooplankton consumers, leading to the clogging of their gills.

Its total density recorded in all analysed samples was the highest compared to other phytoplankton species, reaching 526,663 cells/l, with a maximum of 140,000 cells/l in sample T6.5, and a minimum of 6,666 cells/l in sample T4.1. Correspondingly, its recorded biomass was also the highest among all identified species, with a total value of 25,866.41 µg.

Other diatoms that recorded densities over 100,000 cells/l were *Pinnularia* (261,998 cells/l, present in nine out of the twelve analysed samples); *Cymbella (*139,998 cells/l, present in six samples); and *Licmophora* (103,332 cells/l). Regarding biomass, after *Rhizosolenia, Pinnularia* had a biomass of 4,176 µg/l, *Dityllum brighwellii* had 2,333.25 µg/l, and *Achnates longipes* had 1,343.2 µg/l, with all other diatom species having density values below 1,000 µg/l.

The lowest density (3,333 cells/l) and biomass (0.67 µg/l) were recorded for *Nitzschia delicatissima*, identified in only one sample (P8 from 3rd May 2023). Blooms with this species are generally reported during colder periods of the year, in spring and autumn.

- Density and average biomass of dinoflagellates in the analysed samples

Three species of dinoflagellates were identified in the analysed samples.

Peridinium was identified in nine out of the twelve analysed samples, with a density ranging from 23,333 cells/l (maximum, in sample T6.5) to 3,333 cells/l (minimum, in samples T3.5, T4.1, T7.4, T1.1). The total biomass recorded in these nine samples was 1,173.23 µg/l.

The other identified dinoflagellate species belong to the *Ceratium genus*, easily recognizable due to their characteristic appearance. *Ceratium tripos* has horns as appendages, two on the hyposphere and one on the episphere, while *Ceratium fusus* has one appendage on the episphere and two on the hyposphere, one of which is very small and looks like a small protrusion, while the other is long.

Certium tripos was present in five samples, with a maximum density and biomass of 10,000 cells/l and 1,340 µg/l (sample PM1 from 13th May 2023), respectively. *Ceratium fusus* was present in only two samples (T5.1 and T6.5), both with a density of 6,666 cells/l and biomass of 1,026.56 µg/l.

- Density and average biomass of chrysophytes in the analysed samples

Only one species belonging to the group of golden algae (Chrysophyta) was identified in the analysed samples.

The Chrysophyta phylum comprises yellow-golden algae, mostly unicellular, monadoid, solitary, or colonial, commonly found in cold and temperate oceans and seas.

The genus *Dictyocha* has only three current species, all widely spread in cold and temperate oceans and seas.

Dictyocha speculum, identified in only one sample (T7 from 2nd May 2023), is part of the marine silicoflagellate group, characterized by an internal siliceous skeleton. They are stenohaline algae, very small in size, classified as nanoplankton.

Dictyocha speculum has a characteristic appearance due to the siliceous skeleton, forming a basal ring composed of four to eight elements that create a polygon with spikes at the corners. This structure is called an apical apparatus, which can be simple or complex.

The density of this species was 333 ex/l and the average biomass was 7.66 µg/l.

Table 4.82 The density of phytoplankton species in the analysed samples (individuals/l)

No.	Taxon	Sample PM1 FPK 2.05.2023	Sample P7 FPK 2.05.2023	Sample P8 FPK 3.05.2023	P21 FPK 3.05.2023	Sample PM1 FPK 3.05.2023	Sample T 5.1 FPK 10.05.2023	Sample T 3.1 FPK 10.05.2023	Sample T 4.1 FPK 10.05.2023	Sample T 3.5 FPK 10.05.2023	Sample T 6.5 FPK 10.05.2023	Sample T 7.4 FPK 11.05.2023	Sample T 1.1 FPK 11.05.2023
	Bacillariophyta Link (Diatomeae)												
1.	*Achnantes longipes*					3 333				20 000	20 000		
2.	*Chaetoceros compressus*			3 333			3 333	3 333		6 666	20 000	6 666	20 000
3.	*Cocconeis pediculus*	6 666	16 666									3 333	
4	*Coscinodiscus*						6 666			3 333		6 666	13 333
5.	*Cymbella* sp.	6 666	40 000	3 333			60 000	23 333	6 666				
6.	*Diatoma* sp.	3 333	40 000										
7.	*Diploneis* sp.	3 333	6 666										
8.	*Dityllum brighwellii*			3 333			6 666			3 333	46 666		6 666
9.	*Licmophora* sp.	36 666				43 333						23 333	
10.	*Melosira moniliformis*					6 666					10 000	6 666	3 333
11.	*Navicula* sp.	3 333	6 666				10 000	6 666					
12.	*Nitzschia* sp.			3 333									
13.	*Pinnularia* sp.	130 000	56 666	6 666		13 333	56 666	70 000	40 000	3 333			3 333
14.	*Rhizosolenia*	13 333	20 000	46 666	40 000	36 666	23 333	10 000	6 666	100 000	140 000	76 666	13 333
	Dinophyta Link (Peridineae)												
1.	*Peridinium granii*	10 000		13 333	6 666	6 666			3 333	3 333	23 333	3 333	3 333
2.	*Ceratium fusus*						6 666				6 666		
3.	*Ceratium tripos*				3 333	10 000			3 333		6 666	3 333	
	Chrysophya Link												
1.	*Dictyoha speculum*		3 333										

Table 4.83 The average biomass of phytoplankton species in the analysed samples (µg/l)

No.	Taxon	Sample PM1 FPK 2.05.2023	Sample P7 FPK 2.05.2023	Sample P8 FPK 3.05.2023	P21 FPK 3.05.2023	SamplePM1 FPK 3.05.2023	Sample T 5.1 FPK 10.05.2023	Sample T 3.1 FPK 10.05.2023	Sample T 4.1 FPK 10.05.2023	Sample T 3.5 FPK 10.05.2023	Sample T 6.5 FPK 10.05.2023	Sample T 7.4 FPK 11.05.2023	Sample T 1.1 FPK 11.05.2023
	Bacillariophyta Link (Diatomeae)												
1.	*Achnantes longipes*					103,32				620	620		
2.	*Chaetoceros compressus*			12,35			12,36	12,36		24,73	74,2	24,73	74,2
3.	*Cocconeis pediculus*	23,99	59,99									11,99	
4	*Coscinodiscus*						7,33			3,66		7,33	14,66
5.	*Cymbella* sp.	2,48	14,88	1,24			22,32	8,68	2,47				

No.	Taxon	Sample PM1 FPK 2.05.2023	Sample P7 FPK 2.05.2023	Sample P8 FPK 3.05.2023	P21 FPK 3.05.2023	SamplePM1 FPK 3.05.2023	Sample T 5.1 FPK 10.05.2023	Sample T 3.1 FPK 10.05.2023	Sample T 4.1 FPK 10.05.2023	Sample T 3.5 FPK 10.05.2023	Sample T 6.5 FPK 10.05.2023	Sample T 7.4 FPK 11.05.2023	Sample T 1.1 FPK 11.05.2023
6.	*Diatoma* sp.	9,71	116,52										
7.	*Diploneis* sp.	5,33	10,66										
8.	*Dityllum brighwellii*			116,65			233,31			116,65	1633,33		233,31
9.	*Licmophora* sp.	16,46				19,45						10,47	
10.	*Melosira moniliformis*					159,98					240	159,98	79,99
11.	*Navicula* sp.	1,24	2,47				3,72	2,47					
12.	*Nitzschia* sp.			0,67									
13.	*Pinnularia* sp.	1430	623,3	73,32		143	623,33	770	440	36,66			36 66
14.	*Rhizosolenia*	5333,3	800	1866,64	1 600	1466,6	933,3	400	266,64	4000	5 600	3 066,6	533,33
	Dinophyta Link (Peridineae)												
1.	*Peridinium granii*	160		213,32	106,65	106,65			53,32	53,32	373,33	53,32	53,32
2.	*Ceratium fusus*						513,28				513,28		
3.	*Ceratium tripos*				446,62	1 340			446,62		893,24	446,622	
	Chrysophya												
1.	*Dictyoha speculum*		7,66										

In conclusion, according to the study results, Diatoms (a division of Bacillariophyta) are dominant both in terms of species number and individual count. With over 200 genera, they form one of the most important groups of microalgae. Marine phytoplankton is predominantly composed of centric diatoms with radial symmetry (class Centrobacillariophyceae).

As primary producers, diatoms play an essential role in nature, generating approximately 20% of the oxygen produced on the entire planet. Under favorable conditions, with adequate nutrients and sunlight, a population of live diatoms can double approximately every 24 hours through binary cell division, and their lifespan is generally around six days.

In the pelagic zone, the qualitative and quantitative structure of diatom populations can undergo changes over time. Sudden changes can occur due to rapid shifts in hydro-meteorological conditions, leading to significant modifications in species composition, quantity, and distribution in both vertical and horizontal planes. Strong waves also play a vital role, and unfavorable hydro-meteorological conditions can cause massive reductions in the quantity and specific diversity of diatoms, sometimes within days or even hours.

The microflora represented by diatoms is continually transported by moving water masses, leading to the formation of areas with varying levels of phytoplankton abundance.

Regular variations are related to periodic changes in water temperature, light availability, and nutrient levels. Many diatom species experience significant development during colder periods of the year, occasionally leading to bloom events. Dinoflagellates also constitute an important component of marine phytoplankton. They are easily recognizable due to their characteristic appearance, especially those with a cellulose covering called theca, consisting of cellulose plates,

the number, and arrangement of which serve as important taxonomic criteria. Common genera of dinoflagellates found in marine phytoplankton include *Prorocentrum, Peridinium, Ceratium, and Noctiluca.*

Dinoflagellates are significant in aquatic ecosystems both as primary producers and because, under certain conditions, their excessive growth can lead to harmful algal blooms, depleting resources and nutrients in the surrounding environment and reducing dissolved oxygen in the water, negatively affecting other organisms in the aquatic basin. Some species of the genus Ceratium also contribute to these phenomena.

The **INCDM Grigore Antipa** report on Marine Flora – Phytoplankton Technical Summary (2019) presents the findings based on samples collected during monitoring expeditions in the 2015-2016 period in the Neptun Deep project area. The report provides a list of 150 phytoplankton species identified in the region. After reviewing relevant scientific literature, the report highlights 27 dominant species in the phytoplankton community of the project area.

Overall, dinoflagellates exhibited the highest diversity in the project area. Many dinoflagellate species are cosmopolitan, adapted to a variety of pelagic and benthic habitats, including freshwater and hypersaline waters. Some species produce neurotoxins. Although dinoflagellates were diverse in the project area, their recorded densities were low and did not negatively affect the marine ecosystem.

The report aimed to identify and describe key phytoplankton species expected to be present in the project area. The zone was divided into:

- coastal waters (between 5 and 20 meters deep),
- marine waters (between 20 and 100 meters deep), and
- offshore waters (from 100 to 1000 meters deep).

The analysis of phytoplankton samples from the 2015-2016 period identified a total of 150 species in the project area. The highest diversity was found in offshore waters (136 species), while the lowest was in coastal waters (40 species). Marine waters contained 84 species.

Among the phytoplankton groups, dinoflagellates were dominant, representing 44-47.6% of the total number of identified species in the project area. Diatoms ranked second in number, accounting for 25-28.6% of the total species found. Chlorophytes ranked third, comprising a maximum of 10.6% of the species in offshore waters. Other groups such as cyanobacteria, chrysophytes, cryptophytes, and euglenophytes showed lower diversity, representing between one and seven percent of species, with a maximum of 10-15 species in offshore waters.

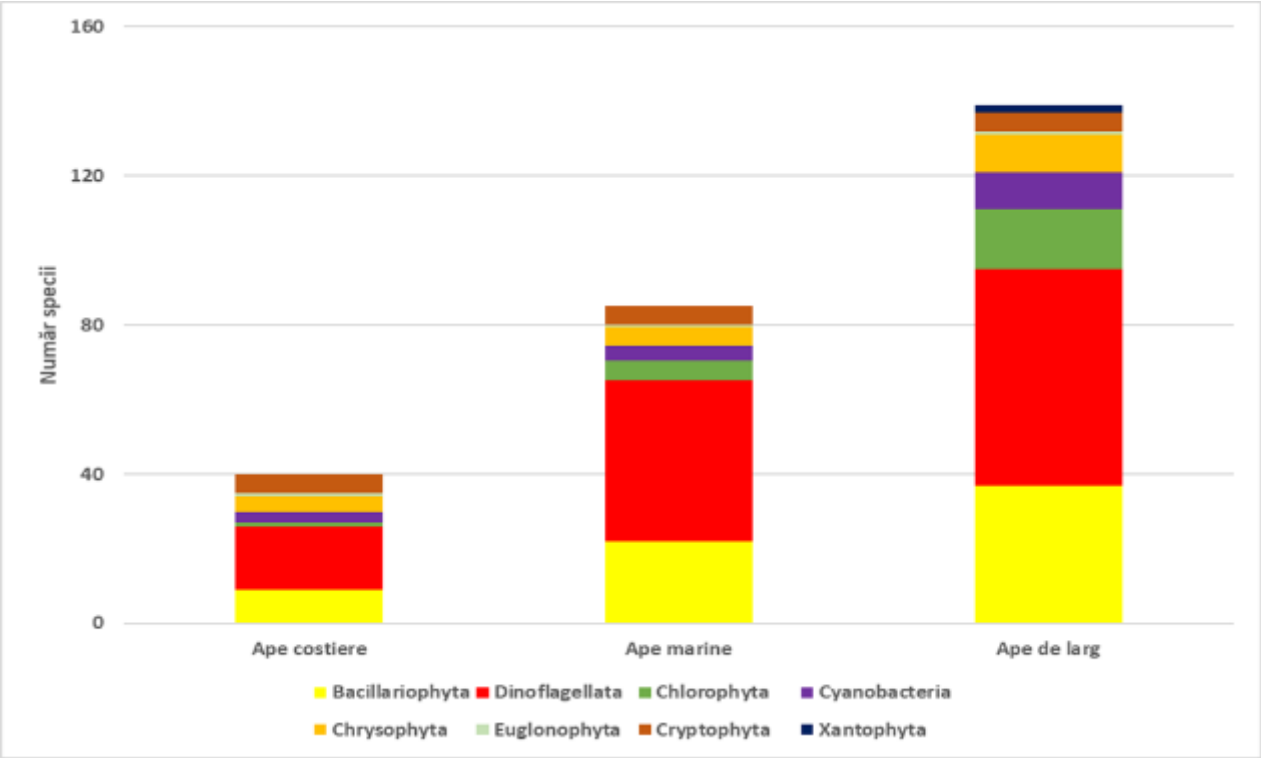


Figure 4.76 Taxonomic composition of phytoplankton communities during the period 2015-2016 in the project area

(source: Marine Flora - Phytoplankton Technical Summary Report - Neptun Deep Project, Grigore Antipa National Museum of Natural History, 2019)

Table 4.84 List of phytoplankton species identified during the period 2015-2016 in the project area (according to Marine Flora - Phytoplankton Technical Summary Report, Grigore Antipa National Museum of Natural History, 2019)

Class	Order	Family	Scientific name
Bacillariophyceae	Achnanthales	Achnanthaceae	*Achnanthes brevipes*
			Achnanthes longipes
	Aulacoseirales	Aulacoseiraceae	*Aulacoseira granulata*
	Bacillariales	Bacillariaceae	*Nitzschia acicularis*
			Nitzschia longissima
			Nitzschia pungens var. atlantica
			Nitzschia tenuirostris
			Pseudo-nitzschia delicatissima
			Pyxidicula compressa var. compressa
	Chaetocerotanae incertae sedis	Chaetocerotaceae	*Attheya septentrionalis*
			Chaetoceros sp.
			Chaetoceros affinis
			Chaetoceros compressus
			Chaetoceros curvisetus
			Chaetoceros danicus
			Chaetoceros muelleri
			Chaetoceros peruvianus
			Chaetoceros similis f. solitarus
			Chaetoceros simplex
			Chaetoceros socialis
			Chaetoceros subtilis
			Chaetoceros wighamii
	Coscinodiscales	Coscinodiscaceae	*Coscinodiscus radiatus*

Class	Order	Family	Scientific name
	Fragilariales	Fragilariaceae	*Diatoma tenuis*
			Synedra acus
			Synedra nitzschioides f. nitzschioides
	Hemiaulales	Hemiaulaceae	*Cerataulina bergonii*
	Leptocylindrales	Leptocylindraceae	*Leptocylindrus danicus*
			Leptocylindrus minimus
	Lithodesmiales	Lithodesmiaceae	*Ditylum brightwellii*
	Naviculales	Naviculaceae	*Navicula*
		Pleurosigmataceae	*Pleurosigma elongatum*
	Rhizosoleniales	Rhizosoleniaceae	*Proboscia alata*
			Pseudosolenia calcar-avis
	Thalassiosirales	Skeletonemaceae	*Skeletonema costatum*
		Stephanodiscaceae	*Cyclotella caspia*
			Cyclotella meneghiniana
		Thalassiosiraceae	*Thalassiosira parva*
			Thalassiosira gravida
			Thalassiosira nordenskioldii
			Thalassiosira parva
			Thalassiosira rotula
			Thalassiosira subsalina
			Gaillonella sulcata
Chlorodendrophyceae	Chlorodendrales	Halosphaeraceae	*Pachysphaera* sp.
Chlorophyceae	Sphaeropleales	Characiaceae	*Schroederia* sp.
	Chlamydomonadales	Chlamydomonadaceae	*Carteria* sp.
			Chlamydomonas sp.
	Sphaeropleales	Hydrodictyaceae	*Tetraëdron caudatum*
			Tetraëdron trigonum
		Scenedesmaceae	*Tetradesmus lagerheimii*
			Desmodesmus communis
		Selenastraceae	*Monoraphidium arcuatum*
			Monoraphidium contortum
			Monoraphidium griffithii
			Monoraphidium irregulare
	Chlamydomonadales	Treubariaceae	*Treubaria triappendiculata*
	Chromulinales	Dinobryaceae	*Dinobryon balticum*
			Dinobryon balticum
Conjugatophyceae	Desmidiales	Desmidiaceae	*Cosmarium* sp.
Cryptophyceae	Pyrenomonadales	Chroomonadaceae	*Chroomonas acuta*
			Chroomonas caudata
	Cryptomonadales	Cryptomonadaceae	*Cryptomonas*
		Hilleaceae	*Hillea fusiformis*
			Flagelate de talie mică
Cyanophyceae	Chroococcales	Chroococcaceae	*Chroococcus minutus*
	Synechococcales	Leptolyngbyaceae	*Planktolyngbya circumcreta*
		Merismopediaceae	*Merismopedia minima*
	Chroococcales	Microcystaceae	*Microcystis aeruginosa*
	Nostocales	Nostocaceae	*Anabaena* sp.
			Aphanizomenon flosaquae
	Oscillatoriales	Oscillatoriaceae	*Oscillatoria* sp.
			Phormidium hormoides
	Synechococcales	Pseudanabaenaceae	*Pseudanabaena limnetica*
			Pseudanabaena limnetica
	Spirulinales	Spirulinaceae	*Spirulina* sp.
Dictyochophyceae	Dictyochales	Dictyochaceae	*Dictyocha speculum*
			Octactis octonaria
	Pedinellales	Pedinellaceae	*Apedinella radians*
Dinophyceae	Amphidiniales	Amphidiniaceae	*Amphidinium crassum*
			Amphidinium extensum

Class	Order	Family	Scientific name
			Amphidinium sp.
	Gonyaulacales	Ceratiaceae	*Ceratium inflatum*
			Tripos furca
			Tripos fusus
			Tripos muelleri
		Cladopyxidaceae	*Peridiniella danica*
	Dinophysiales	Dinophysiaceae	*Dinophysis acuminata*
			Dinophysis caudata
			Dinophysis sacculus
	Gonyaulacales	Gonyaulacaceae	*Gonyaulax ceratocoroides*
			Lingulodinium polyedra
			Protoceratium reticulatum
	Gymnodiniales	Gymnodiniaceae	*Akashiwo sanguinea*
			Akashiwo sanguinea
			Gymnodinium agiliforme
			Gymnodinium najadeum
			Gymnodinium simplex
			Gymnodinium sp.
			Gymnodinium sp. (20-40 microns)
			Gymnodinium sp. (5-20 microns)
			Gymnodinium wulffii
			Gyrodinium helveticum
			Gyrodinium fusiforme
			Gyrodinium lachryma
			Gyrodinium pingue
			Margalefidinium citron
			Torodinium robustum
	Peridiniales	Heterocapsaceae	*Heterocapsa rotundata*
			Heterocapsa triquetra
		Kryptoperidiniaceae	*Durinskia agilis*
		Lessardiaceae	*Lessardia elongata*
	Gonyaulacales	Ostreopsidaceae	*Alexandrium minutum*
			Alexandrium
	Dinophysiales	Oxyphysaceae	*Phalacroma rotundatum*
	Peridiniales	Peridiniaceae	*Glenodinium paululum*
			Palatinus apiculatus
			Peridinium quadridentatum
			Scrippsiella trochoidea
	Gymnodiniales	Polykrikaceae	*Polykrikos schwartzii*
		Ptychodiscaceae	*Herdmania litoralis*
	Prorocentrales	Prorocentraceae	*Mesoporos perforatus*
			Prorocentrum micans
			Prorocentrum cordatum
			Prorocentrum scutellum
	Peridiniales	Protoperidiniaceae	*Diplopsalis lenticula*
			Oblea rotunda
			Peridinium cysts
			*Peridinium (*20-40 µm)
			*Peridinium (*5-20 µm)
			Preperidinium meunieri
			Protoperidinium bipes
			Protoperidinium brevipes
			Protoperidinium brevipes
			Protoperidinium depressum
			Protoperidinium divergens
			Protoperidinium granii
			Protoperidinium mite
			Protoperidinium solidicorne

Class	Order	Family	Scientific name
			Protoperidinium steinii
Ebriophyceae	Ebriales	Ebriaceae	*Ebria tripartita*
Euglenoidea	Eutreptiida	Eutreptiaceae	*Eutreptia lanowii*
Prasinophyceae	Halosphaerales	Pterospermataceae	*Pterosperma cristatum*
Prymnesiophyceae	Coccolithales	Calyptrosphaeraceae	*Calyptrosphaera oblonga*
	Isochrysidales	Noelaerhabdaceae	*Emiliania huxleyi*
	Syracosphaerales	Rhabdosphaeraceae	*Acanthoica quattrospina*
Trebouxiophyceae	Chlorellales	Chlorellaceae	*Dictyosphaerium ehrenbergianum*
			Micractinium pusillum
	Trebouxiophyceae incertae sedis	Trebouxiophyceae incertae sedis	*Crucigenia fenestrata*

Zooplankton

In the framework of the monitoring study of marine habitats and planktonic and benthic communities in the influence zone of the Neptun Deep project conducted by Blumenfield® experts, ten zooplankton samples were collected from the neritic pelagic waters of the Black Sea, within the influence zone of the Neptun Deep project - microtunnel outlet section + pipeline route and interpreted based on monitoring sheets.

For each of the ten samples, densities and biomasses were calculated and reported per cubic meter. Following the qualitative and quantitative analysis of the zooplankton, individuals belonging to 6 species corresponding to holoplankton and 9 categories of meroplanktonic forms were identified. The meroplanktonic forms include different larval stages of scyphozoan jellyfish, polychaetes, bivalves, cirripede crustaceans, and copepods (Table 4.85).

Table 4.85 The qualitative structure of zooplankton in May 2023, from the neritic pelagic waters of the Black Sea, within the Neptun Deep project area.

No.	Supraspecific	Specific
Holoplankton		
1.	Cystoflagellata (Dinoflagellata)	*Noctiluca miliaris (scintilans)*
2.	Coelenterata, Scyphozoa	*Aurelia aurita*
3.	Rotifera	*Asplanchna herricki*
4.	Crustacea, Cladocera	*Pleopis polyphemoides*
5.	Copepoda, Calanoida	*Acartia clausi*
6.	Copepoda, Calanoida	*Calanus helgolandicus*
Meroplankton		
1.	Coelenterata, Scyphozoa	Efirula de *Aurelia aurita*
2.	Polychaeta	Larve- trochophora
3.	Polychaeta	Larve -nectochaeta
4.	Bivalvia	Larve Veligere
5.	Cirripedia	Larve nauplius de *Balanus*
6.	Cirripedia	Larve metanauplius de *Balanus*
7.	Copepoda	Nauplius – *Calanus helgolandicus, Acartia clausi*
8.	Copepoda	Copepodiţi
9.	Decapoda	Larve nauplius/ zoea

The holoplanktonic species *Noctiluca miliaris* (formerly known as *Noctiluca scintillans), Asplanchna herricki*, *Pleopis polyphemoides*, and *Acartia clausi* showed a high frequency of occurrence, specifically 100%, in the

analysed samples. This indicates that these species are eurytopic or euconstant in the neritic waters of the respective zone.

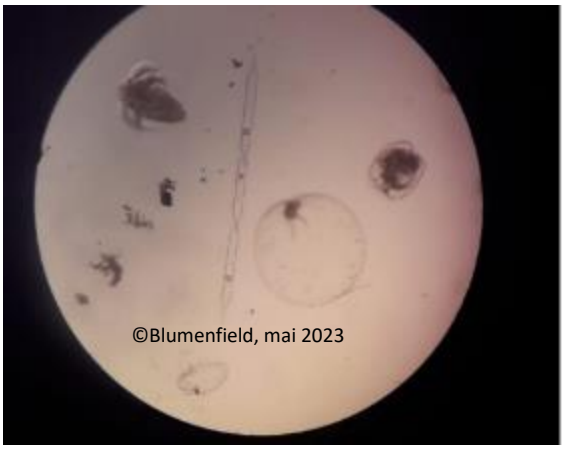


Figure 4.77 Microscopic image of plankton: Noctiluca scintillans, Asplanchna kerrcki, copepod nauplius, and the alga Rhizosolenia sp.

Figure 4.78 Acartia clausi

The jellyfish *Aurelia* aurita was present in 60% of the samples, while the copepod *Calanus helgolandicus* was present in 40% of them.

Regarding the larval forms, some variations were observed in their presence between different samples/stations. Ephyrae of *Aurelia aurita*, *Balanus* metanauplii, and copepodid stages have a frequency of occurrence of 70% in the samples, while decapod nauplii have a frequency of 40%, and bivalve veligers have a frequency of 20%. The rest of the meroplanktonic forms are consistently present in all analysed samples.

Additionally, the fact that individuals of all recorded zooplankton forms, both adult and larval, are equipped with locomotor appendages ensures good mobility, allowing them to move over distances of tens or hundreds of meters.

As for the proportion between adult and larval stages, holoplankton dominates in abundance, accounting for 91%, while meroplankton is present in a smaller quantity, at 9%.

Regarding the biomass of the two categories - holoplankton and meroplankton, holoplankton records higher values, mainly because certain species, especially copepods, have higher specific weights than larval forms. This data is also correlated with the density values, which were significantly higher for adult zooplankton compared to larval stages.

The analysis of zooplankton populations by species and taxonomic groups reveals a highly varied proportion of adults, with the rotifer *Asplanchna herricki* dominating quantitatively at 63% and the ciliate *Noctiluca scintillans* representing 16% of the total recorded. The populations of *Acartia clausi* reach 9%, and the cladoceran *Pleopis polyphemoides* represents 2%.

The meroplanktonic forms highlight very low values, with a contribution of 3% from *Balanus nauplii*, the same for copepod nauplii, 1% for metanauplii, and 1% for polychaete larvae, in relation to the total analysed zooplankton.The analysis of the total zooplankton density in the marine waters studied for this research shows a quantitative dominance of the rotifer *Asplanchna herricki* Throughout the entire investigated zone.

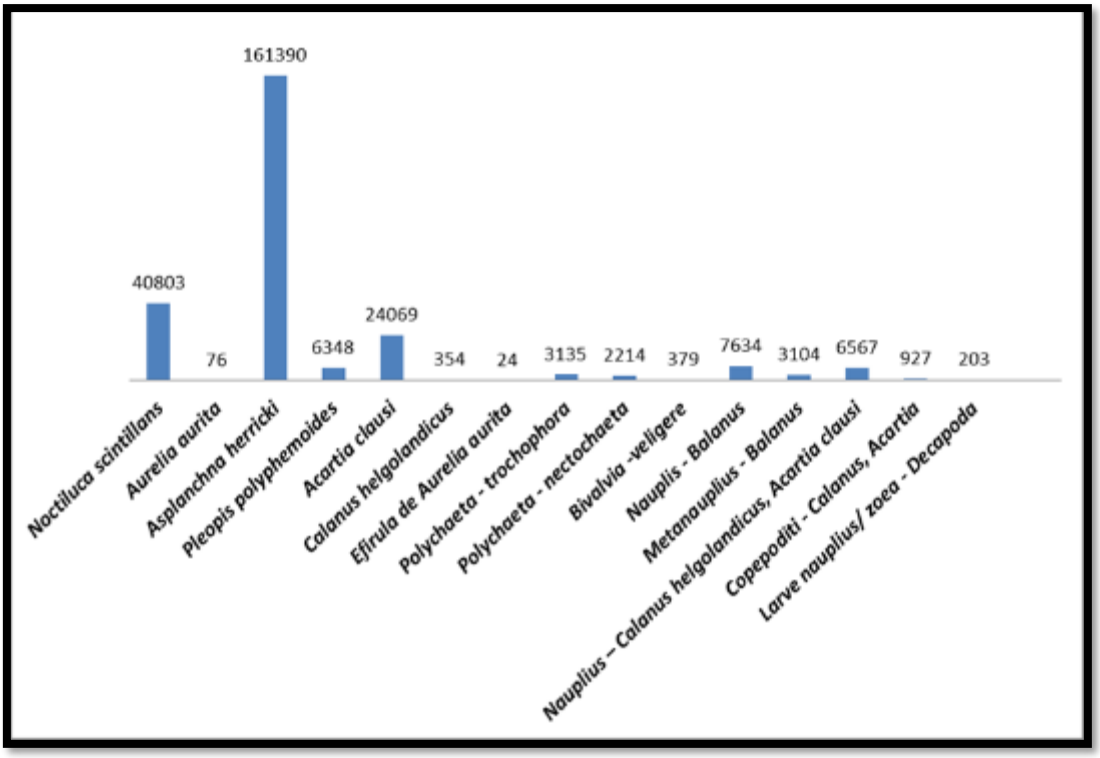


Figure 4.79 The variation in density (ind./m³) of zooplankton populations and larval forms in May 2023 - in the marine waters of the project area

The rotifer *Asplanchna herricki* reaches very high-density values, on the order of hundreds of thousands; similar situations have been recorded on other occasions as well. For the ciliate *Noctiluca* and the copepod *Acartia clausi*, the combined values of individuals reach tens of thousands in the studied area.

Among the zooplankton elements, both *Noctiluca scintillans* and the scyphozoan *Aurelia aurita* (as well as its ephyrae) fall into the category of non-trophic, where their contribution to the matter flux in the food chains is almost negligible.

It should be noted that biomass estimates for scyphozoans, specifically the jellyfish *Aurelia aurita*, were not considered, either for adults (which varied in size) or for ephyra larvae (which also varied in size). The jellyfish does not play a trophic role, and its specific weight varies according to individual size.

The rest of the individuals, from species such as rotifers, crustaceans - cirripedes, cladocerans, copepods, as well as decapod larvae, can be consumers of the first or second order, which are, in turn, consumed either by larger carnivorous zooplankton organisms or by pelagic zooplanktivorous fish. Due to their sometimes-high abundance, they constitute a trophic resource worth considering in the respective waters.

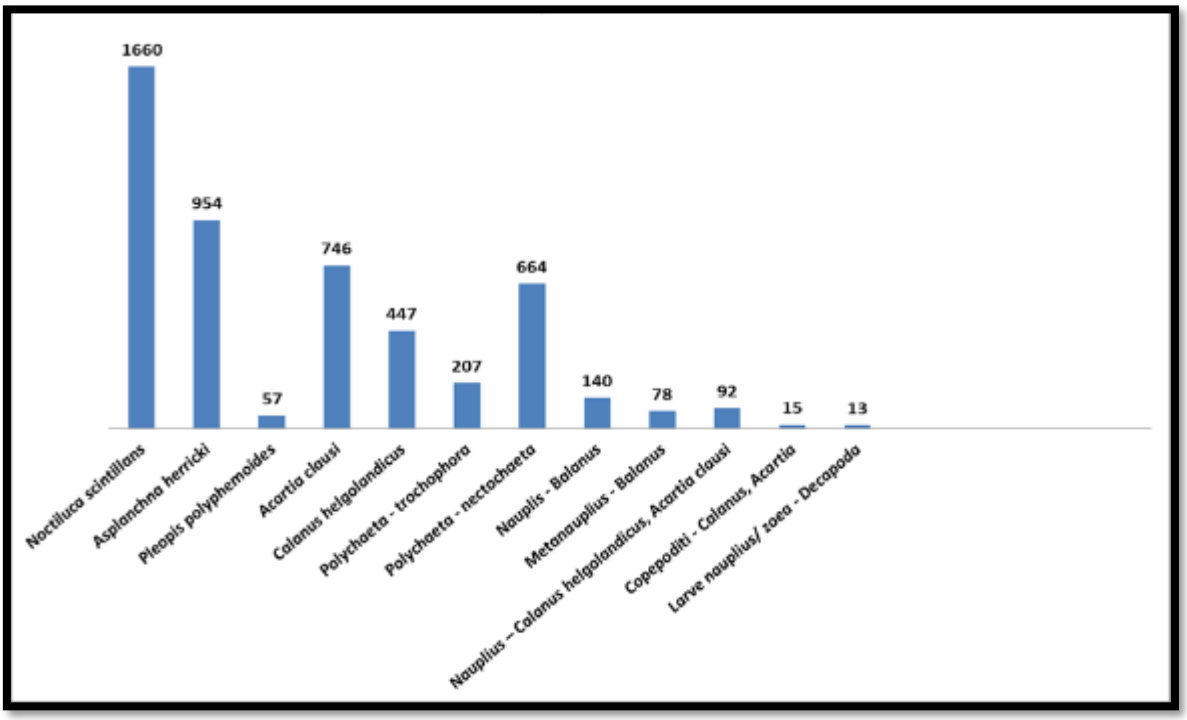


Figure 4.80 The variation in biomass (mg/m^3) of zooplankton populations and larval forms in May 2023 - in the marine waters of the project area.

The analysis of biomass (mg/m^3) for each zooplankton species or meroplanktonic category shows that the highest values are obtained by adult populations of Noctiluca scintillans and *Asplanchna herricki (*correlated here with the very high density of the rotifer). *Acartia clausi* and *Calanus helgolandicus* also have higher specific weights compared to other microscopic pelagic crustaceans, thus reaching combined biomasses on the order of hundreds of milligrams per cubic meter.

Even some larval stages - trochophores and nectochaetes of polychaetes, as well as *Balanus* naupliar stages, reach values on the order of hundreds of milligrams in the studied waters.

The report conducted by the **Grigore Antipa National Museum of Natural History** (Black Sea Marine Fauna - Zooplankton Summary Report, 2019) provides an analysis of zooplankton species present in the project area and an inventory of species.

Zooplankton comprises small and microscopic animals, representatives of almost all major taxonomic groups, especially invertebrates, which passively float in the water column. Zooplankton represents the main link in the marine food web, connecting primary producers with higher-level

consumers. Zooplankton plays an important role in controlling phytoplankton while serving as food for a variety of larger pelagic organisms, including fish.

In general, there is uniformity in the structure of the zooplankton community, with seasonal changes in species associations. The taxonomic composition of zooplankton is mainly composed of copepods, cladocerans, meroplanktonic larvae of benthic organisms, *Noctiluca scintillans*, an unpigmented dinoflagellate alga, and gelatinous organisms.

Based on the collected data, 31 species have been identified in the project area.

Table 4.86 The list of zooplankton species identified in the project area

No.	Species
1	*Noctiluca scintillans* (Macart.) Kof. & Sw.
2	Polychaeta (larvae)
3	*Bosmina (Bosmina) longirostris (O. F. Müller, 1785)*
4	*Chydorus sphaericus* (O.F. Müller, 1785)
5	*Daphnia longispina* O.F. Müller, 1785
6	*Evadne spinifera* O.F. Müller, 1867
7	*Penilia avirostris* Dana, 1849
8	*Pleopis polyphemoides* (Leucart, 1859)
9	*Pseudevadne tergestina* (Claus, 1877)
10	*Acartia (Acartiura) clausi* Giesbrecht, 1889
11	*Anomalocera patersoni* Templeton, 1837
12	*Calanus euxinus* Hulsemann, 1991
13	*Centropages ponticus* Karavaev, 1895
14	*Paracalanus parvus* (Claus, 1863)
15	*Pontella mediterranea* (Claus, 1863)
16	*Pseudocalanus elongatus* (Boeck, 1872)
17	*Oithona similis* Claus, 1863
18	*Oithona davisae* Ferrari F.D. and Orsi, 1984
19	*Harpacticoida sp.*
20	Cirripedia (larvae: nauplia, cypris)
21	Decapoda (larvae: zoea, megalopa)
22	*Mesopodopsis slabberi* van Beneden,1861
23	Gastropoda (larvae)
24	Bivalvia (larvae)
25	*Parasagitta setosa* (Müller, 1847)
26	*Oikopleura (Vexillaria) dioica* Fol, 1872
27	*Aurelia aurita* (Linnaeus, 1758)
28	*Rhizostoma pulmo* (Macri, 1778)
29	*Beroe ovata* (Bruguière, 1789)
30	*Mnemiopsis leidyi* (A. Agassiz, 1865)
31	*Pleurobrachia pileus* (O. F. Müller, 1776)

Macrophytobenthos

Within the study of monitoring marine habitats in the Neptun Deep project area conducted by Blumenfield®, samples were collected for the qualitative determination of macrophyte species. Species identification was based on both macroscopic and microscopic characteristics (where applicable).

As a result of the observations, four species of macrophytic algae were identified, categorized into phyla as follows: three species of green algae (Chlorophyta) and one species of red algae (Rhodophyta).

The number of macrophytic algae species identified in the samples was four, distributed into phyla as follows:

Three species of green algae (Chlorophyta): Ulva lactuca, Ulva intestinalis (syn. Enteromorpha intestinalis), and Cladophora vagabunda.

One species from the red algae group (Rhodophyta): Ceramium virgatum (syn. Ceramium rubrum).

The report conducted by the Grigore Antipa National Museum of Natural History (Rare (Endangered) and Threatened Species - Marine/Coastal Flora Technical Report- 2019) identified and described the phytobenthic species within a radius of 10 km from the Project area, from a qualitative perspective, aiming to establish the dominant type of species in the study area (perennial or opportunistic species) and their sensitivity level to human activities.

Over the past decades, along the Romanian Black Sea coast, phytobenthic communities have experienced a significant decline due to the cumulative action of various natural (marine frosts during the winter of 1971-1972, powerful storms) and anthropogenic factors (hydro-technical constructions, etc.) (Vasiliu and Müller, 1973). Anthropogenic impacts can alter the state of an ecosystem and transform an area where opportunistic species such as *Ulva and Cladophora* dominate to the detriment of sensitive species like *Cystoseira and Phyllophora* (Litter and Litter, 1980). Submerged vegetation represents a major component of primary producers, forming the basis for life in the marine environment, driving the marine ecosystem. Considering these aspects, phytobenthic communities hold special ecological importance for the marine environment.

Macrophytes are attached organisms found in coastal biotopes, and the vast majority are adapted and resilient to anthropogenic impacts in the coastal zone. Some species have long life cycles (perennial), while others grow relatively rapidly (opportunistic species). Alongside opportunistic species, there are also dominant large species that form an indicator community for the quality of the marine environment, such as those belonging to the genera *Cystoseira, Zostera, and Phyllophora.*

The benthic flora in the project area is dominated by opportunistic macroalgal species with rapid growth, but historically, perennial species (macroalgae and marine phanerogams) were also present, which are now extinct. The closest presence of the *Cystoseira* species is at a distance of 17 km south of the project area*, Zostera* at 18 km south, and *Phyllophora* at 25 km north.

In the project area, the dominant macrophytic species are opportunistic macroalgae. The dominant species are green algae, especially the photophilous association of *Ulva - Cladophora*. The species identified in the project area in recent years are presented in the table below. The zones were characterized by the exclusive presence of macroalgal species with a rapid development cycle and high reproductive capacity.

Table 4.87 Macrophyte species identified in the Eforie Sud - Tuzla - Costinești area during the period 2015 - 2018.

Link	Macrophyte species	Eforie Sud	Tuzla	Costinești
Chlorophyta	*Cladophora albida*			*
	Cladophora sericea	*	*	
	Cladophora vagabunda	*	*	*
	Ulva intestinalis	*	*	*
	Ulva flexuosa	*		
	Ulva rigida	*	*	*
Rhodophyta	*Callithamnion corymbosum*		*	
	Ceramium diaphanum var. *elegans*	*	*	*
	Ceramium virgatum	*	*	*
	Polysiphonia denudata	*		

Benthic Communities and Marine Habitats

To update the data and information regarding benthic communities in the project area, a monitoring activity was carried out in 2023 (May-June) by Blumenfield®. Both qualitative and quantitative sampling methods were applied (from known surfaces) using dredges, direct collection devices by divers, cameras, and Remote Operated Vehicles (ROVs).

The approach to studying benthic zoocenoses in the project area was dictated, on one hand, by the purpose of this study and, on the other hand, by the structuring of zoocenoses based on bathymetry and the nature/type of substrate/sediments. Thus, the analysis within the study followed two types of approaches:

a) The perspective of monitoring the structure of communities from shallow to deep waters along three transects (established based on the pipeline route).
b) The perspective of organizing communities based on bathymetric and substrate structure criteria.

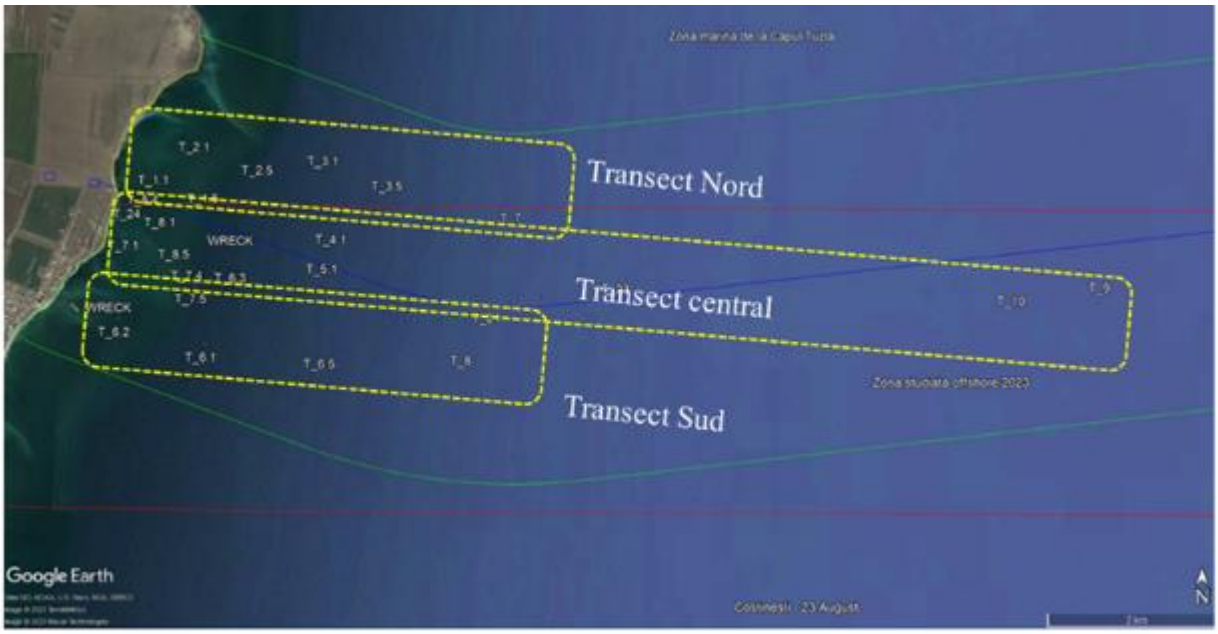


Figure 4.81 The approach to studying the benthic zoofauna along three transects (north, central, and south) - Blumenfield®, 2023.

Legend:
North Transect: 8 sampling locations, Central Transect: 16 sampling locations, South Transect: 6 sampling locations.

The study of species for benthic zoocenoses highlighted higher values for two out of the three transects, primarily explained by the relatively high similarity of substrate typology (Figure 4.82).

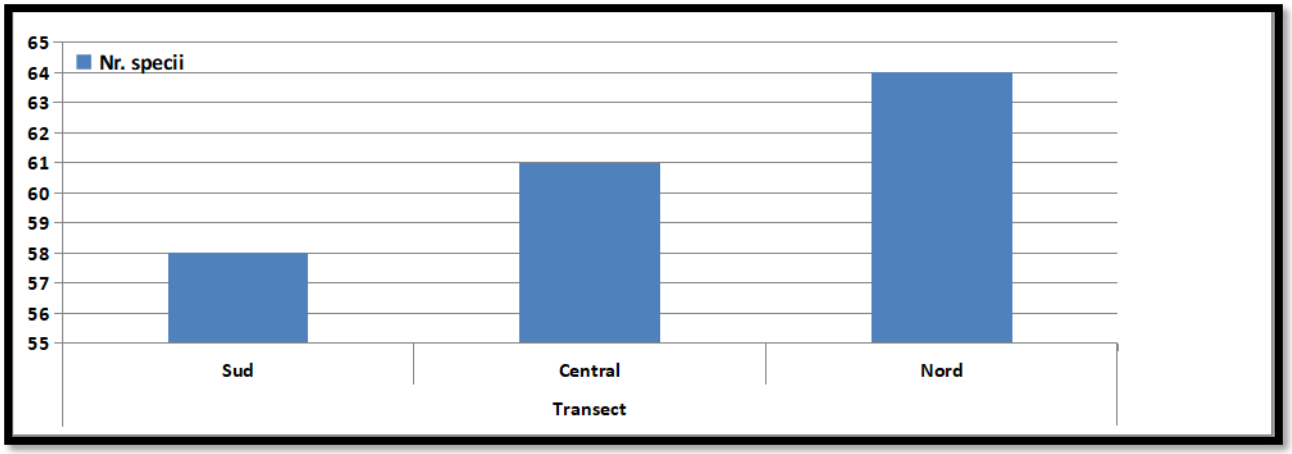
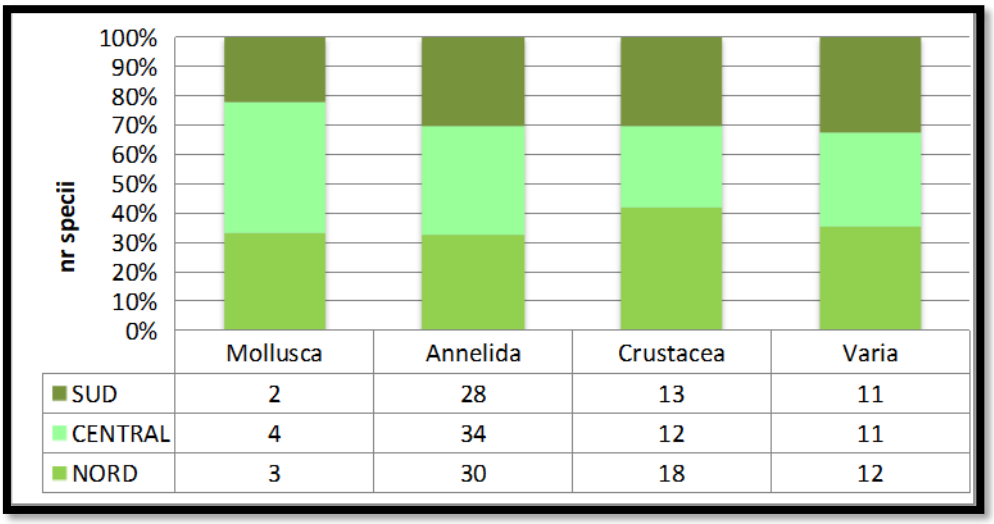


Figure 4.82 Distribution of zoofauna in the benthos of the three transects

A total of 86 specific taxa from 10 supraspecific categories (at the Phylum level) were identified, with dominant groups being Annelida, Arthropoda-Crustacea, and Mollusca.
A relatively constant presence in the samples from all three transects was observed for the following macrobenthic species: *Leucocephalonemertes aurantiaca (Rhynchocoela), Rapana venosa (Mollusca), Mysta picta, Harmothoe reticulata, Polynoe scolopendrina, Aricidea jeffreysii, Scolelepis squamata, Spio filicornis, Oligochaeta (Annelida), Apohyale perieri, Corophium volutator,* and species of *Gammaridae (Crustacea).* Other macrobenthic forms identified include*: Mytilus galloprovincialis, Anadara kagoshimensis (Mollusca), Alitta succinea, Namanereis pontica, Platynereis dumerilii, Perinereis cultrifera, Pterocirrus limbatus, Nephtys hombergii, Ophelia limacina, Euclymene collaris (Annelida-Polychaeta), Phoronis sp., Upogebia pusilla, Palemon elegans, Eriphia verrucosa, Pilumnus hirtellus, Clibanarius erythropus, Diogenes pugilator (Crustacea - Decapoda), Leptosynapta inhaerens, Amphiura stepanovi (Echinodermata),* and the chordate *Branchiostoma lanceolatum syn Amphioxus lanceolatus*.

The statistical analysis of the taxonomic structure of benthic zoocenoses conducted in the study is shown in the graph presented in Figure 4.83, and the taxonomic structure of the zoobenthic communities is displayed in the graph in Figure 4.84, below.

Figure 4.83 The taxonomic structure of the zoobenthic community at the level of the entire studied area'szoobenthic community



	Mollusca	Annelida	Crustacea	Varia
SUD	2	28	13	11
CENTRAL	4	34	12	11
NORD	3	30	18	12

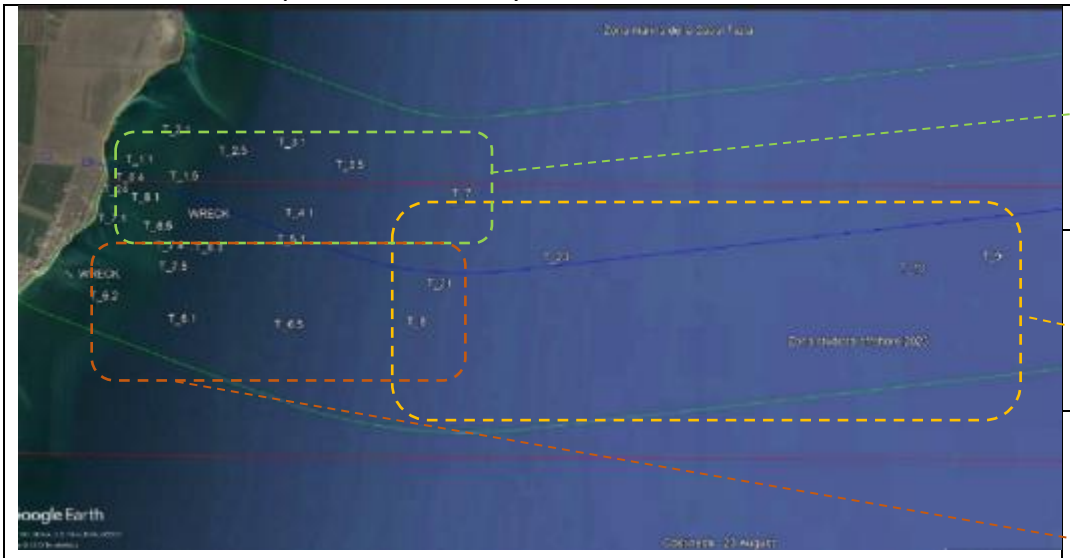
Figure 4.84 The taxonomic structure at the level of benthic zoocoenoses associated with each transect

The approach regarding the structuring of benthic zoocoenoses based on bathymetric and substrate configuration criteria is based on the study conducted within three perimeters (identified as morpho-functional units of the benthic system model in the study area):

- Two perimeters (North and South) limited to the shallow-depth zone (shallow infralittoral and partial transition zone towards deeper infralittoral with zoocoenoses of greater depth), and
- The perimeter covering the deeper infralittoral and the transition zone towards circalittoral, as follows:

- The perimeter in the northern and shallow-depth area: P1-7, which includes 11 sampling points;
- The perimeter in the southern and shallow-depth area: P5-21, which includes 9 sampling points;

- The perimeter in the offshore area, P7-26, which includes 11 sampling points; we mention that sampling points T_7, T_8, T_21, although included in the study of the northern and southern perimeters, were also included for study in this perimeter as they are locations in an ecotone zone of benthic coenoses, an area of great importance in terms of species richness and specific biodiversity.



Perimeter North P1-7 with sampling points T.1,2,3,4, 8.1-4, T.7, T24

Perimeter P7-26 with sampling points:T. 7, 8, 9, 10, 21, 23, A1, A2, A3

Perimeter P5-21 with sampling points:T. 5, 6-3. 7.1-5, 8.5, P 8, P21

Figure 4.85 The approach of studying benthic zoofauna based on the perimeters defining characteristic benthic habitats (according to sediment descriptions and associated zoofauna)

- The study of benthic zoocenoses in the Northern Perimeter P1-7

The Northern Perimeter includes data collected from 11 sampling locations, and out of the 82 specific and supraspecific taxa from the taxonomic list compiled for the entire area of interest, 67 taxa are found in this sector. It should be noted that some taxa are only present in this sector, such as the species of syllids (*Syllis gracilis, Annelida-Polychaeta*) and amphipod crustaceans: *Dexamine spinosa, Melita nitida, Nototropsis, the cumacean Pseudocuma longicorne,* as well as brachyuran and anomuran decapods, which is attributed to their biology, ecology, and especially their affinity for sedimented substrates (with a higher content of silty-sandy matrix).

Among the three species of conservation interest*, Eriphia verrucosa, Upogebia pusilla* (Crustacea-Decapoda), reported as threatened (EN), and *Branchiostoma lanceolatum* (Chordata), a rare species (R) (BSEC_BBSEA_ESMF_WB_RO, 2021 - Black Sea Basin Ecosystem Analysis, Environmental Status Monitoring, Fisheries and Water Quality- Regional Global Environment Facility Project), all have been identified in this perimeter.

The sector analysis of this perimeter highlights that the coastal zone is populated by approximately 79% of the total number of species identified in this area. This is due to the diversity of habitats and trophic offerings, as well as the pronounced affinity of populations for specific habitat types (determined by adaptations for movement and, most importantly, preferred food resources).

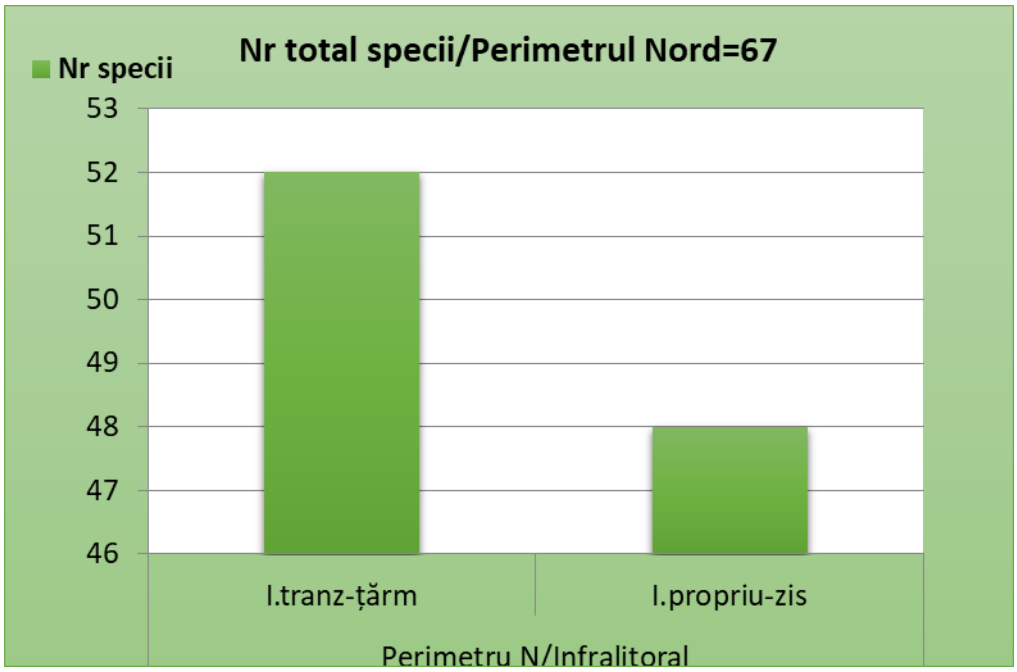


Figure 4.86 Taxonomic structure and distribution of benthic zoofauna in the shallow waters of the northern sector.

Out of all the recorded taxa in this area, over 50% are frequently encountered (without depth preferences), and only 11 of them have been found exclusively in the transition zone from the shore (macrobenthos: *Actinia equina* (Coelenterata), annelids *Namanereis pontica*, *Syllis gracilis*, amphipods *Dexamine spinosa*, Nototropis sp, *Melita nitida*, decapods *Diogenes pugilator*, *Clibanarius erythropus*, and *Branchiostoma lanceolatum (*Chordata)

- The study of benthic zoocoenoses in the Southern Perimeter T 5-8, P 8, 21

The southern perimeter includes 11 stations from which qualitative samples were collected, many of which were stones with epibiosis: phytobenthos and zoobenthos, as well as quantitative samples. The taxonomic list for this perimeter comprises 59 specific and supraspecific taxa, accounting for 72% of the taxonomic list of benthic zoofauna from the study area.

Near the shallow-water habitats, 62% of the identified taxa in this perimeter were found, while in the actual infralittoral habitats, 38% were present. This can be explained by a decrease in habitat diversity in the actual infralittoral zone, leading to a higher degree of sedimentary substrate homogeneity.

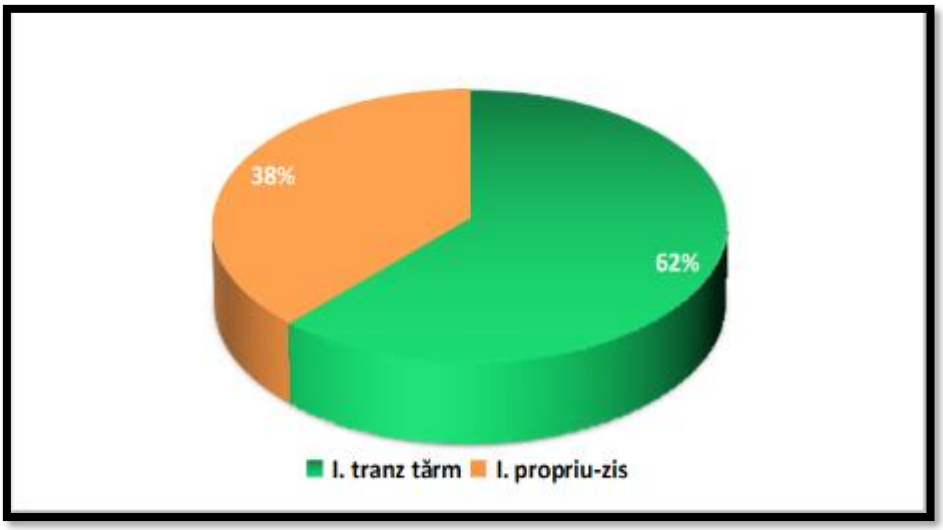


Figure 4.87 The taxonomic structure and distribution of benthic zoofauna in the shallow-water zone of the southern sector.

Among the species of conservation interest, the presence of *Upogebia pusilla* (Crustacea-Decapoda) threatened with extinction (EN) and *Branchiostoma lanceolatum* (Chordata) a rare species (R) (BSEC_BBSEA_ESMF_WB_RO, 2021 - Black Sea Basin Environmental Strategic Management Framework and World Bank - Romania) has been reported.

In this sector, the number of recorded taxa is higher in the shallow-water zone (mediolittoral transition zone and shallow infralittoral) compared to the proper infralittoral zone. In the transition zone, this situation is due to a greater variety of habitat types resulting from different substrate types: phytal habitats (composed of macroalgae fronds), hard substrates (limestone platforms and boulders, as well as intact mollusk shells that were notable for their size and intact state), and lastly, sediment accumulations and crevices among boulders or uneven limestone platforms.

The benthic samples from this sector do not indicate species exclusively found here, but we note that all species from this sector are also present either in the northern sector or in the transition zone between infralittoral and circalittoral (P7-23).

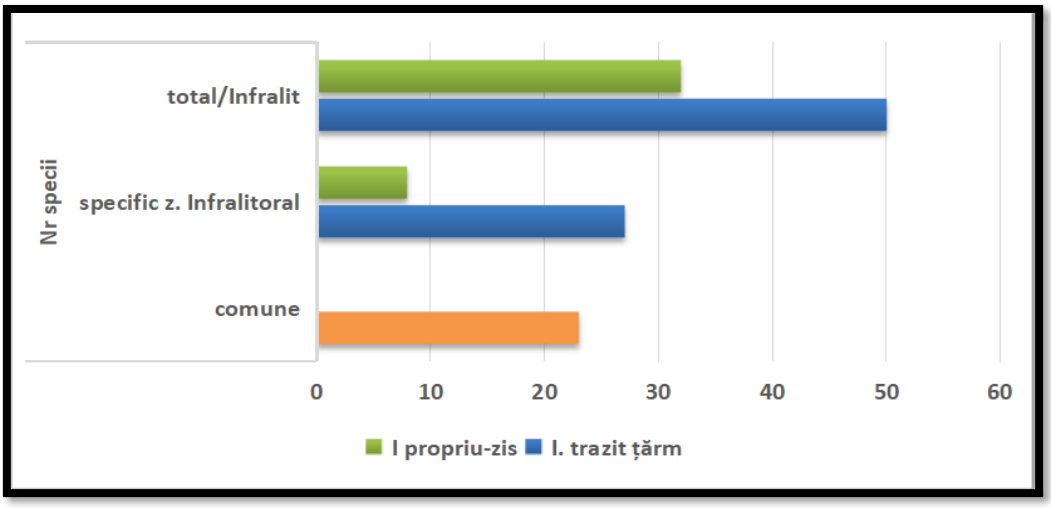


Figure 4.88 The study of zoobenthic communities from the perspective of the common number of taxa for the studied habitats in the southern sector

- The study of benthic zoocenoses in the P7-23 and A1-A3 perimeters

This perimeter is characterized by a much less varied substrate (in terms of sediment typology), and this is highlighted by a poorer fauna (in terms of species count) but with a much better presence compared to the benthic zoofauna from the previously presented perimeters.

In this perimeter, the substrate structure does not show significant variations, with predominance of muddy sediments; however, it was observed that two sub-communities with characteristic fauna have been identified. In a relatively central position of the investigated area (T7-8, T21-T23), a characteristic infralittoral habitat populated by the crustacean *Upogebia* is present, while the second area transitions towards the circalittoral (characterized by fine sediments), with characteristic benthic species such as the polychaete *Terebellides stroemii* and the echinoderm species *Leptosynapta inhaerens and Amphiura stepanovi*.

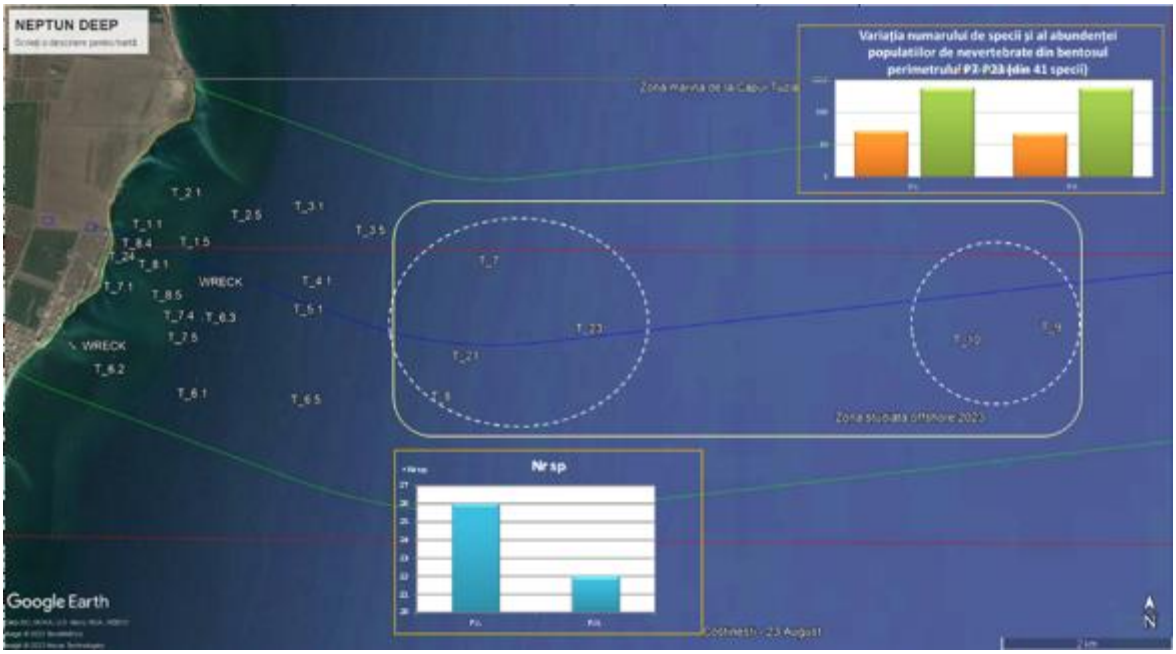


Figure 4.89 Identification of two sub-cenotic divisions in the benthos of the central perimeter

This perimeter is characterized by a much lower number of taxa (compared to the other two perimeters analysed earlier, less than 50%), of which only 40% of the 35 mentioned taxa are found in both presented sub-divisions. Species characteristic of each of the two sub-cenotic divisions are very few: 4 taxa for the habitats populated by Upogebia and 3 taxa for the habitats of the transition zone (the species listed above).

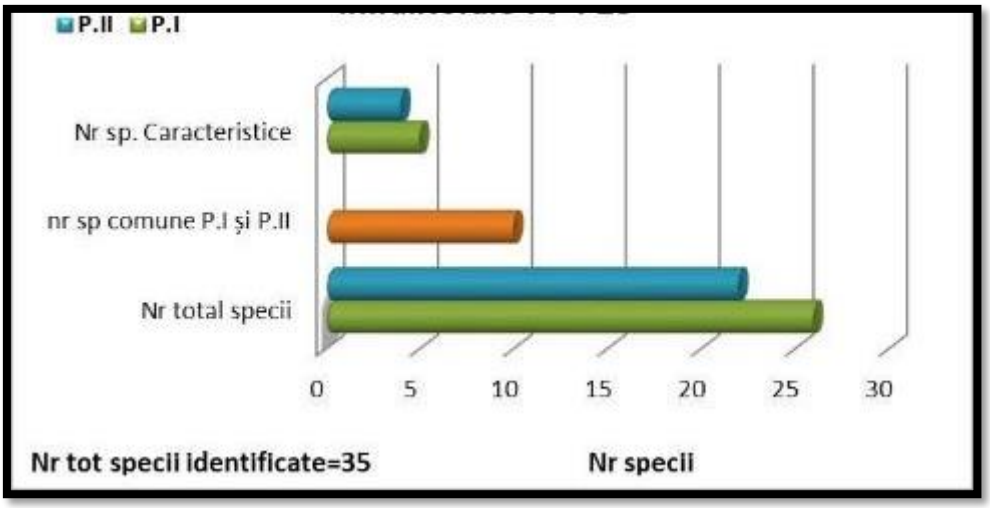


Figure 4.90 Distribution of the number of taxa in the central perimeter

From the macrofaunal perspective, the analysis of zoobenthos samples indicates that the populations of *Obelia and Amphioxus* are recorded in the shallow zone with sedimentary substrate composed of well-sorted, rolled shell material. On the other hand, the population of the crustacean Upogebia is reported in the offshore zone with finer sandy sediments and silt or muddy matrix. In this zone, the vulnerable species *Pitar rudis* was also identified, which is listed in the "List of Threatened Marine Species from the Romanian Coast of the Black Sea" for protection and conservation, as approved by the MMAP Order no. 488 from March 24, 2020

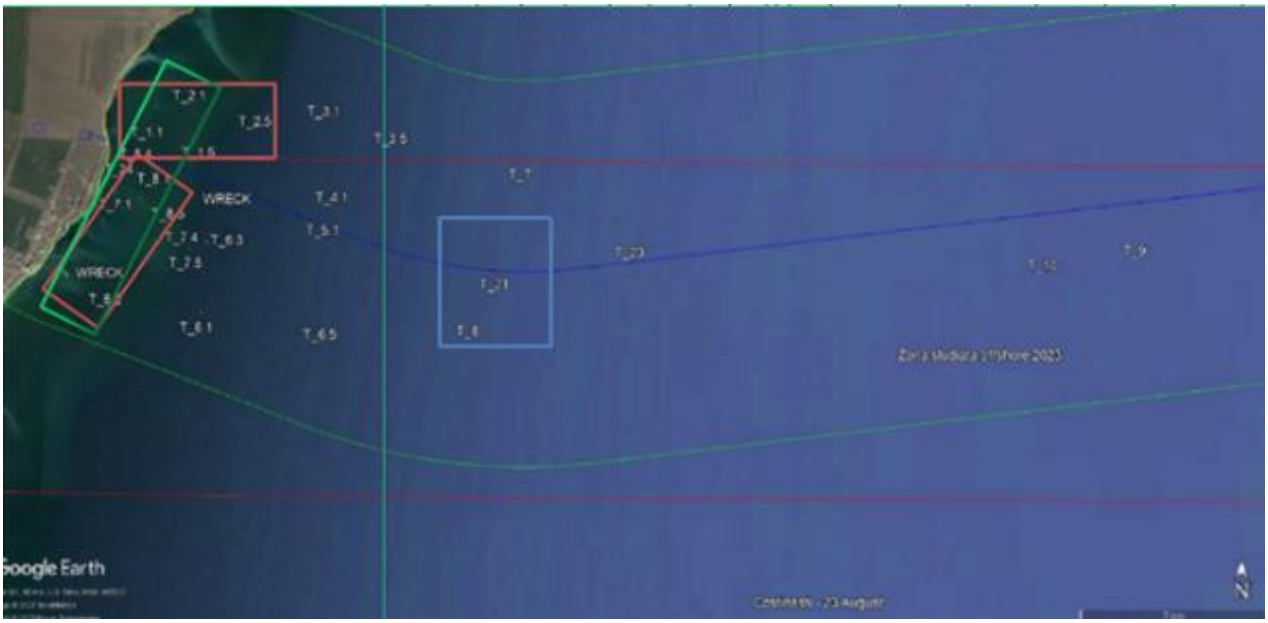


Figure 4.91 Distribution of habitats based on substrate/sediment description from samples

(*where: Red quadrant: Ophelia Habitat, Green quadrant: Amphioxus Habitat, Blue quadrant: Upogebia Habitat***)**

Conclusions regarding the zoobenthic communities:

From the study of the zoobenthic communities, the typology of the substrate (sedimentary and biological samples), and the collected video and photo materials from the area of interest, we can conclude that:

A total of 86 specific taxa belonging to 10 higher taxonomic groups (Phyla) were identified. Among the dominant taxa in the macrofauna, representatives of the groups Annelida, Artropoda-Crustacea, Mollusca, and Rhynchocoela were observed. Regarding the meiobenthic forms (which, despite their small size, play a significant role as a rich food source for the benthic fish fry and juveniles of macrobenthic forms), we note the presence of representatives from turbellarians (Platyhelminthes), nematodes (with the highest frequency), small-sized nemerteans (Rhynchocoela), polychaetes from the *Syllida and Nerilla antenata group, Protodrilus, and Saccocirrus papilocercus* (Polychaeta), mites, and last but not least, harpacticoid and cyclopoid crustaceans.

Table 4.88 The taxonomic list with frequency and abundance indices from the studied area

NO.	SUPRASPECIFIC TAXA	SPECIFIC TAXA	INDEXES	
			F%	AB (INDV /M2)
1	**Cnidaria**/ Ceriantharia	*Cerianthus membranaceus (*Gmelin, 1791)	3,22	5
2	**Cnidaria**/Hydrozoa	*Obelia* (Pallas, 1766)	25,80	34
3	**Cnidaria**/Actiniaria	*Diadumene lineata* (Verrill, 1869)	12,90	28
4		*Actinia equina (*Linnaeus, 1758)	6,45	9
5	**Platyhelminthes**/ Turbellaria	Varia	51,61	535
6		Polycladida	6,45	8
7	**Nemathoda**	Varia	80,64	1302
8	**Rhynchocoela**-Nemertinea	*Leucocephalonemertes aurantiaca* (Grube, 1855)	22,58	57
9		Varia	67,74	435
10	**Mollusca**/Bivalvia-Arcidae	*Anadara kagoshimensis (*Tokunaga, 1906)	3,22	5
11	- Mytilidae	*Mytilus galloprovincialis (Lamarck, 1819)*	22,58	35
12		*Mytilaster lineatus (*Gmelin, 1791)	3,22	4
13	- Cardiidae	*Cerastoderma glaucum (*Bruguiere, 1789)	6,45	10
14	- Venerida	*Spisula subtruncata (*da Costa, 1778)	9,67	21
15		*Pitar rudis* (Poli, 1795)	3,22	5
16	Gastropoda-Muricidae	*Rapana venosa* (Valenciennes, 1846)	16,12	26
17	**Annelida**/Polychaeta-Nereidinae	*Hediste diversicolor (*O.F. Müller, 1776)	6,45	30
18		*Alitta succinea* (Leuckart, 1847)	12,90	20
19		*Namanereis pontica (*Bobretzky, 1872)	3,22	5
20		*Platynereis dumerilii (*Audouin & Milne Edwards, 1833)	12,90	24
21		*Perinereis cultrifera (*Grube, 1840)	22,58	68
22	/Polychaeta-Syllida	*Salvatoria clavata (*Claparède, 1863)	29,03	110
23		*Syllis sp. (*Grube, 1840)	3,22	6
24		*Syllis gracilis (*Grube, 1840)	3,22	9
25		*Sphaerosyllis bulbosa (*Southern, 1914)	64,51	688
26	/Polychaeta- Phyllodocida	*Mysta picta (*Quatrefages, 1866)	32,25	220
27		*Harmothoe reticulata* (Claparede, 1870)	29,03	66
28		*Phyllodoce* sp (Lamarck, 1818)	6,45	18
29		*Glycera alba (*O.F. Müller, 1776)	3,22	5
30		*Pterocirrus limbatus* (Claparède, 1868)	19,35	133
31		*Nephtys hombergii* (Savigny in Lamarck, 1818)	19,35	56
32		*Pseudomystides limbata (*Saint-Joseph, 1888)	19,35	75
33		*Polynoe scolopendrina* (Savigny, 1822)	32,25	68
34	/Polychaeta-Scolecida	*Paraonis sp. (*Grube, 1873)	32,25	541
35		*Capitella capitata* (Fabricius, 1780)	51,61	421
36		*Capitella minima (*Langerhans, 1880)	25,80	89
37		*Euclymene collaris* (Claparède, 1869)	29,03	123
38		*Aricidea jeffreysii* [Auctt. (Non McIntosh, 1879)]accepted as *Aricidea (Acmira) cerrutii (*Laubier, 1966)	32,25	556
39		*Heteromastus filiformis (*Claparède, 1864)	12,90	44
40		*Ophelia limacina (*Ratke, 1843)	22,58	129
41	Polychaeta-Spionidae	*Pygospio elegans* (Claparède, 1863)	3,22	6

NO.	SUPRASPECIFIC TAXA	SPECIFIC TAXA	INDEXES	
			F%	AB (INDV /M2)
42		*Spio filicornis (*Müller, 1776)	32,25	182
43		*Scolelepis squamata (*Müller, 1806)	25,80	389
44		*Scolelepis (Parascolelepis) tridentata (*Southern, 1914)	22,58	71
45		*Aonides paucibranchiata (*Southern, 1914)	19,35	119
46		*Polydora sp* (Bosc, 1802)	3,22	20
47	Polychaeta-Sabellida	*Sabellida sp.* (Latreille, 1825)	9,67	16
48		*Fabricia stellaris (*Müller, 1774)	3,22	6
49	Polychaeta-Terebellida	*Melinna palmata (*Grube, 1870)	3,22	5
50		*Terebellides stroemii (Sars, 1835)*	9,67	23
51	*Polychaeta incertae sedis*	*Nerilla antennata* (Schmidt, 1848)	19,35	206
52		*Lindrilus flavocapitatus* (Uljanina, 1877)	29,03	687
53		*Saccocirrus papillocercus* (Bobretzky, 1872)	22,58	205
54	**Annelida** /Oligochaeta	Varia	51,61	740
55	**Phoronidae**	*Phoronis* sp. (Wright, 1856)	9,67	28
56	**Acari**	*Halacarellus sp. (*Viets, 1927)	3,22	4
57		Varia	12,90	48
58	**Crustacea** /Cirripedia	Varia	12,90	17
59	/Ostracoda	Varia	6,45	8
60	/Harpacticoida	Varia	29,03	958
61	/Cyclopoida	Varia	6,45	8
62	/Amphipoda	*Ampelisca diadema (*Costa, 1853)	16,12	35
63		*Ampithoe ramondi (*Audouin, 1826)	3,22	4
64		*Apohyale perieri (*Lucas, 1846)	12,90	28
65		*Corophium volutator* (Pallas, 1766)	35,48	129
66		*Dexamine spinosa (*Montagu, 1813)	6,45	10
67		*Gammaridea*	19,35	40
68		*Nototropis sp. (*A. Costa, 1853)	3,22	5
69		*Melita palmata* (Montagu, 1804)	9,67	17
70		*Microdeutopus gryllotalpa (*Costa, 1853)	12,90	30
71		*Microdeutopus* sp. (Costa, 1853)	19,35	51
72	/Cumacea	*Pseudocuma longicorne (*Bate, 1858)	6,45	10
73	/Mysidae	*Varia*	3,22	6
74	/Isopoda	*Idotea balthica* (Pallas, 1772)	12,90	27
75		*Eurydice sp.* (Leach, 1816)	6,45	8
76	/Tanaidacea	*Tanais dulongii (*Audouin, 1826)	9,67	17
77	Decapoda/Upogebiidae	*Upogebia pusilla* (Petagna, 1792)	3,22	5
78	Decapoda/Palaemonoidea	*Palemon elegans (*Rathke, 1836)	6,45	8
79	Decapoda/Brachiura	*Eriphia verrucosa (*Forskål, 1775)	9,67	16
80		*Pachygrapsus marmoratus (*Fabricius, 1787)	6,45	19
81		*Pilumnus hirtellus* (Linnaeus, 1761)	3,22	5
82	Decapoda/Anomura	*Diogenes pugilator* (P. Roux, 1829)	3,22	8
83		*Clibanarius erythropus (*(Latreille, 1818)	3,22	4
84	**Echinodermata** /Holothuroidea	*Leptosynapta inhaerens (*O.F. Müller, 1776)	3,22	5
85	/Ophiuroidea	*Amphiura stepanovi (*Djakonov, 1954)	3,22	5
86	**Chordata /**Branchiostomatidae	*Branchiostoma lanceolatum* (Pallas, 1774) syn *Amphioxus lanceolatus* (Pallas, 1774)	9,67	16

From the total of 86 specific benthic taxa identified in the project area, 5 species of conservation and protection interest in the Black Sea can be highlighted:

- *Clibanarius erythropus* - listed in Order No. 488 of March 24, 2020, approving the List of threatened marine species from the Romanian Black Sea coast for protection and conservation purposes;

- *Eriphia verrucosa* - endangered (EN) species listed in the Provisional List of Species of Importance for the Black Sea from the Black Sea Environmental and Social Management Fund of the Black Sea Environmental Program, World Bank (BSEC_BBSEA_ESMF_WB_RO, 2021);
- *Upogebia pusilla* - endangered (EN) species listed in the Provisional List of Species of Importance for the Black Sea from the Black Sea Environmental and Social Management Fund of the Black Sea Environmental Program, World Bank (BSEC_BBSEA_ESMF_WB_RO, 2021);
- *Branchiostoma lanceolatum* - rare (R) species listed in the Provisional List of Species of Importance for the Black Sea from the Black Sea Environmental and Social Management Fund of the Black Sea Environmental Program, World Bank (BSEC_BBSEA_ESMF_WB_RO, 2021);
- *Pitar rudis* - listed in Order No. 488 of March 24, 2020, approving the List of threatened marine species from the Romanian Black Sea coast for protection and conservation purposes.

Benthic habitats and associated communities were also the subject of a study conducted by the **National Institute for Research and Development of Marine Geology and Geoecology - Grigore Antipa** (INCDM Grigore Antipa) in 2021, in order to investigate these habitats in the southern part of the Romanian sector of the Black Sea, where the placement of the Neptun Deep project's pipeline, production platform, and wells is proposed.

A total of 15 stations were selected, and 45 macrofaunal samples were collected for analysis (three replicates per station). As a result of this study, it was found that there are no habitats of community interest (Natura 2000) in the offshore zone of the Neptun Deep project.

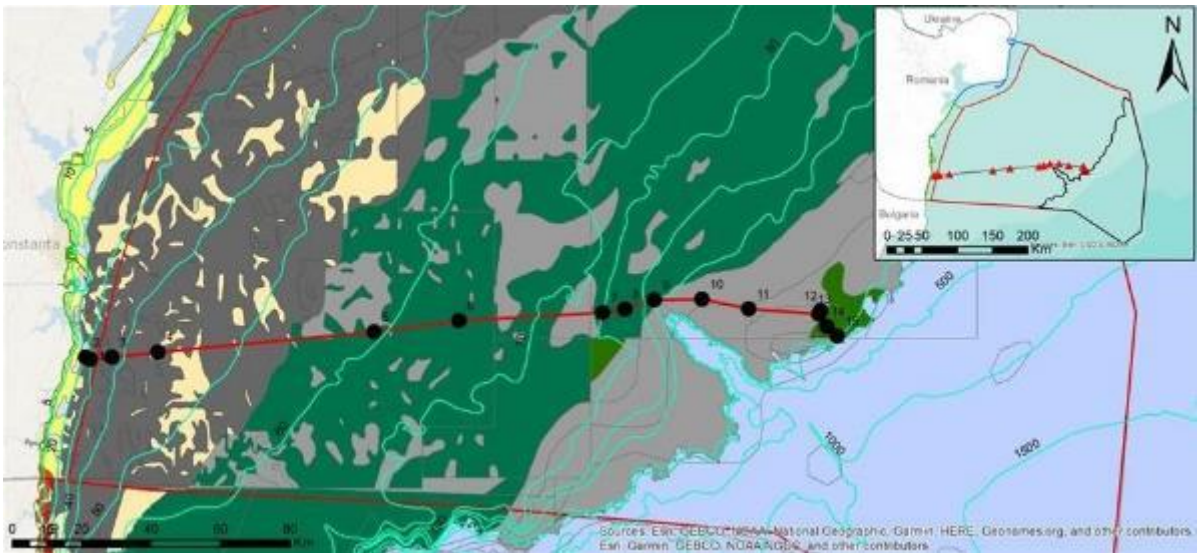


Figure 4.92 The study area with the 15 benthic sampling stations (source: INCDM Grigore Antipa, 2021)

In the 45 collected samples, 79 species belonging to 17 different classes were identified. Among them, *Pitar rudis* is considered vulnerable according to IUCN (VU). Three major taxonomic groups of macrofauna dominated in terms of species number: Polychaeta - 32 species, Malacostraca (Crustacea) - 17 species, and Bivalvia - 9 species.

Annelids (e.g., polychaete worms) and mollusks (e.g., bivalves) were the dominant benthic groups in terms of abundance and biomass.

Table 4.89 Types of marine habitats identified along the offshore route of the pipeline, the area of production platform (Neptun Alpha), and the wellheads

Date of Sample Collection	Sampling Station	Localisation	Lat.	Long.	Depth (m)	Identified habitat type (EUNIS)	Correspondence with the classification system Natura 2000
20/03/2021	Station 01	Pipeline route	43.965	28.688	26	MC44- Circalitoral mixed sediments from the Black Sea	Without correspondent
20/03/2021	Station 02	Pipeline route	43.961	28.709	30	MC643- Silty sandy sediment from the upper circalittoral zone of the Black Sea	Without correspondent
20/03/2021	Station 03	Pipeline route	43.967	28.796	40	MC641- Circalittoral terrigenous muds from the Black Sea	Without correspondent
20/03/2021	Station 04	Pipeline route	43.989	29.098	50	MC641- Circalittoral terrigenous silts from the Black Sea	Without correspondent
20/03/2021	Station 05	Pipeline route	44.014	29.476	60	MD44- Mixed sediments from the lower circalittoral of the Black Sea	Without correspondent
20/03/2021	Station a 06	Pipeline route	44.040	29.865	70	MD44- Mixed sediments from the offshore circalittoral of the Black Sea	Without correspondent

Date of Sample Collection	Sampling Station	Localisation	Lat.	Long.	Depth (m)	Identified habitat type (EUNIS)	Correspondence with the classification system Natura 2000
21/03/2021	Station 07	Pipeline route	44.047	30.032	80	MD44- Mixed sediments from the lower circalittoral of the Black Sea	Without correspondent
21/03/2021	Station 08	Pipeline route	44.066	30.140	90	MD44- Mixed sediments from the lower circalittoral of the Black Sea	Without correspondent
21/03/2021	Station 09	Pipeline route	44.074	30.176	100	MD64 - Mud sediments from the lower circalittoral of the Black Sea	Without correspondent
21/03/2021	Station 10	Pipeline route	44.074	30.308	110	MD64- Mud sediments from the lower circalittoral of the Black Sea	Without correspondent
21/03/2021	Station 11	Pipeline route	44.056	30.499	120	MD64- Mud sediments from the lower circalittoral of the Black Sea	Without correspondent
21/03/2021	Station 12	Drilling Centre Pelican	44.048	30.589	130	MD64- Silts from the lower circalittoral of the Black Sea	Without correspondent
24/03/2021	Station 13	Neptun Alpha Platform	44.054	30.602	128	MD64- Silts from the lower circalittoral of the Black Sea	Without correspondent
24/03/2021	Station 14	Domino Drilling Centre	44.024	30.610	135	MD54- Sands from the lower circalittoral of the Black Sea	Without correspondent
24/03/2021	Station 15	Pipeline route	44.008	30.626	150	MD54- Sands from the lower circalittoral of the Black Sea	Without correspondent

From the analysis of species variation across the entire study area by INCDM Grigore Antipa for this project, a decreasing trend in species diversity was observed from Station 01 to Station 15. The number of species increased from Station 01 (26m) to Station 05 (60m), after which a sharp decline was observed. At Stations 11-15, the diversity was very low. In general, the benthic communities sampled at stations with water depths greater than 120m were composed only of individuals from Oligochaeta and Nematoda.

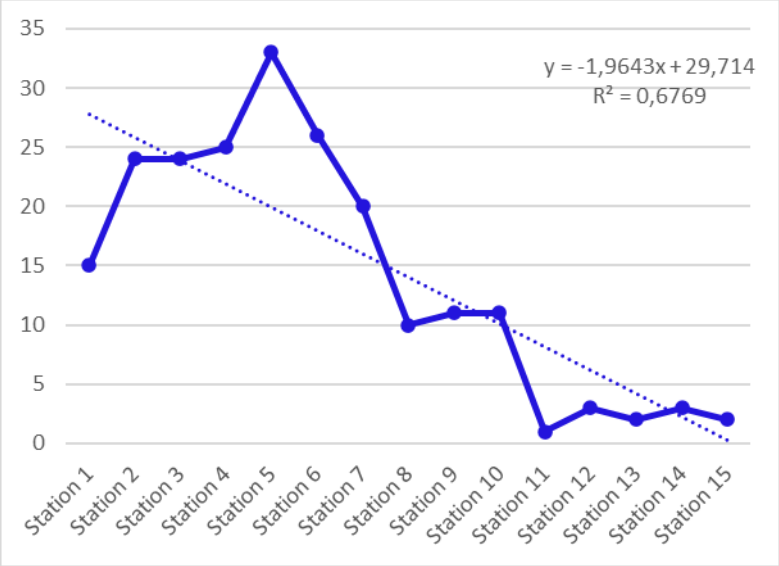


Figure 4.93 Number of taxa

The ecological status of benthic habitats and associated communities in the project area was assessed according to relevant EU standards. Except for Station 01, Stations 02 to 10 have achieved Good Environmental Status. The results for Stations 11 to 15 were excluded at this stage due to the lack of reference values. Benthic communities at these stations are strongly influenced by low oxygen conditions found at depths over 100 meters of water.

Table 4.90 Benthic species list (INCDM Grigore Antipa-2021)

Species	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15
Anthozoa															
Cerianthus membranaceus (Gmelin, 1791)									+	+					
Diadumene lineata **(**Verrill, 1869)		+	+	+											
Arachnida															
Thalassarachna basteri (Johnston, 1836)					+	+	+								
Ascidiacea															
Eugyra adriatica Drasche, 1884					+	+	+	+	+	+					
Bivalvia															
Abra alba (W. Wood, 1802)				+											
Abra prismatica (Montagu, 1808)															
Acanthocardia paucicostata (G. B. Sowerby II, 1834)			+	+											
Modiolula phaseolina (Philippi, 1844)					+	+	+	+	+	+					
Mytilus galloprovincialis Lamarck, 1819		+						+							
Cerastoderma glaucum (Bruguiere, 1789)						+									
Pitar rudis (Poli, 1795)			+	+											
Polititapes aureus (Gmelin, 1791)			+	+											
Spisula subtruncata (da Costa, 1778)		+	+	+											
Calcarea															
*Sycon ciliatum (*Fabricius, 1780)					+	+									
Clitellata															
Oligochaeta Grube, 1850							+					+	+	+	+

Species	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15
Demospongiae															
Haliclona sp. Grant, 1841							+								
Suberites carnosus (Johnston, 1842)							+		+	+					
Gastropoda															
*Calyptraea chinensis (*Linnaeus, 1758)				+											
Hoplonemertea															
Amphiporus bioculatus McIntosh, 1874	+		+												
Tetrastemma sp. Ehrenberg, 1831					+	+	+								
Malacostraca															
Ampelisca diadema (Costa, 1853)		+			+	+	+	+	+						
Apherusa bispinosa (Spence Bate, 1857)					+	+									
Apseudopsis ostroumovi Bacescu & Carausu, 1947				+	+	+	+								
Cumella (Cumella) pygmaea euxinica Bacescu, 1950			+												
Diogenes pugilator (P. Roux, 1829)		+													
Eudorella truncatula (Bate, 1856)					+	+	+								
Iphinoe elisae Băcescu, 1950		+	+	+											
Iphinoe tenella Sars, 1878						+									
Medicorophium runcicorne (Della Valle, 1893)		+	+												
Microdeutopus damnoniensis (Spence Bate, 1856)		+			+										
Microdeutopus gryllotalpa Costa, 1853	+														
Nototropis guttatus Costa, 1853				+	+	+									
Orchomene humilis (Costa, 1853)						+									
Phtisica marina Slabber, 1769		+	+	+	+										
Stenosoma capito (Rathke, 1836)					+										
Synchelidium maculatum Stebbing, 1906			+	+											
Upogebia pusilla (Petagna, 1792)		+													
Ophiuroidea															
Amphiura stepanovi Djakonov, 1954			+	+	+	+	+		+	+					
Palaeonemertea															
Carinina heterosoma Müller, 1965				+	+		+								
Pilidiophora															
Leucocephalonemertes aurantiaca (Grube, 1855)			+	+											
Micrura fasciolata Ehrenberg, 1828					+	+	+								
Polychaeta															
Alitta succinea (Leuckart, 1847)	+	+			+										
Aonides paucibranchiata Southern, 1914					+		+	+	+						
Capitella capitata (Fabricius, 1780)	+	+	+	+		+									
Capitella minima Langerhans, 1880	+														
Eulalia viridis (Linnaeus, 1767)						+									
Exogone naidina Örsted, 1845	+				+	+	+		+						
Fabricia stellaris (Müller, 1774)			+												
Glycera tridactyla Schmarda, 1861					+										
Harmothoe reticulata (Claparède, 1870)	+	+	+	+	+			+		+					

Species	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15
Heteromastus filiformis (Claparède, 1864)	+	+	+	+	+	+									
Lagis koreni Malmgren, 1866		+													
Leiochone leiopygos (Grube, 1860)					+										
Lindrilus flavocapitatus (Uljanina, 1877)								+							
Melinna palmata Grube, 1870									+	+					
Micronephthys longicornis (Perejaslavtseva, 1891)	+	+	+	+	+										
Mysta picta (Quatrefages, 1866)	+														
Nephtys cirrose Ehlers, 1868		+	+	+		+	+	+							
Nephtys hombergii Savigny in Lamarck, 1818		+	+	+		+				+					
Nephtys sp. Cuvier, 1817									+						
Nereiphylla rubiginosa (de Saint-Joseph, 1888)			+		+	+									
Notomastus profundus Eisig, 1887					+		+								
Oriopsis armandi (Claparède, 1864)									+						
Phyllodoce maculate (Linnaeus, 1767)					+	+	+								
Polychaeta sp.Grube, 1850										+					
Polydora ciliate (Johnston, 1838)		+													
Prionospio cirrifera Wirén, 1883	+	+			+	+									
Pygospio elegans Claparède, 1863	+														
Salvatoria clavate (Claparède, 1863)	+														
Scolelepis (Scolelepis) squamata (O.F. Muller, 1806)	+	+			+										
Sphaerosyllis bulbosa Southern, 1914					+	+				+					
Spio filicornis (Müller, 1776)	+														
Terebellides stroemii Sars, 1835				+	+	+	+		+	+					
Pycnogonida															
Callipallene phantoma (Dohrn, 1881)					+										
Thecostraca															
Amphibalanus improvises (Darwin, 1854)		+	+												
Phoronida															
Phoronis euxinicola Selys-Longchamps, 1907		+	+	+											
Chironomida larvae													+	+	
Nematoda					+		+	+			+	+		+	+
Nemertea					+										

Where: S – station

The most frequent species encountered in the project area belong to 3 major taxonomic groups: Polychaeta, Mollusca, and Crustacea. In addition to these, one species of echinoderm, *Amphiura stepanovi,* is fairly common in the project area.

The most common polychaete species identified in the project area are *Nephtys hombergii* and *Melinna palmata.*

All species of mollusks in the Black Sea are benthic, with selective behavior related to the type of substrate (e.g., species from the class Polyplacophora live exclusively on hard substrates),

gastropods live on all types of substrate, and bivalves are sedentary on different substrates in the epi- or endobenthos (living on or within the substrate).

The most frequent mollusk species in the project area are *Rapana venosa, Mytilus galloprovincialis, Modiolula phaseolina, Steromphala divaricate, Donax trunculus, and Polititapes aureus.*

Crustaceans are the most diverse group and include crabs, hermit crabs, shrimp, ostracods, barnacles, and isopods. This group plays an essential role in the food chain, mainly as primary consumers (filter feeders and detritivores), mediating the transfer of energy and matter to higher trophic levels in marine food webs.

The most common crustacean species found in the project area are *Ampelisca diadema, Upogebia pusilla, Diogenes pugilator, Carcinus aestuarii, Eriphia verrucosa, and Pachygrapsus marmoratus*.

Types and subtypes of marine habitats in the Natura 2000 sites in the project area

1110-3 Shallow fine sands. Along the Romanian coast, this habitat is present from the Danube River mouths to Vama Veche, where sandy beaches exist. The substrate consists of fine terrigenous, siliceous, or biogenic sands mixed with shell fragments and pebbles, extending from the shore to the 5-6m isobath. In the south, at Tuzla and Mangalia, where salinity is more stable, this habitat hosts the biocenosis with Donax trunculus, which is characterized by abundant populations of this bivalve. Due to high hydrodynamics, the associated fauna is not very diverse (gastropod Cyclope neritea, crustaceans Liocarcinus vernalis, and Diogenes pugilator) but can be abundant.

1140-1 Supralittoral detritic deposits with rapid drying. This habitat occurs on the part of the beach that is not wetted by waves except during storms. The deposits consist of materials brought in by the sea, of plant origin (tree trunks, pieces of wood, terrestrial and palustrine plant remains, algae, leaves), animal origin (carcasses of aquatic animals, insects, drowned terrestrial animals), or anthropogenic origin (solid waste), as well as dense foam from marine plankton. The fauna consists of isopods and insects, mainly.

1140-2 Supralittoral detritic deposits with slow drying. This habitat is present on shores formed by boulders or shingle beaches at Agigea, Tuzla, Mangalia, and Vama Veche. It occupies the part that is only wetted by waves during storms. These deposits accumulate the materials described above, as well as humidity, so they dry slowly. The fauna consists of detritivores, decomposers, and their predators.

1170-2 Biogenic reefs of Mytilus galloprovincialis. Mussel reefs occur on sedimentary substrates: mud, sand, rubble, or a mixture, most frequently between the 35 and 60m isobaths. Biogenic reefs of Mytilus galloprovincialis are made up of mussel banks whose shells have accumulated over time, forming a raised hard support compared to the surrounding sediment, mud, sand, rubble, or mixture, on which live colonies of living mussels. This type of reef is unique due to the crucial ecological role of mussel banks in the self-purification of the ecosystem and the benthic-pelagic coupling.

1170-4 Agglomerations of rocks and boulders. The habitat occurs in the middle and lower intertidal zones of rocky shores, at the foot of cliffs made of hard rocks. The blocks can be rolled and eroded by wave action. The structural complexity of the spaces between the blocks and the darkness attract

a surprisingly diverse fauna for such shallow depths. This habitat provides a mosaic of microhabitats, allowing the presence of species usually found at deeper depths near the shore. In the Romanian Black Sea, this habitat is found in a few places with natural rocky shorelines at Agigea, Tuzla, Costineşti, and Vama Veche. The large offshore breakwaters of the Constanța and Mangalia harbors can be considered an artificial version of this habitat.

1170-8 Infralittoral rock with photophilic algae. It starts immediately below the lower middle intertidal zone, where emersions are only accidental, and extends to the lower limit of the distribution of photophilic algae and marine phanerogams. This lower limit is determined by light penetration and thus highly variable depending on topography and water clarity. Generally, on the Romanian coast, this limit is around 10-15 meters in depth, but in areas with high turbidity, it can be less than 1 meter. The rocky substrate between these limits is covered with rich and diverse populations of photophilic algae. It includes numerous differentiated facies based on dominant algal associations, which vary with the season. Among these, the coastal belts formed by the perennial brown algae *Cystoseira barbata* have the highest conservation value. These belts develop between depths of 0.2-4 meters, only in areas with clear, clean water, and relatively sheltered from waves. *Cystoseira* beds are solid, resistant, elastic, reaching lengths of 1.5-2 meters and forming dense "forests," whose structural complexity and permanence over time allow the development of a rich and diverse fauna, including many rare or threatened species.

1170-9 Infralittoral rock with *Mytilus galloprovincialis*. The mussels (*Mytilus galloprovincialis*) covering the rocky bottom are present in the previous habitat as well but become dominant starting from its lower limit, continuing as a compact carpet down to the lower limit of the rocky substrate distribution at 30-35 meters in depth. The fauna is diverse, comprising numerous species of sponges, hydrozoans, polychaete worms, mollusks, crustaceans, ascidians, and fish, characteristic only of this habitat, some of which are rare or protected.

8330 Totally or partially submerged marine caves. In the Romanian Black Sea, this habitat corresponds to vertical walls, overhangs, grottoes, and tunnels. Light and hydrodynamics are reduced or linear, creating a stable but selective environment for the groups of organisms that can develop here. The flora is poorly represented, with only the sciaphilous algae *Hildebrandtia proptotypus* and *Phyllophora crispa* able to grow in the underhangs and entrances to the galleries. The fauna is dominated by sponges, cnidarians, bryozoans, ascidians, mysid crustaceans, decapods, and cave-dwelling fish.

To eliminate uncertainties regarding the presence of habitats in the direct influence area (within a radius of 2 km around the project - marine zone), a monitoring activity was conducted in 2023 (May-June) by Blumenfield®

The establishment of sampling points for zoobenthos samples, later inspected through belt-transects using an ROV (Remotely Operated Vehicle), took into consideration the following aspects:

- Initially, the coordinates of the anchoring points of the barge involved in the construction activities of the microtunnel traversing the ROSAC0273 Marine Zone at Tuzla Cape were determined and included in the monitoring program..

- Locations with the designation "Biogenic Structure" from the archaeological diagnostic report conducted by the National History and Archaeology Museum of Constanța were included in the monitoring program
- Additional sampling and ROV inspection points were established in the infralittoral zone (to the north and south of the microtunnel position) and in the circalittoral zone (within the ROSAC0273 Marine Zone at Tuzla Cape)

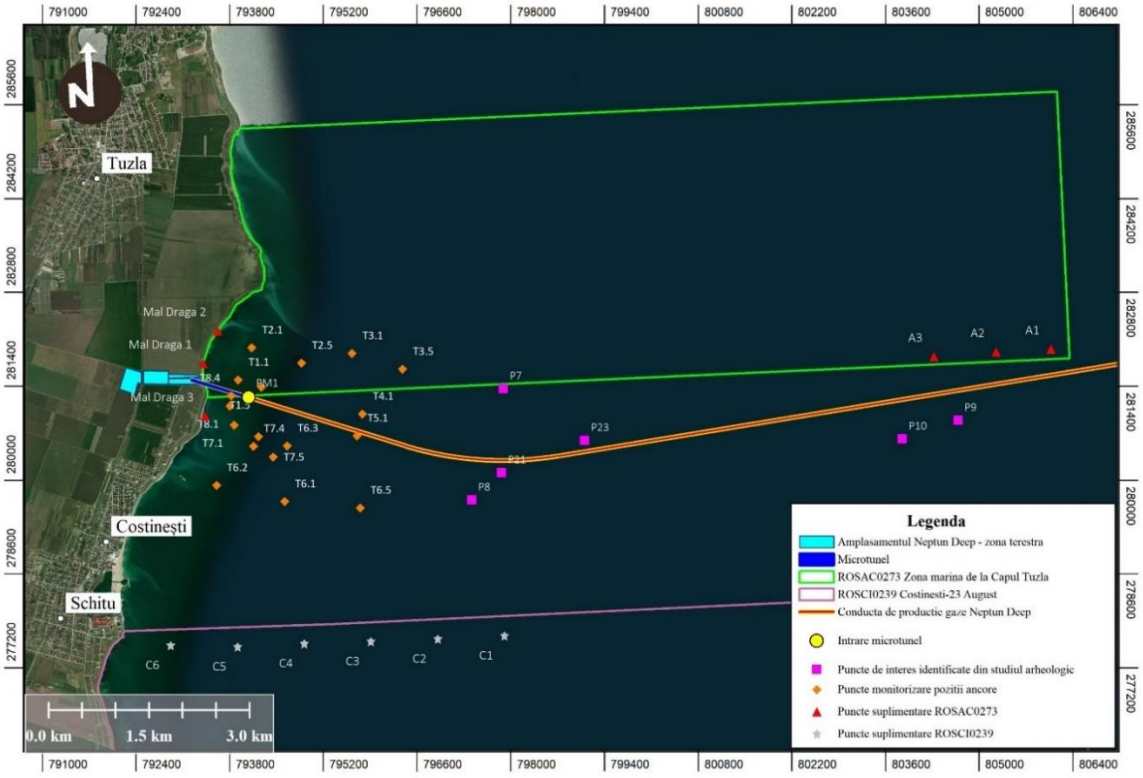


Figure 4.94 Sampling points for sediment samples and ROV inspections (Blumenfield, 2023)

Table 4.91 Types of marine habitats identified in the project area (Blumenfield, 2023)

Date of sampling	Test station	Location	X	Y	Depth (m)	EUNIS identified habitat type	Correspondence with the Natura 2000 classification system*
02.05.2023	**Q7**	north of the pipeline/ approx. 1.07 km Except ROSAC0273 and ROSCI0293	797892.711	281363.524	32	MC241- *Mytilus galloprovincialis* biogenic reefs on circumlittoral terrigenous banks in the Sea MC54 Circalittoral sands of the Black Sea	*Mytilus galloprovincialis* biogenic reefs
05.03.2023	**P8**	south of the pipeline/approx. 600m Except ROSAC0273 and ROSCI0293	797417.811	279705.604	30	MC541- Silty sand from the Black Sea coast	No correspondent
05.03.2023	**Q9**	south of the pipeline/approx. 445m Except ROSAC0273 and ROSCI0293	804686.477	280890.871	40	MC241- Biogenic reefs of *Mytilus galloprovincialis* on circumlittoral terrigenous banks in the Black Sea	*Mytilus galloprovincialis* biogenic reefs
05.03.2023	**P10**	south of the pipeline/approx. 550m Except ROSAC0273 and ROSCI0293	803853.723	280612.727	40	MC241- Biogenic reefs of *Mytilus galloprovincialis* on circumlittoral terrigenous banks in the Black Sea MC44-Mixed sediments from the circumlittoral of the Black Sea	*Mytilus galloprovincialis* biogenic reefs
05.03.2023	**P21**	south of the pipeline/approx. 182m	797860.906	280110.636	32	MC541- Silty sand from the Black Sea coast	No correspondent
05.03.2023	**P23**	north of the pipeline/approx. 162m Except ROSAC0273 and ROSCI0293	799103.732	280589.567	35	MC241- Biogenic reefs of *Mytilus galloprovincialis* on circumlittoral terrigenous banks in the Black Sea	*Mytilus galloprovincialis* biogenic reefs
						MC541- Silty sand from the Black Sea coast	From inspections ROV-1110-9 Silty sands and sandy mires bioturbated by *Upogebia pusilla*
10.05.2023	**T3.1**	barge anchor point Inside ROSAC0273	795625.573	281892.106	19	MB542- Infralittoral sands and silty sands, without vegetation, from the Black Sea	1110-9 Silty sands and sandy muds bioturbated by *Upogebia pusilla*
						MB141- Lower Infralittoral rock dominated by invertebrates, from the Black Sea	1170-9 Infralittoral rock with *Mytilus galloprovincialis*
10.05.2023	**T3.5**	barge anchor point Inside ROSAC0273	796382.003	281657.859	24	MC541- Silty sand from the Black Sea circumlittoral	From inspections ROV- 1110-9 Silty sands and sandy muds bioturbated by *Upogebia pusilla*

Date of sampling	Test station	Location	X	Y	Depth (m)	EUNIS identified habitat type	Correspondence with the Natura 2000 classification system*
10.05.2023	**T4.1**	barge anchor point Except ROSAC0273 and ROSCI0293	795781.371	280989.199	20	MC541- Silty sand from the Black Sea circumlittoral	From inspections ROV- 1110-9 Silty sands and sandy muds bioturbated by *Upogebia pusilla*
10.05.2023	**T5.1**	barge anchor point Except ROSAC0273 and ROSCI0293	795701.131	280663.39	20	MC541- Silty sand from the Black Sea circumlittoral	From inspections ROV- 1110-9 Silty sands and sandy muds bioturbated by *Upogebia pusilla*
10.05.2023	**T6.5**	barge anchor point Except ROSAC0273 and ROSCI0293	795747.489	279583.284	21	MC541- Silty sand from the Black Sea circumlittoral	From inspections ROV- 1110-9 Silty sands and sandy muds bioturbated by *Upogebia pusilla*
11.05.2023	**T1.1**	barge anchor point Inside ROSAC0273	793925.193	281496.752	4	MB143- Upper infralittoral rock with photophilous algae, other than *Fucales*, from the Black Sea	1170-8 Infralittoral rock with photophilous algae other than *Fucales*
11.05.2023	**T6.1**	barge anchor point Except ROSAC0273 and ROSCI0293	794618.214	279684.318	14	MB542- Infralittoral sands and silty sands, without vegetation, from the Black Sea	1110-9 Silty sands and sandy muds bioturbated by *Upogebia pusilla*
						MB141- Lower infralittoral rock dominated by invertebrates, from the Black Sea	1170-9 Infralittoral rock with *Mytilus galloprovincialis*
11.05.2023	**T6.3**	barge anchor point Except ROSAC0273 and ROSCI0293	794657.756	280508.988	12	MB141-Lower infralittoral rock dominated by invertebrates, from the Black Sea	1170-9 Infralittoral rock with *Mytilus galloprovincialis*
						MB14E-Caves, overhangs and channels in the infralittoral rock of the Black Sea	8330 Totally or partially submerged sea caves
						MB542-Infralittoral sands and silty sands, without vegetation, from the Black Sea	1110 Shallow submerged sandbars
11.05.2023	**T7.4**	barge anchor point Except ROSAC0273 and ROSCI0293	794156.438	280508.246	8	MB143- Upper infralittoral rock with photophilous algae, other than *Fucales*, from the Black Sea	1170-8 Infralittoral rock with photophilous algae, other than *Fucales*
11.05.2023	**T7.5**	barge anchor point Except ROSAC0273 and ROSCI0293	794447.2	280345.633	12	MB542- Infralittoral sands and silty sands, without vegetation, from the Black Sea	1110 Shallow submerged sandbars
						MB141- Lower infralittoral rock dominated by invertebrates, from the Black Sea	1170-9 Infralittoral rock with *Mytilus galloprovincialis*
24.05.2023	**T2.1**	barge anchor point Inside ROSAC0273	794126.080	281980.385	4	MB143- Upper infralittoral rock with photophilous algae, other than *Fucales*, from the Black Sea	1170-8 Infralittoral rock with photophilous algae other than *Fucales*

Date of sampling	Test station	Location	X	Y	Depth (m)	EUNIS identified habitat type	Correspondence with the Natura 2000 classification system*
24.05.2023	**T8.4**	barge anchor point Inside ROSAC0273	793819.448	281259.624	3	MB143- Upper infralittoral rock with photophilous algae, other than *Fucales*, from the Black Sea	1170-8 Infralittoral rock with photophilous algae other than *Fucales*
25.05.2023	**T1.5**	barge anchor point Inside ROSAC0273	794272.821	281387.774	7	MB14D- Exposed infralittoral rock, from the Black Sea	No correspondent
25.05.2023	**T2.5**	barge anchor point Inside ROSAC0273	794872.512	281745.523	13	MB141- Lower infralittoral rock dominated by invertebrates, from the Black Sea	1170-9 Infralittoral rock with *Mytilus galloprovincialis*
22.06.2023	**A1**	additional points from ROSAC0273	806077.182	281957.695	42	MC241- Biogenic reefs of *Mytilus galloprovincialis* on circumlittoral terrigenous banks in the Black Sea	*Mytilus galloprovincialis* biogenic reefs
22.06.2023	**A2**	additional points from ROSAC0273	805255.993	281915.893	41	MC641- Terrigenous banks of the Black Sea circalittoral	No correspondent
22.06.2023	**A3**	additional points from ROSAC0273	804324.828	281846.129	40	MC241- Biogenic reefs of *Mytilus galloprovincialis* on circumlittoral terrigenous banks in the Black Sea	*Mytilus galloprovincialis* biogenic reefs
22.06.2023	**M3/PM1**	microtunnel entrance	794082.071	281233.367	5	MB14D- Exposed infralittoral rock, from the Black Sea	No correspondent
22.06.2023	**M4**	point in ROSAC0273 located in the immediate vicinity of the microtunnel entrance	794084.402	281274.735	5	MB14D- Exposed infralittoral rock, from the Black Sea	No correspondent
21.07.2023	**C1**	additional point in ROSCI0293 At approx. 2.7 km from the trench for the gas production pipeline	797908.141	277672.145	31	MC541- Silty sand from the Black Sea circumlittoral MC144 - The bare circalittoral rock of the Black Sea	No correspondent The presence of habitats of community interest resulted from the ROV-nu inspections
21.07.2023	**C2**	additional point in ROSCI0293 At approx. 2.72 km from the trench for the gas production pipeline	796908.578	277626.535	28	MC541- Silty sand from the Black Sea circumlittoral MC144 - The bare circalittoral rock of the Black Sea	No correspondent The presence of habitats of community interest resulted from the ROV-nu inspections
28.07.2023	**3**	additional point in ROSCI0293 At approx. 2.95 km from the trench for the gas production pipeline	795911.178	277587.080	22	MC541-Loamy sand from the Black Sea circumlittoral MC54-Circlittoral sand from the Black Sea	From inspections ROV- 1110-9 Silty sands and sandy muds bioturbated by *Upogebia pusilla*

Date of sampling	Test station	Location	X	Y	Depth (m)	EUNIS identified habitat type	Correspondence with the Natura 2000 classification system*
28.07.2023	**4**	additional point in ROSCI0293 At approx. 3.27 km from the trench for the gas production pipeline	794913.408	277555.848	17	MC541-Loamy sand from the Black Sea circumlittoral MC54-Circlittoral sand from the Black Sea	From inspections ROV- 1110-9 Silty sands and sandy muds bioturbated by *Upogebia pusilla*
28.07.2023	**C5**	additional point in ROSCI0293 At approx. 3.6 km from the trench for the gas production pipeline	793916.380	277508.376	15	MC541-Loamy sand from the Black Sea circumlittoral MC54-Circlittoral sand from the Black Sea	From inspections ROV- 1110-9 Silty sands and sandy muds bioturbated by *Upogebia pusilla*
28.07.2023	**6**	additional point in ROSCI0293 At approx. 3.9 km from the trench for the gas production pipeline	792916.333	277527.817	10	MB542-Infralittoral sands and silty sands, without vegetation, from the Black Sea	From inspections ROV- 1110-9 Silty sands and sandy muds bioturbated by *Upogebia pusilla*

Note: The correspondence between the EUNIS (2022) and NATURA 2000 habitat classification systems can be total or partial. It should be noted that these correspondences are made only for NATURA 2000 habitat types and do not include specific habitat subtypes.

Figure 4.95 Aspect of marine habitat MB14D - Denuded Infralittoral Rock (microtunnel entrance), Black Sea (Blumenfield, May 2023

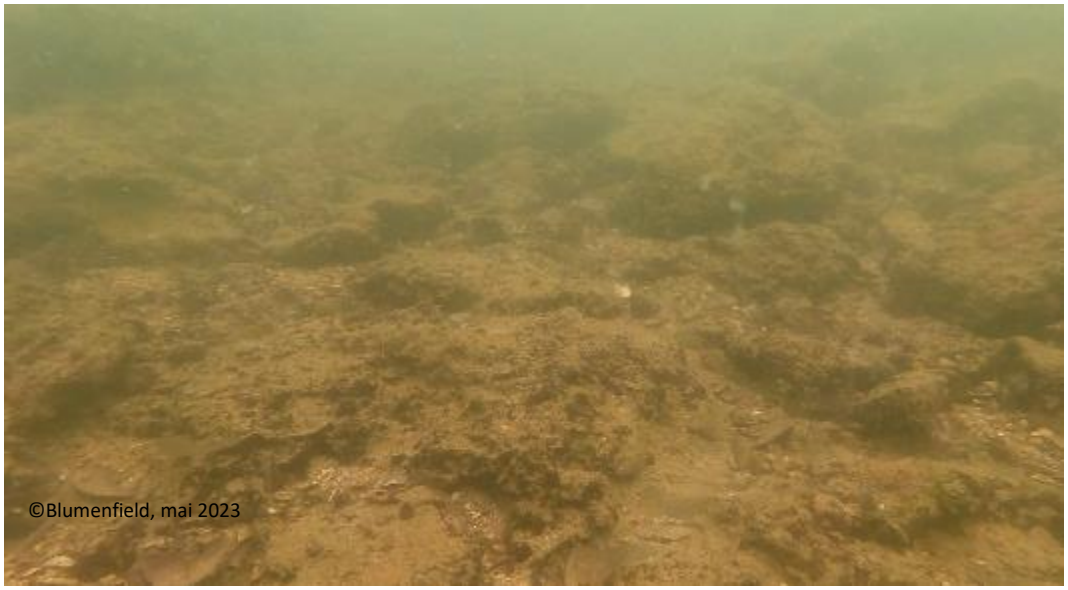


Figure 4.96 Microtunnel entrance - Habitat MB14D Denuded Infralittoral Rock, Black Sea (Blumenfield, May 2023)

Figure 4.97 Point P9 - Habitat MC241 Biogenic reefs of *Mytilus galloprovincialis* on circalittoral terigenous shores in the Black Sea (Blumenfield, May 2023)

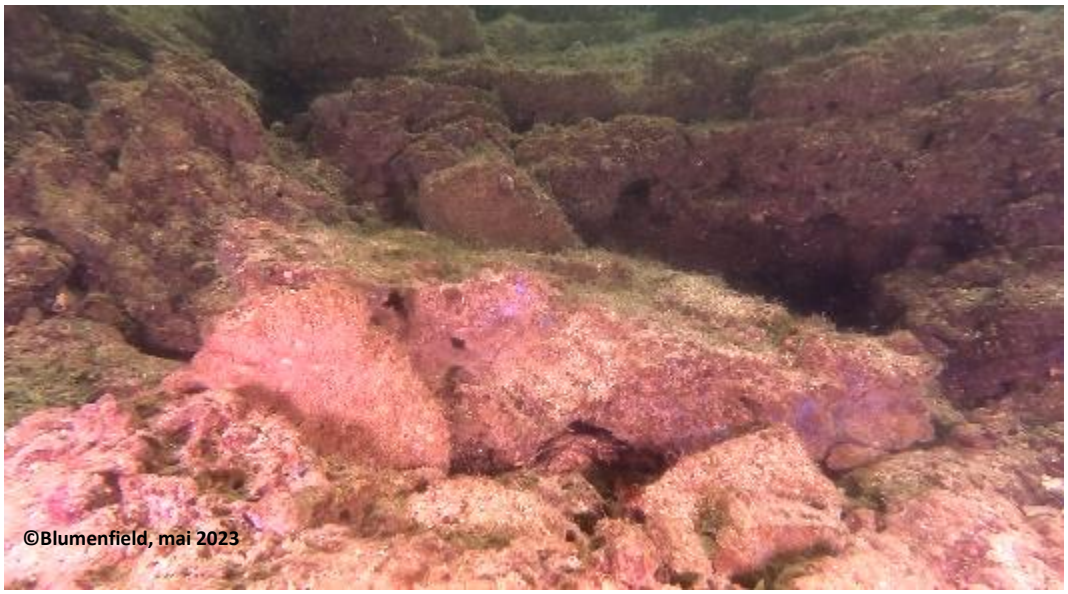


Figure 4.98 Point T6.3 - Habitat MB14E Marine caves, overhangs, and channels in the infralittoral rock in the Black Sea (Blumenfield, May 2023)

Figure 4.99 Point P23 - Habitat MC541 Mixed sandy sediments in the circalittoral zone of the Black Sea (Blumenfield, May 2023)

Ichthyofauna of the project area

In the INCDM Grigore Antipa report (Marine/Coastal Fauna - Fish and Shellfish Technical Summary Report-2019), the fish species from the Neptun Deep project area are described. The fish species found in the Project area, including those present according to the Natura 2000 Protected Marine Area Management Plan: ROSAC0273 Zona marină de la Capul Tuzla, have been classified into three main categories for easy interpretation.

The first category pertains to species listed in the IUCN categories, i.e., those that are vulnerable, threatened, or critically endangered.

Secondly, to provide support in assessing future socio-economic impact, species of economic importance have been presented, whether as commercially exploited species or as targets of traditional subsistence activities of local fishermen.

The third category studied includes the rest of the species that do not fall into either of the two previous categories.

Table 4.92 The list of fish species encountered in the project area (compiled after INCDM Grigore Antipa-2019)

No.	Species	Species falling under the IUCN categories Vulnerable-VU, Endangered-EN, or Critically Endangered-CR.	Fish species of economic importance (commercially exploited or targeted for traditional activities)	Other fish species found in the project area and their IUCN category	Species from the list Ord. MMAP no. 488 dated March 24, 2020	Species from the annexes of G.E.O. nr. 57/2007
1	Chondrychthyes Order Squaliformes Family Squalidae ***Squalus acanthias*** Linnaeus, 1758,	VU			NT	
2.	Family Rajidae ***Raja clavata*** Linnaeus, 1758			NT	NT	
3.	***Acipenser stellatus*** Pallas, 1771	CR			CR	Annex 5A
4.	Order Clupeiformes Family Clupeidae ***Sprattus sprattus*** Linnaeus, 1758 LC, secondary consumer		LC			
5.	***Alosa tanaica*** Grimm, 1901		LC			Annex 3, 5A
6.	***Alosa immaculata (Alosa pontica)*** Bennett, 1835	VU				Annex 3, 5A
7.	Family Engraulidae ***Engraulis encrasicolus*** Linnaeus, 1758		LC			
8.	Family Salmonidae ***Salmo labrax*** Pallas, 1814			LC	VU	
9.	Order Scombriformes Family Scombridae ***Scomber scombrus*** Linnaeus, 1758		LC			
10.	Order Anguilliformes Family Anguillidae ***Anguilla anguilla*** Linnaeus, 1758	CR			CR	
11.	Order Beloniformes Family Belonidae ***Belone belone*** Linnaeus, 1761		LC			
12.	Order Gadiformes Family Gadiidae ***Gaidropsarus mediterraneus*** Linnaeus, 1758, tertiary consumer			LC	NE	

No.	Species	Species falling under the IUCN categories Vulnerable-VU, Endangered-EN, or Critically Endangered-CR.	Fish species of economic importance (commercially exploited or targeted for traditional activities)	Other fish species found in the project area and their IUCN category	Species from the list Ord. MMAP no. 488 dated March 24, 2020	Species from the annexes of G.E.O. nr. 57/2007
13.	***Merlangius merlangus*** Linnaeus, 1758			LC		
14.	Order Syngnathiformes Family Syngnathidae ***Syngnathus tenuirostris*** Rathke, 1837			DD	DD	
15.	***Syngnathus typhle*** Linnaeus, 1758 LC, tertiary consumer			LC	DD	
16.	***Syngnathus variegatus*** Pallas, 1811			DD	DD	
17.	***Nerophis ophidion*** Linnaeus, 1758			LC		
18.	***Hippocampus guttulatus*** Leach, 1814			DD	VU	
19.	Order Mugiliformes Family Mugilidae ***Liza aurata*** Risso, 1810		LC			
20.	***Mugil cephalus*** *Linnaeus,* 1758		LC			
21.	Family Atherinidae ***Atherina boyeri*** Linnaeus, 1758			LC		
22.	Order Perciformes Family Sciaenidae ***Umbrina cirrosa*** Linnaeus, 1758,			DD		
23.	Family Mullidae ***Mullus barbatus*** *ponticus* Essipov, 1927		LC			
24.	***Mullus surmuletus*** Linnaeus, 1758 LC, secondary consumer		LC			
25.	Family Pomatidae ***Pomatomus saltatrix*** Linnaeus, 1766	VU				
26.	Family Carangidae ***Trachurus mediterraneus*** (Steindachner, 1868)		LC			
27.	Family Labridae ***Symphodus cinereus*** Nordmann, 1848 LC, secondary consumer			LC		
28.	***Symphodus ocellatus*** Forsskal, 1775			LC		
29.	***Symphodus roissali*** Risso, 1810			LC		

No.	Species	Species falling under the IUCN categories Vulnerable-VU, Endangered-EN, or Critically Endangered-CR.	Fish species of economic importance (commercially exploited or targeted for traditional activities)	Other fish species found in the project area and their IUCN category	Species from the list Ord. MMAP no. 488 dated March 24, 2020	Species from the annexes of G.E.O. nr. 57/2007
30.	***Symphodus rostratus*** Bloch, 1797			LC		
31.	***Symphodus tinca*** Linnaeus, 1758			LC		
32.	***Ctenolabrus rupestris*** Linnaeus, 1758			LC		
33.	***Coris julis*** Linnaeus, 1758			LC		
34.	Family Trachinidae ***Trachinus draco*** Linnaeus, 1758			LC		
35.	Family Uranoscopidae ***Uranoscopus scaber*** Linnaeus, 1758			LC		
36.	Family Blenniidae ***Blennius sphynx*** Valencienns, 1837			LC		
37.	***Parablennius sanguinolentus*** Pallas, 1811			LC		
38.	***Parablennius tentacularis*** Brunnich, 1768			LC		
39.	Family Ammodytidae ***Gymnammodites cicerellus*** Rafinesque, 1810			LC		
40.	Family Gobiidae ***Gobius niger*** Linnaeus, 1758		LC		NE	
41.	***Mesogobius batrachocephalus*** Pallas, 1811		LC			5B
42.	***Neogobius melanostomus*** Pallas, 1811		LC			
43.	***Ponticola platyrostris*** Pallas, 1811			LC		
44.	***Proterorhinus marmoratus*** Pallas, 1811			LC		4B
45.	***Aphia minuta*** Risso, 1810			LC		
46.	Family Scorpaenidae ***Scorpaena porcus*** Linnaeus, 1758			LC		
47.	Family Triglidae ***Chelidonichthys lucerna*** Linnaeus, 1758			LC	VU	
48.	Family Gasterosteidae ***Gasterosteus aculeatus*** Linnaeus, 1758			LC		

No.	Species	Species falling under the IUCN categories Vulnerable-VU, Endangered-EN, or Critically Endangered-CR.	Fish species of economic importance (commercially exploited or targeted for traditional activities)	Other fish species found in the project area and their IUCN category	Species from the list Ord. MMAP no. 488 dated March 24, 2020	Species from the annexes of G.E.O. nr. 57/2007
49.	Order Pleuronectiformes Family Bothidae ***Scophthalmus maximus*** Linnaeus, 1758 ***(Psetta maeotica*** Pallas, 1811)		NT			
50.	Soleidae Family ***Pegusa lascaris*** Risso, 1810 LC, tertiary consumer			LC		

Legend:

IUCN - International Union for Conservation of Nature: EX - Extinct, EW - Extinct in the Wild, CR - Critically Endangered, EN - Endangered, VU - Vulnerable, NT - Near Threatened, LC - Least Concern, DD - Data Deficient, NE - Not Evaluated.

G.E.O. No. 57/2007: **ANNEX 3** - Species of plants and animals that require the designation of special conservation areas and special protection areas for avifauna. **ANNEX 4 B** - SPECIES OF NATIONAL INTEREST - Species of animals and plants that require strict protection. **ANNEX 5 A** - SPECIES OF COMMUNITY INTEREST - Species of plants and animals of community interest, excluding bird species, which are subject to management measures for their collection from nature and exploitation. **ANNEX 5 B** - SPECIES OF NATIONAL INTEREST - Species of animals that are subject to management measures for their collection from nature and exploitation.

Fish migration routes

In the marine area of the project, the ichthyofauna may undergo qualitative and quantitative changes both seasonally and annually, directly related to the availability of food sources and seasonal migrations for reproduction, which involve movements of populations from offshore deeper areas to shallow waters near the shore, where they lay their eggs.

Fish migrations are defined as the regular and periodic movements that certain species undertake under the influence of internal and external factors, following more or less stable routes between two geographic regions representing specific habitats for certain moments in the species' life. However, there are species, especially pelagic ones, where the majority, if not all individuals, undertake long cyclic and periodic movements.

Below, we present the species of fish that regularly migrate in the Black Sea (source: Atlas of the main fish species of the Black Sea, 2008)

Engraulis encrasicolus (European anchovy)

The European anchovy is a pelagic marine species that forms large shoals and approaches the shore during spring (when the water temperature exceeds 7°C).

It performs irregular migrations from offshore to the coast and vice versa, depending on thermal conditions and food availability. During winter, it forms large shoals far from the shore at depths of 60-70 meters but can occasionally come to the surface.

Figure 4.100 *Engraulis encrasicolus* (photo: M. Galaţchi, INCDM)

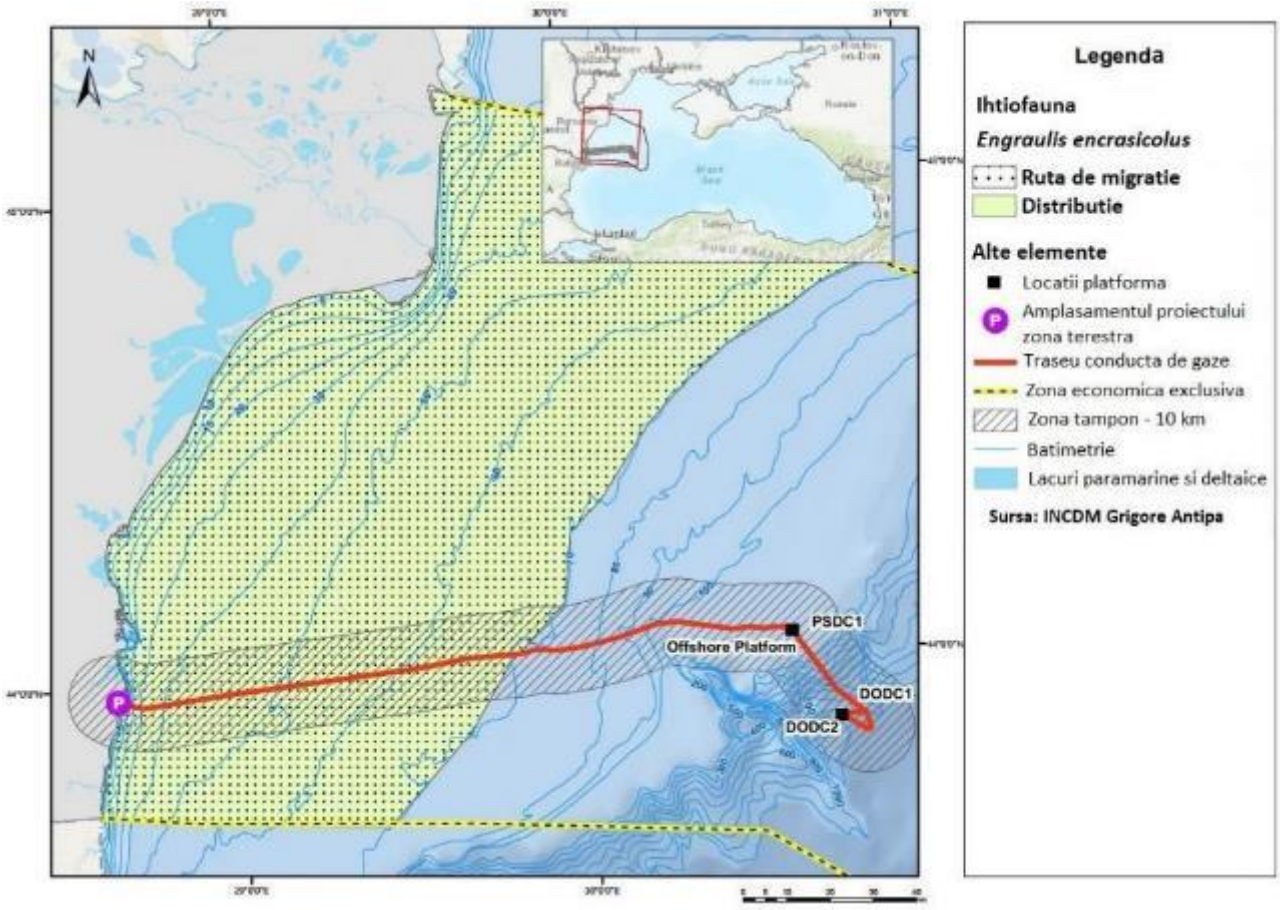


Figure 4.101 Distribution of the species Engraulis encrasicolus at the Romanian coast

Gasterosteus aculeatus (Three-spined stickleback)

It is found along the entire coastline, and in spring, it enters the estuaries of the Danube River, as well as the coastal lagoons connected to the sea. It is a migratory marine form, wintering at sea, and approaching the shore in schools during spring, entering freshwater and brackish coastal lakes for reproduction.

Figure 4.102 Gasterosteus aculeatus (Source: INCDM)

Pomatomus saltatrix (Bluefish or Tailor)

The species is cosmopolitan and common throughout the Mediterranean Sea and the Black Sea. It is a pelagic species that inhabits waters above the continental shelf, ranging to depths of 20 meters. During summer, it comes closer to the coast. In the Black Sea, it undertakes migrations driven by temperature, approaching the shoreline starting from May when the water temperature reaches 15°C. Adults and especially juveniles are found near the shore at temperatures of 20-26°C. From October-November, it retreats to deeper waters, likely towards the south. It remains active during the day.

During the winter, a significant portion of the summer population migrates to the Sea of Marmara for hibernation, while a small proportion stays in the Black Sea for wintering.

Figure 4.103 Pomatomus saltatrix

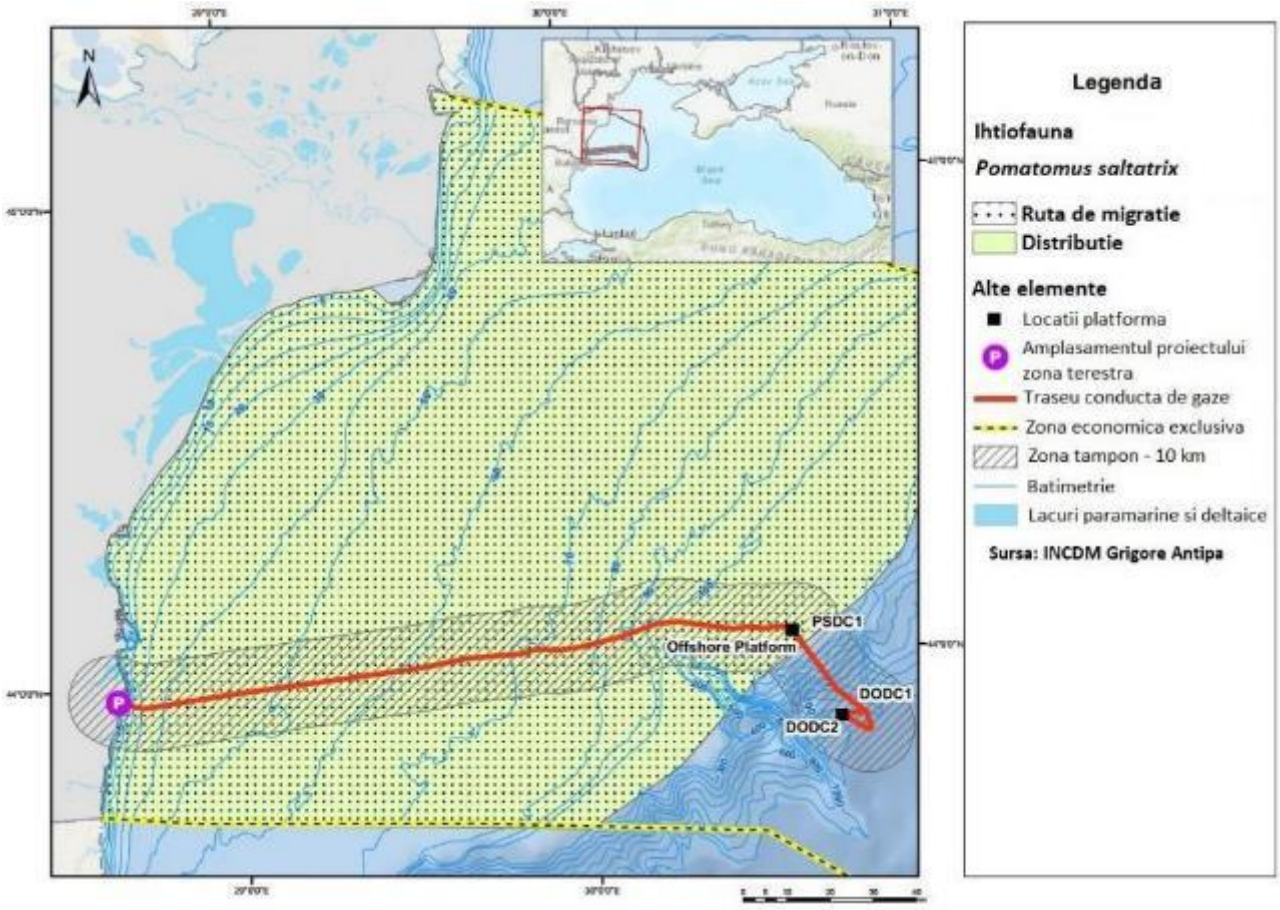


Figure 4.104 Distribution of the species Pomatomus saltatrix along the Romanian coastline

Trachurus mediterraneus ponticus (Horse mackerel)

Commonly found in the Black Sea, the Sea of Azov (except for its brackish parts), and the Sea of Marmara (especially during winter). Along the Black Sea coast, it is mainly distributed in the northern regions. It is a pelagic marine species that forms schools and exhibits a pronounced thermophilic behavior. During winter, it overwinters at depths of 80-100 meters in the Sea of Marmara and the southwestern part of the Black Sea.

In spring, they leave their wintering grounds en masse and head northward. Schools of horse mackerel can be observed along the Bulgarian coast in March and the Romanian coast in April. The return to their wintering grounds starts in October.

During the summer, schools of horse mackerel undertake irregular migrations from open waters to the coast and vice versa, depending on water temperature, wind, salinity, food availability, and other factors. They tend to stay in the upper water layers, at depths of up to 25 meters.

Figure 4.105 *Trachurus mediterraneus* (photo: G. Ţiganov, INCDM)

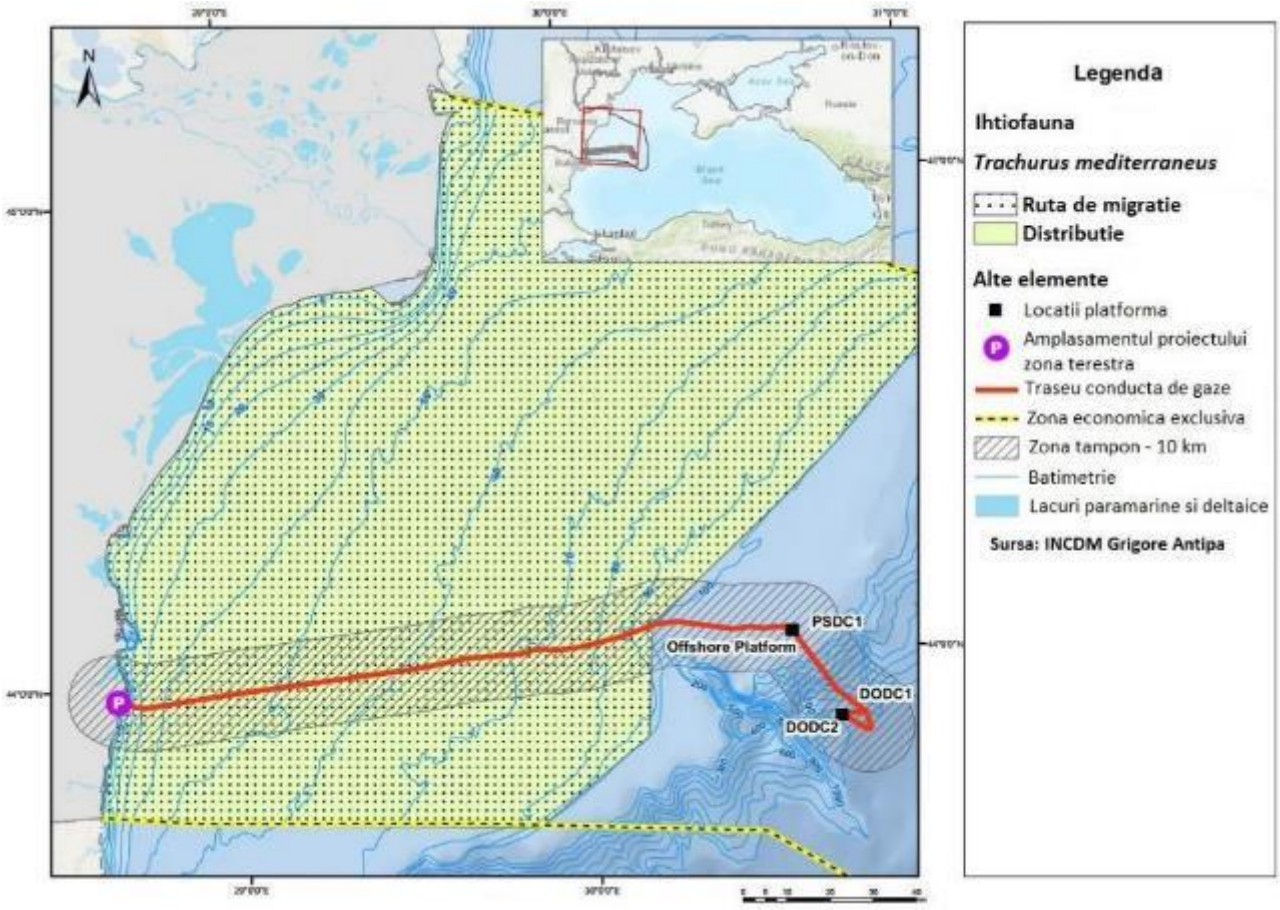


Figure 4.106 The distribution of the species Trachurus mediterraneus ponticus along the Romanian coast

Acipenser stellatus (Stellate Sturgeon)

As an anadromous migratory species, the Stellate Sturgeon is distributed in the Black Sea, Sea of Azov, northern Caspian Sea, and the rivers that flow into these seas. The majority of its life is spent in the sea, at depths slightly shallower than those of the Beluga and Sevruga sturgeons, typically in the zone characterized by the mytiloid facies. During spring and summer, it approaches the shore

at depths of 10-40 meters, while in autumn, it can be found at depths of 40-100 meters. The species undertakes long migrations in the sea.

Figure 4.107 *Acipenser stellatus* (Source: INCDM)

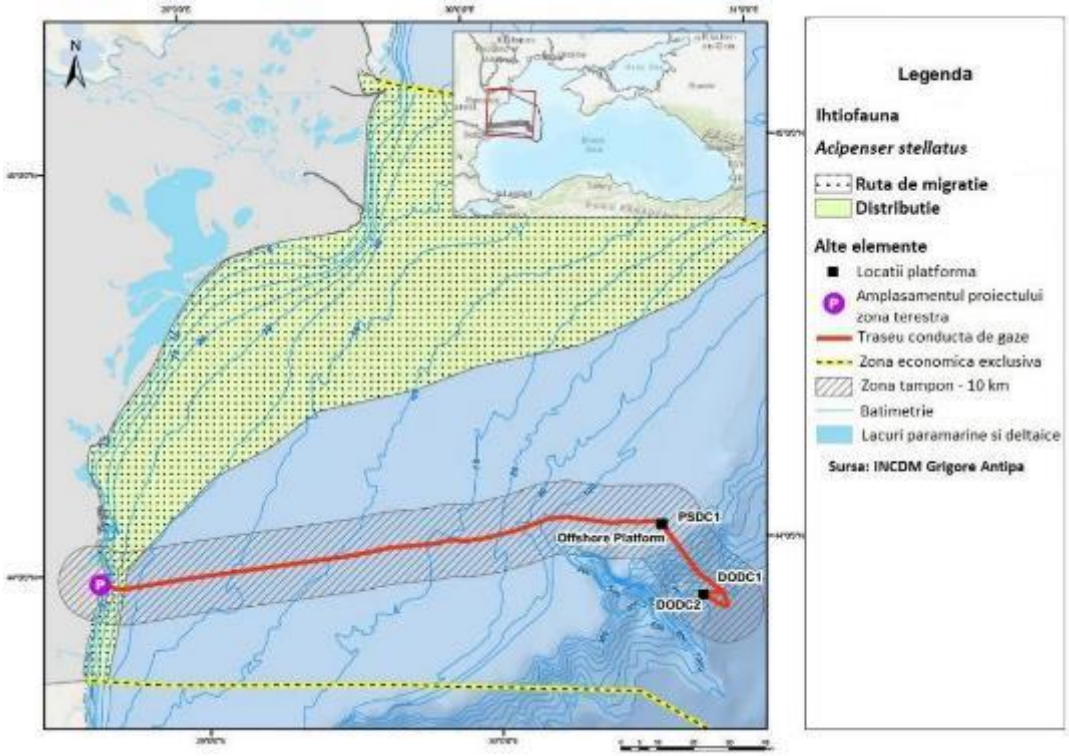


Figure 4.108 Distribuția speciei *Acipenser stellatus* la litoralul românesc

Alosa tanaica (Shad)

Marine species, anadromous, which migrates for reproduction from the sea to the freshwaters of lakes, lagoons, and coastal rivers.

Figure 4.109 *Alosa tanaica (*photo: G. Ţiganov, INCDM)

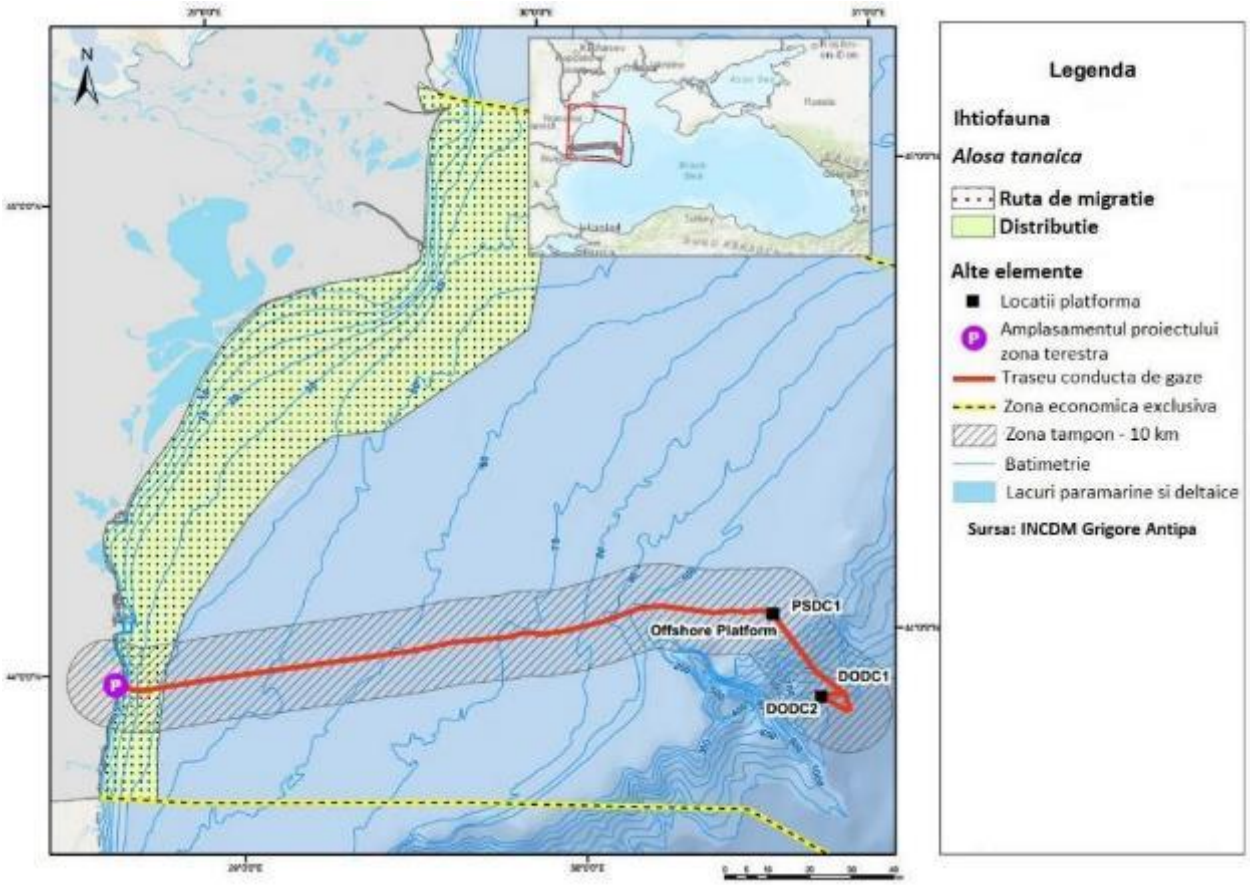


Figure 4.110 Distribuția speciei *Alosa tanaica* la litoralul românesc

*Alosa immaculata (*Danube Herring)

Marine migratory species, which winters at sea and reproduces in the river. The species winters at a considerable distance from the shore and at depths of up to 90 meters. Migration begins in March and peaks in the interval of April-May. After reproduction, adult individuals descend into the sea, a period that can last until July; the migration back to the sea is grouped, retreating to deep waters, far from the shore

Figure 4.111 *Alosa immaculata* (Source: INCDM)

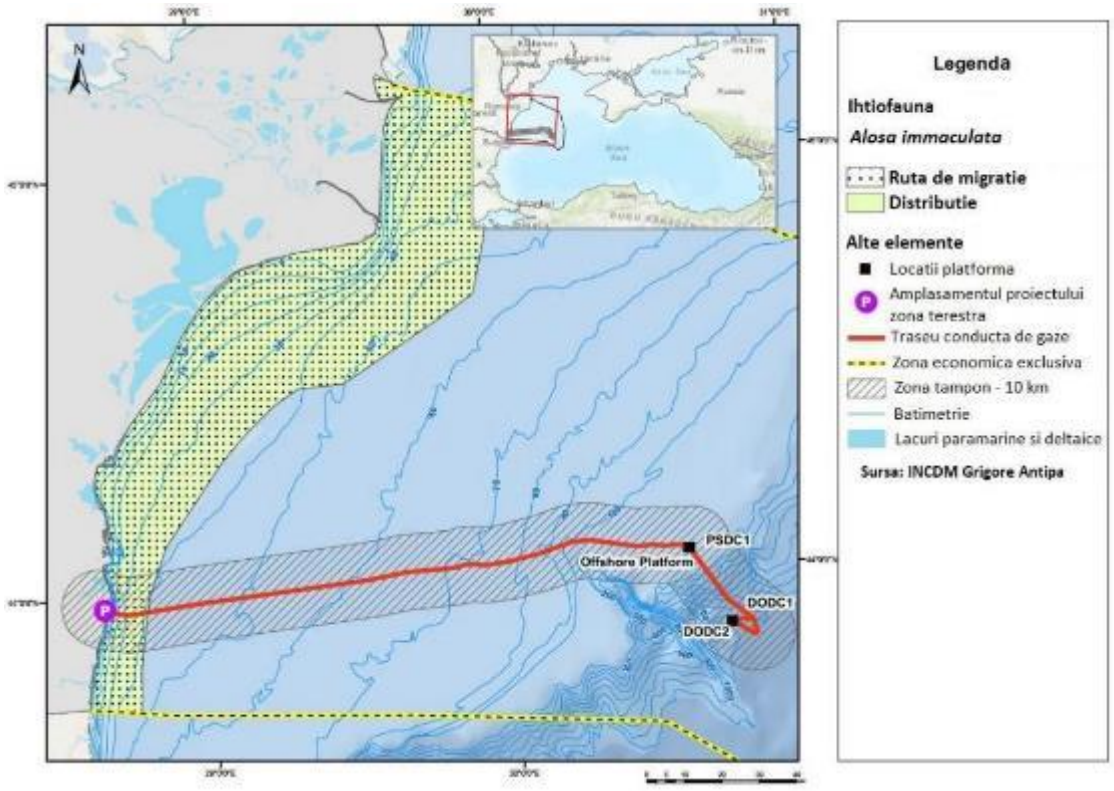


Figure 4.112 Distribution of the species Alosa immaculata at the Romanian coastline

*Dicentrarchus labrax (*European sea bass)

The subspecies of European sea bass found in the Black Sea and the Sea of Azov has a wide distribution range. Until reaching maturity, it lives in coastal marine waters, at depths of up to 80 meters, and undertakes migrations of hundreds of kilometers. Starting at the age of 2 years for males and 3 years for females, they can enter freshwater for reproduction, migrating up rivers over long distances. After spawning, the adult breeders return to the sea. Some individuals remain in freshwater and establish permanent populations in lakes and rivers.

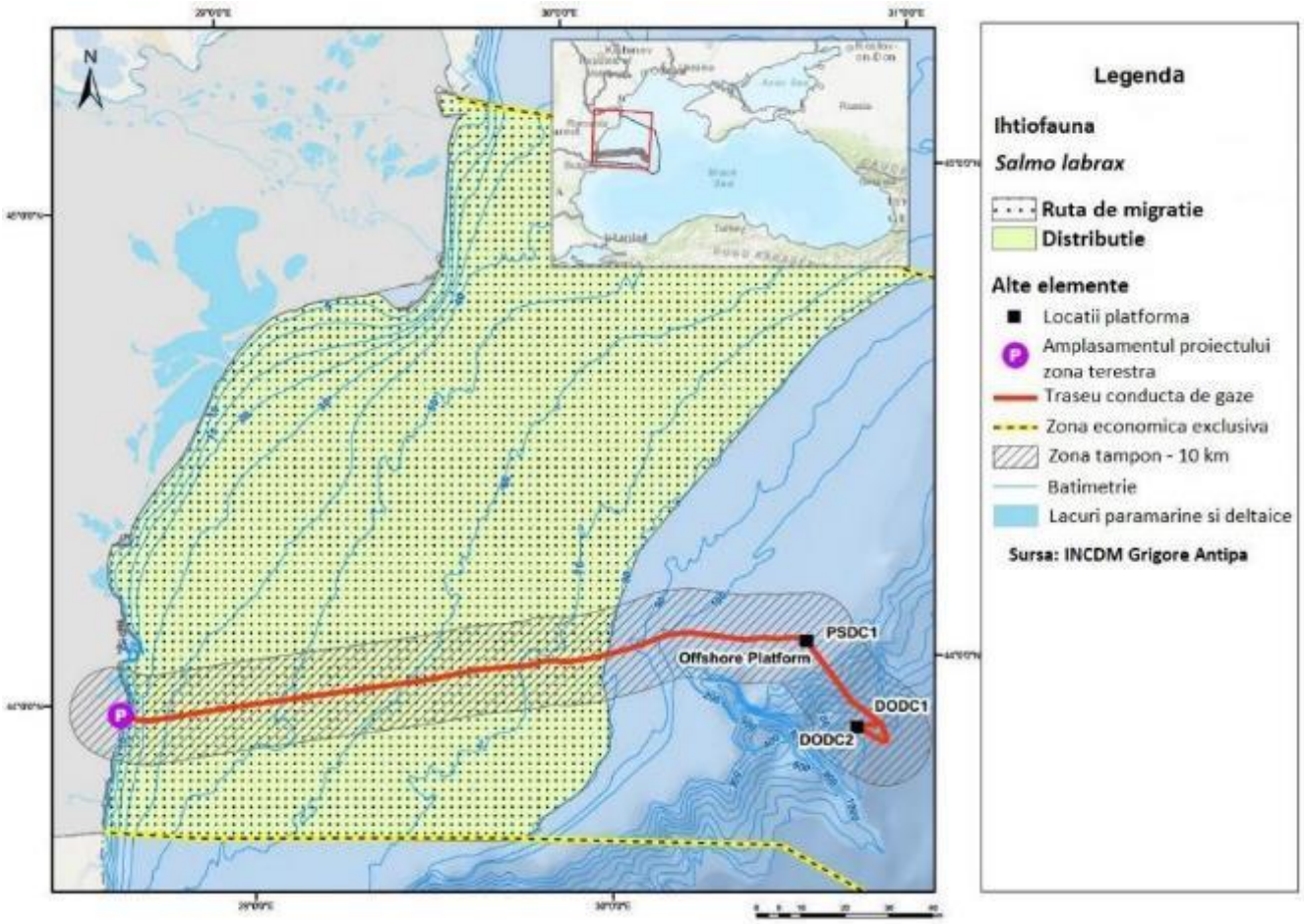


Figure 4.113 The distribution of the species Salmo labrax (European sea bass) along the Romanian coast

*Sarda sarda (*Atlantic bonito)

A cosmopolitan species, the Atlantic bonito, can be found in coastal waters, at depths of up to 100 meters. It is a migratory species and often forms schools near the surface. It migrates from the Mediterranean Sea to the Black Sea and the Atlantic Ocean, reaching as far south as Morocco. During the winter, individuals from the Black Sea mostly overwinter in the Sea of Marmara and the Aegean Sea.

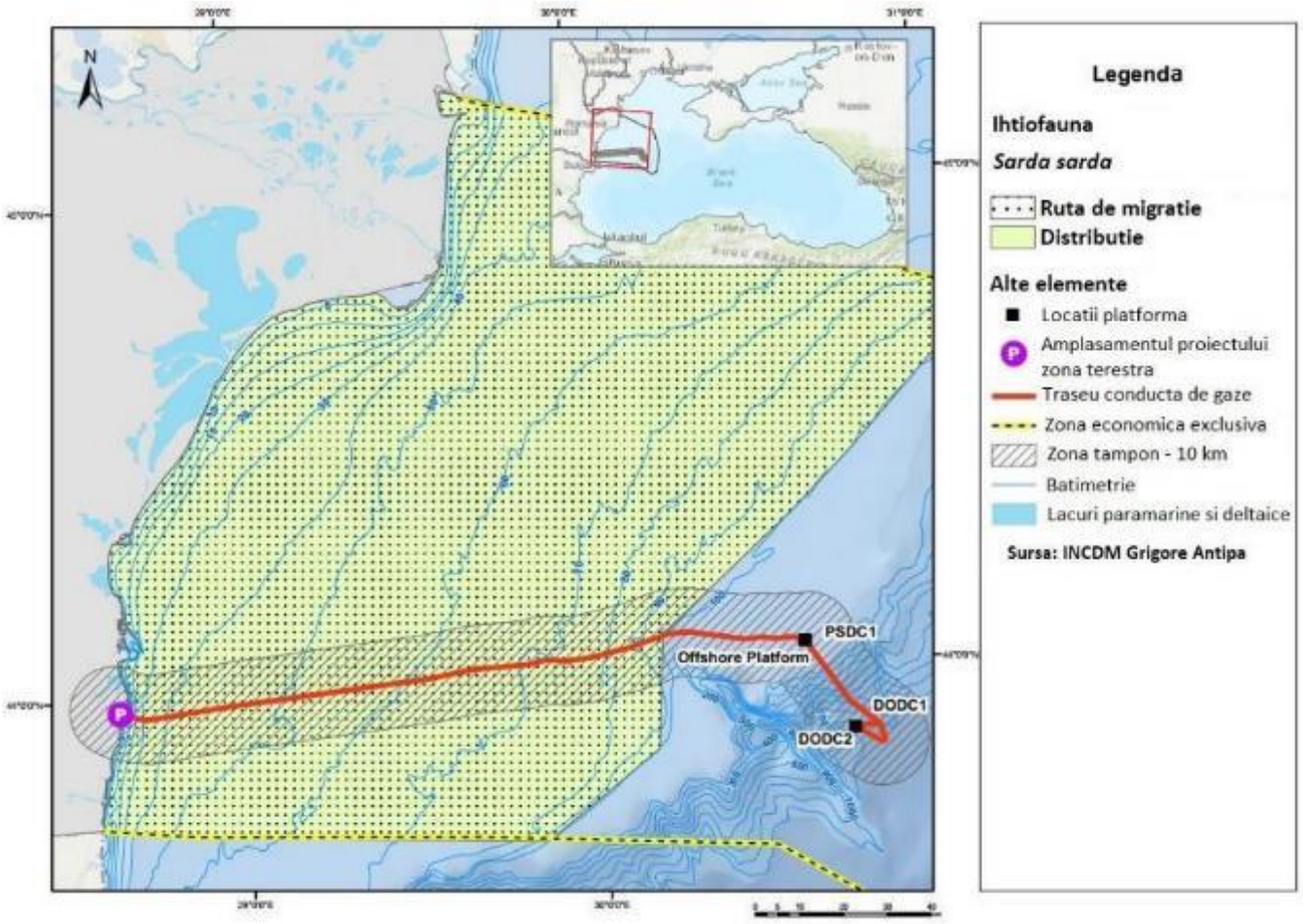


Figure 4.114 The distribution of the species *Sarda sarda* along the Romanian Coast

Scomber scombrus (Atlantic mackerel)

It has a wide distribution in the Atlantic Ocean, Mediterranean Sea, and the Black Sea. It is a pelagic and semi-demersal species that does not exceed depths of 250 meters. This species is gregarious, forming schools of individuals of similar size. During the winter and early spring, it can be found in deeper waters, while in shallow waters above the continental shelf. Periodically, it undergoes migrations for purposes such as reproduction, feeding, and wintering, in accordance with its physiological needs. During the winter, it can be found overwintering in the Sea of Marmara and in front of the Bosphorus.

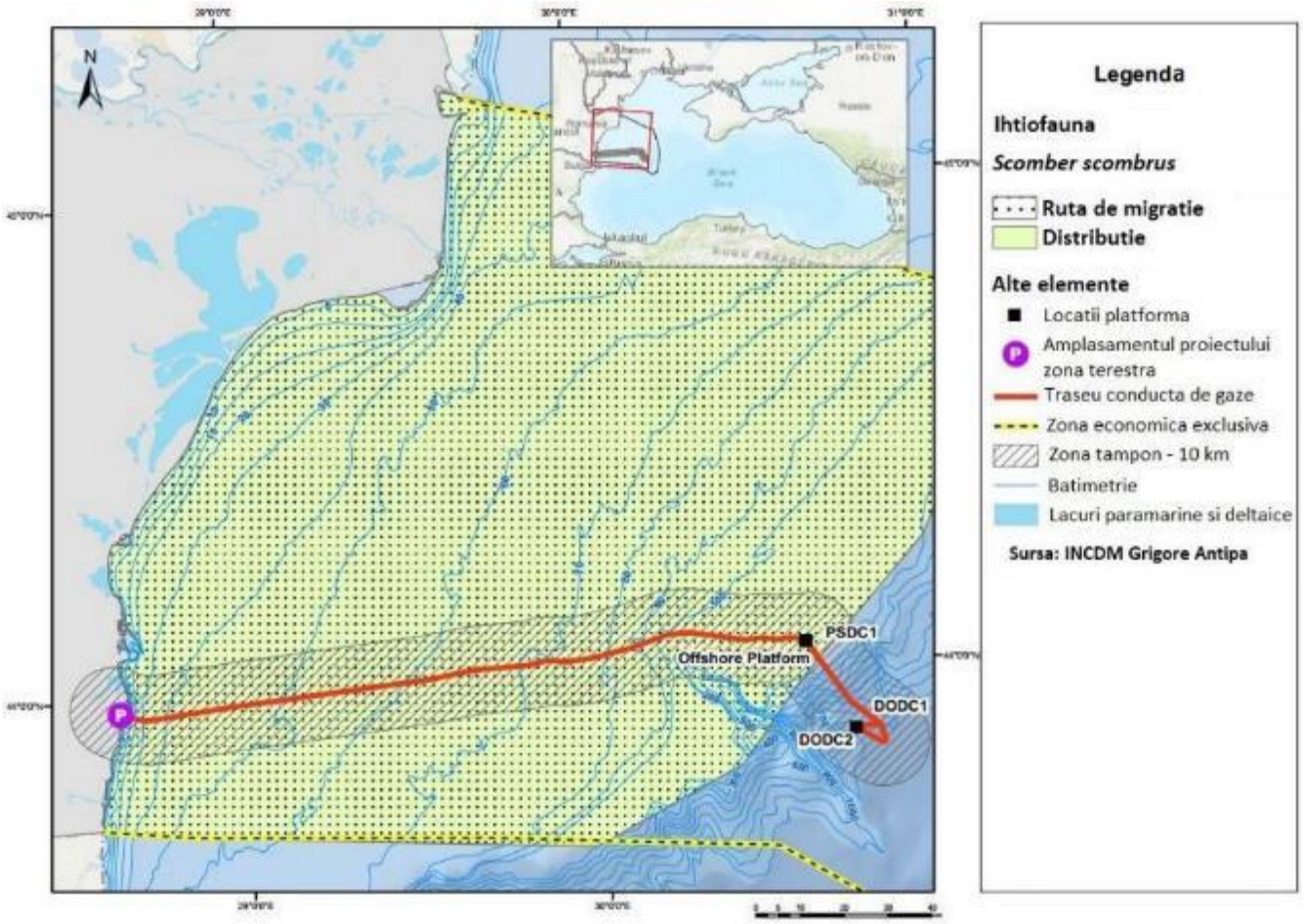


Figure 4.115 Distribution of Scomber scombrus at the Romanian coast

*Mullus barbatus (*Red mullet)

Mullus barbatus (Red mullet) is a benthic marine species that lives in small schools above sandy substrates. During summer, it stays at deeper depths, approaching the shore with the help of cool currents (10-15°C). In spring, it appears near the shore at a temperature of 7-8°C, and when the water temperature reaches 15-16°C, the red mullets retreat to deeper waters.

Figure 4.116 *Mullus barbatus (*photo: G. Ţiganov, INCDM)

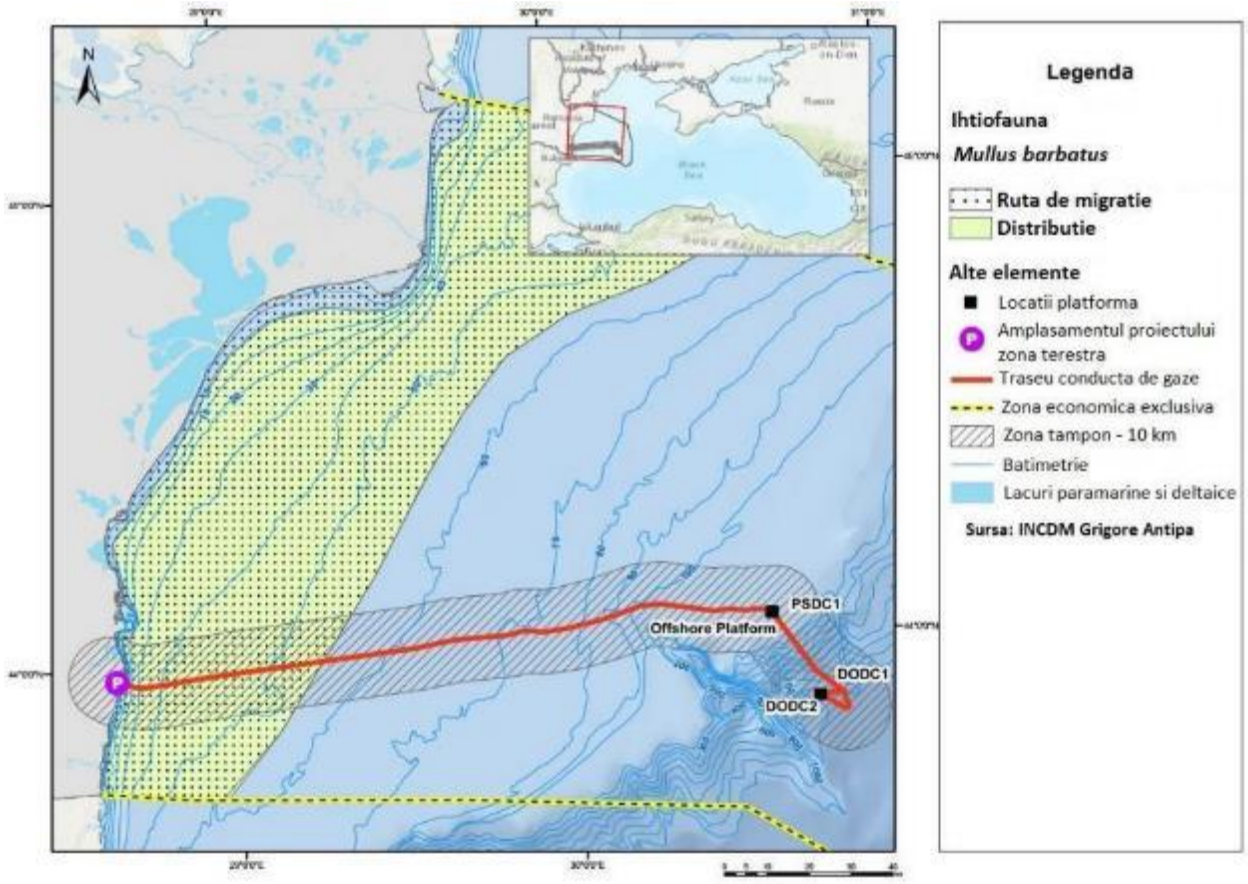


Figure 4.117 The distribution of the species Mullus barbatus (Red mullet) along the Romanian coastline

Marine mammals

Marine mammals in the Black Sea are represented by three species: the harbor porpoise (*Phocoena phocoena ssp. relicta*), the common dolphin (*Delphinus delphis ssp. ponticus*), and the bottlenose dolphin (*Tursiops truncatus ssp. ponticus*).

All three species are protected under various conventions and are listed in Annex IV of the Habitats Directive, thus requiring strict protection by the European Union member states. Based on specialized and occasional observations in the project area (INCDM Grigore Antipa), the most frequently observed species have been the harbor porpoise and the bottlenose dolphin (especially in the coastal area of the project), while the common dolphin may be present in the project area, particularly in the offshore zone.

The presence of these species in the project area is primarily dependent on the season and the availability of food. Current knowledge regarding important areas for cetaceans (critical habitats) in the Black Sea is incomplete (according to INCDM Grigore Antipa, Marine/Coastal Fauna – Cetaceans (Marine Mammals) Technical Summary Report, 2019).

The western Black Sea, including the Bulgarian and Romanian areas, as well as the eastern and southern parts of the basin, are less studied than the northern part of the Black Sea. Seasonal and interannual variations in cetacean migration and distribution have been poorly studied.

Within the ROSAC0273 Cape Tuzla Marine Zone, the harbor porpoise (*Phocoena phocoena relicta*) and the bottlenose dolphin (*Tursiops truncatus ssp. ponticus*) are present. The common dolphin

(*Delphinus delphis ssp. ponticus*) is not indicated as being present within the ROSAC0273 Cape Tuzla Marine Zone.

Phocoena phocoena ssp. relicta (Abel, 1905) primarily inhabits the relatively shallow coastal waters of the Black Sea. Along the Romanian coast, this species can be observed from April to November, most often in front of the Danube river mouths. It can even be seen in ports while searching for food. After the lactation period, both juveniles and adults feed on small benthic fish species (gobies), pelagic species (anchovy, sand smelt), and benthic invertebrates.

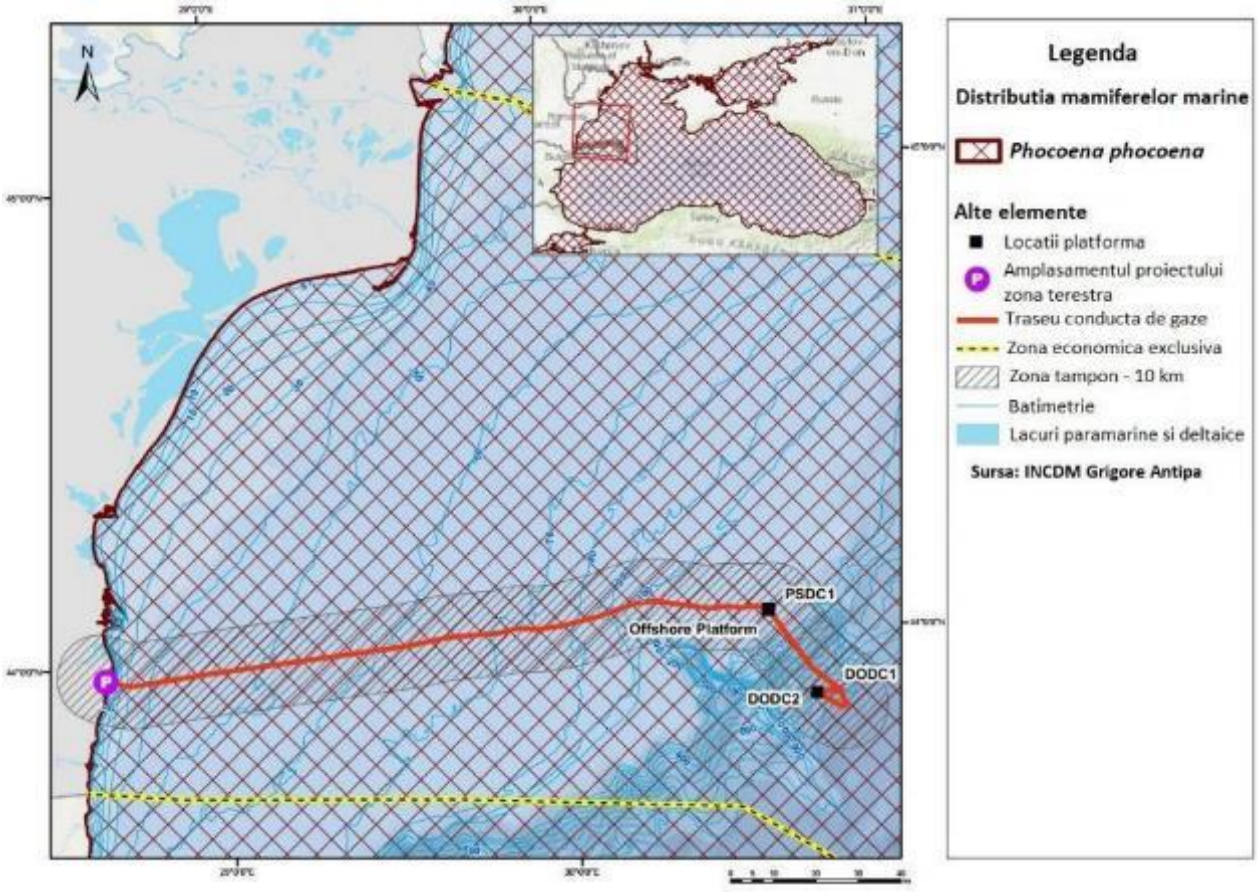


Figure 4.118 The distribution of the species Phocoena phocoena ssp. relicta in the project area.

Tursiops truncatus ssp. *ponticus* (Barabasch, 1940)

Tursiops truncatus ssp. ponticus (Bottlenose Dolphin) is the most frequently observed species, due in part to its coastal habitat and also because of its higher ability to live in captivity. It is the most robust pontic species, reaching up to 3.3 meters in length, with a very long lifespan (20-30 years) and high fertility. The species is common throughout the entire continental shelf of the Black Sea, although it can occasionally appear in open waters and very rarely in the Sea of Azov. Along the Romanian coast, it can be observed from the end of June to the end of August; in November, it leaves Romanian waters and migrates towards the coasts of Crimea and Anatolia. Bottlenose dolphins can associate in groups of 30-500 individuals, and adults and juveniles always associate in groups. In the spring, they appear near the shore in search of food, which includes various species of pelagic fish, both small and large: anchovies, cod, sea bream, mullet, and others.

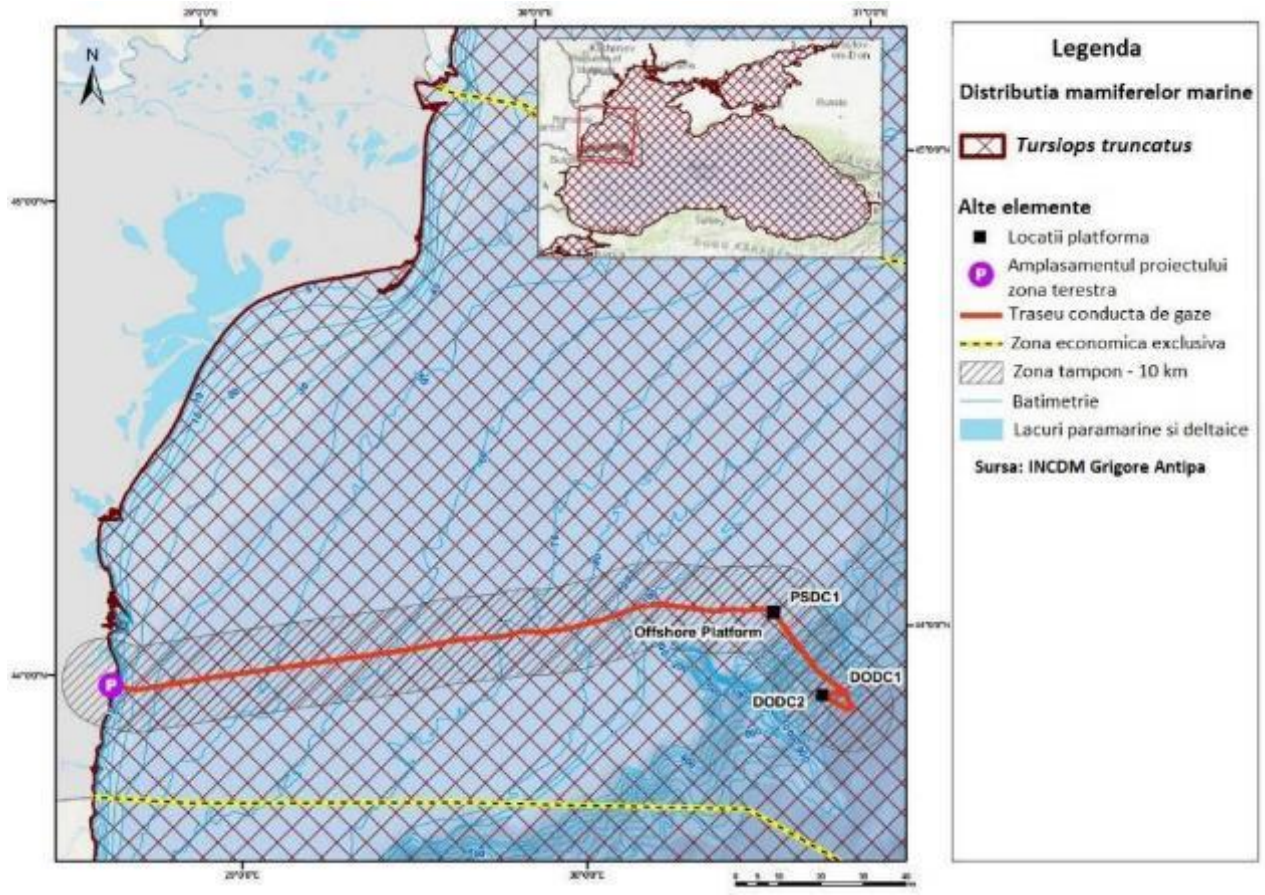


Figure 4.119 The distribution of the species *Tursiops truncates* in the project area

Delphinus delphis ssp. *ponticus* (Barabash-Nikiforov, 1935)

The distribution of the common dolphin (*Delphinus delphis ssp. ponticus*) covers almost the entire Black Sea, including the territorial waters and exclusive economic zones of Bulgaria, Georgia, Romania, Russia, Turkey, and Ukraine, as well as the inland waters of Ukraine in the Gulf of Karkinitsky. Common dolphins are also found in the Bosporus, the Sea of Marmara, and the Dardanelles, but the possibility that they belong to the subspecies in the Black Sea should be verified through appropriate taxonomic studies, including genetic analysis. The species is not found in the Sea of Azov and usually avoids the Kerch Strait.

Its main habitat consists of offshore areas of the sea, usually with depths over 200 meters, and it visits shallower coastal waters following seasonal aggregations and mass migrations of its preferred prey, such as anchovies and sprat. Similar to the porpoise, annual concentrations of anchovies in the southeastern Black Sea and, to a lesser extent, in the southern Crimea create favorable conditions for wintering gatherings of common dolphins. On the other hand, sprat aggregations in the summer in the north-western, north-eastern, and central Black Sea attract common dolphins to different feeding areas. These dolphins avoid waters with low salinity, which may explain why they never appear in the Sea of Azov and normally not in the Kerch Strait.

In Bulgarian waters, during spring (March-April, sometimes in February), common dolphins first appear in the southern area (from the Rezovska River to Cape Maslen). As the season progresses,

their distribution shifts towards deeper and northern waters. Here, they form larger aggregations - up to several thousand individuals. In autumn, these cetaceans make a reverse migration along the same route.

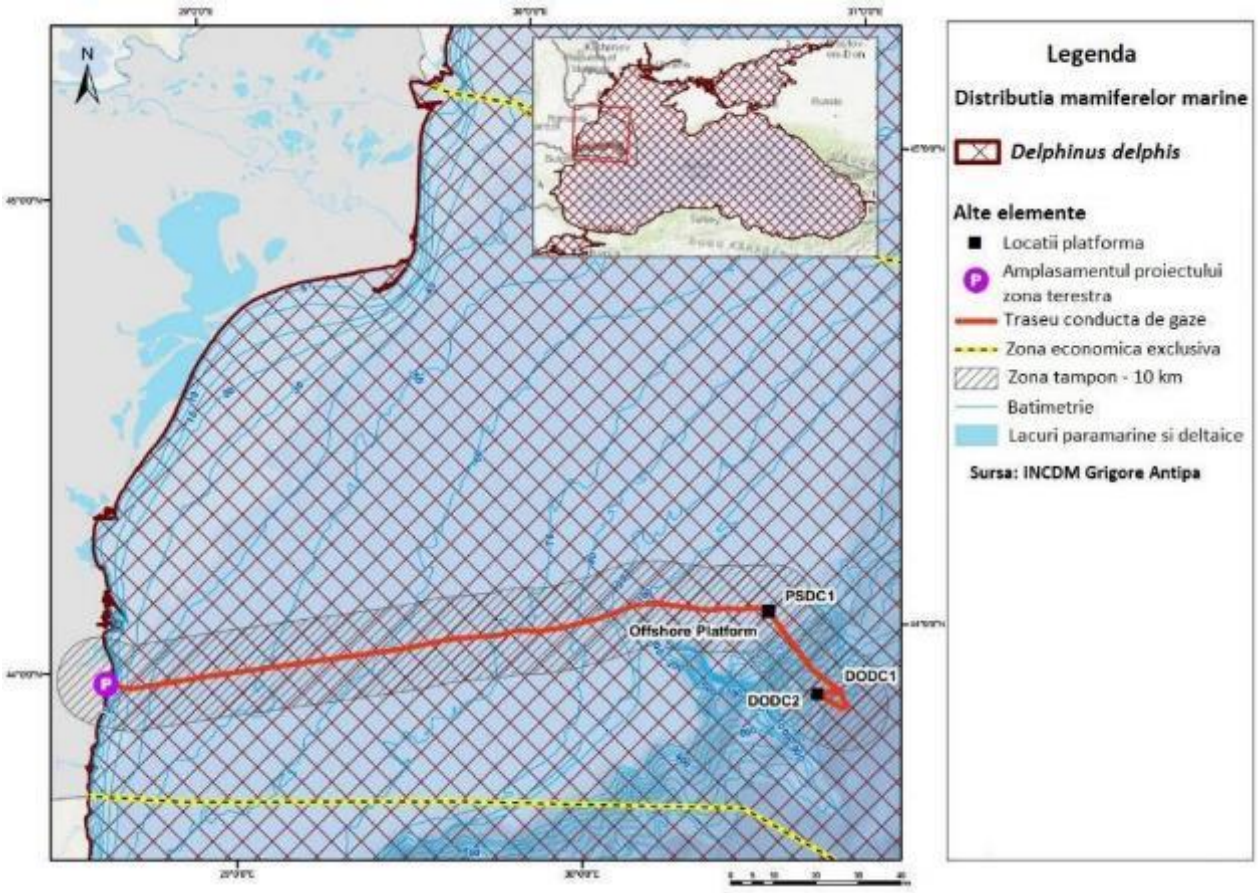


Figure 4.120 The distribution of the species *Delphinus delphis* in the project area

4.10.4 Data collection and methods of conducting investigations

For the development of Section **4.10 - Biodiversity**, two methods were applied. Firstly, the method of reviewing scientific and technical data and information from documents, reports, and field studies carried out for the Neptun Deep project during the period 2018-2022 was employed.

Secondly, for updating field data, field trips and marine expeditions were conducted by Blumenfield® experts during the period March - June 2023.

The methodologies and methods used in the field investigations for species inventory of fauna and flora are presented in Annex L.

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- Romanian annual report on the national data collection program for fisheries;
- Scientific research projects;
- Marine environment monitoring program during drilling campaigns executed in the Neptun block during 2012-2015;
- Dedicated baseline environmental study carried out along the pipeline route and the location of the SWP and wells, conducted in 2017 and 2021;
- Study on habitats and benthic species carried out along the pipeline route in 2021;
- Scientific research papers and reports of the projects carried out in the project area;
- NIMRD "Grigore Antipa" databases containing information on biological parame-ters covering the period 2010-2021.

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4.11 ENVIRONMENTAL RADIOACTIVITY

Environmental radioactivity monitoring is done by monitoring the radioactivity of environmental components, by measuring the radioactive concentration of substances that contain radionuclides and that produce the external and internal exposure of the body: soil, air, water and a lot of components of the biosphere (flora and fauna). In order to follow the variation over time of the radioactive concentrations of substances of interest for radioprotection and to announce significant increases, it is necessary to know the values of these radioactive concentrations that provide the natural background[18].

4.11.1 Air radioactivity

Air radioactivity monitoring is the fastest way to identify the presence of natural and artificial radionuclides in the atmosphere, beyond the limits of the natural radiation background.

For this purpose, determinations of the gamma dose rate in air, global beta determinations and spectrometric gamma are performed on atmospheric aerosols, as well as on total atmospheric deposition (wet and dry).

4.11.1.1 Gamma dose rate absorbed in air

The determination of the gamma dose rate is carried out continuously with the help of automatic stations for the determination of the ambient gamma dose rate, the values obtained give a first indication of the radioactivity in the atmosphere.

[18] The environmental state report of Constanta County, EPA, 2021 , http://www.anpm.ro/ro/web/apm-constanta/rapoarte-anuale1

The gamma dose rate was within the variation limit of the natural background.

In 2021, at SSRM Constanța the gamma dose flow values varied in the range of 0.080 – 0.150 µSv/h, the annual average being 0.095 µSv/h, and at SSRM Cernavodă the variation range was 0.060-0.150 µSv/h, the annual average being 0.101 µSv/h. (SSRM - Environmental Radioactivity Monitoring Station).

In 2022, at SSRM Constanța, the values of the gamma dose flow varied in the range of 0.080 - 0.120 µSv/h, the annual average being 0.095 µSv/h.

In the first quarter of 2023, at SSRM Constanța, the values of the gamma dose flow ranged between 0.092 - 0.130 µSv/h, the quarterly average being 0.094 µSv/h.

Operational notification limits for gamma dose flow values in air (according to OM no. 1978/2010) are: 0.250 µSv/h - warning, 1 µSv/h - warning, 10 µSv/h - alarm.

The gamma dose rate was within the variation limit of the natural background.

The evolution of the gamma dose rate, recorded in recent years at SSRM Constanța and Cernavodă, is presented in the figure below:

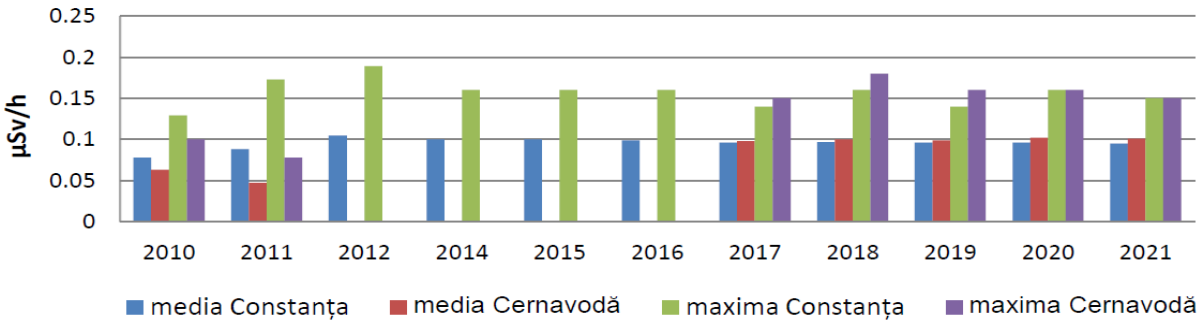

Figure 4.121 Average and maximum gamma dose rates in air

4.11.1.2 Atmospheric aerosols

The procedure for determining the radioactivity of the atmosphere consists of sucking atmospheric aerosols onto filters and measuring the activity of the filters at different time intervals. The air volumes sucked are 25-30 mc, and the suction intervals are 5 hours. In the case of stations with a continuous program, vacuuming is carried out in the time intervals: 02 - 07 (03 - 08, summer time), 08 - 13 (09 - 14, summer time), 14 - 19 (15 - 20, summer) and 20 – 01 (21 – 02, summer time).

The evolution of the average global beta activity upon immediate measurement of atmospheric aerosol samples, in the period 2010 – 2021, at SSRM Constanța and Cernavodă is presented in the figure below. The annual average was 1.44 Bq/mc at SSRM Constanța and 3.42 Bq/mc at SSRM Cernavodă.

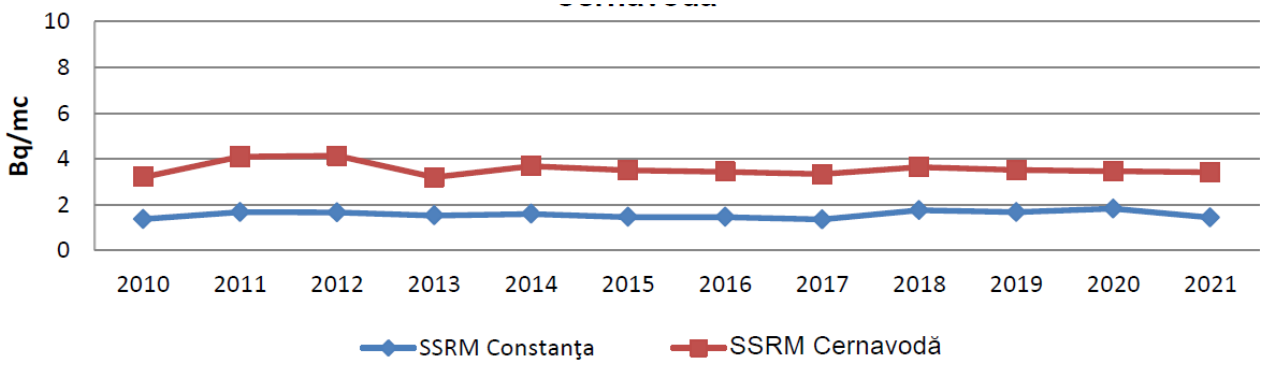

Figure 4.122 Annual averages of global beta activity of atmospheric aerosols - immediate measurements at SSRM Constanța and Cernavodă

Starting in 2021, SSRM Constanța has carried out high-frequency measurements on air filters sucked in at the station headquarters, in order to determine at an early stage the possible presence of artificial radionuclides in the atmosphere. A number of 52 samples accumulated weekly were analysed, the results obtained confirming the absence of artificial radionuclides.

In 2022, the evolution of the average global beta activity upon immediate measurement of atmospheric aerosol samples, at SSRM Constanța, was as follows: the annual average for the interval 02 – 07 (03 – 08, summer time) of 2.30 Bq/m^3 , 08 - 13 (09 – 14, summer time) of 1.36 Bq/m^3 , 14 - 19 (15 – 20, summer time) 1.135 Bq/m^3 and 20 – 01 (21 – 02, lime time) 1.79 Bq/m^3.

In 2023, the evolution of the global average beta activity in the immediate measurement of atmospheric aerosol samples, at SSRM Constanța, in the first quarter was as follows: the quarterly average for the interval 02 – 07 (03 – 08, summer time) of 1.92 Bq/m^3 , 08 - 13 (09 – 14, summer time) of 1.35 Bq/m^3 , 14 - 19 (15 – 20, summer time) 1.16 Bq/m^3 and 20 – 01 (21 – 02, lime time) 1.59 Bq/m^3.

4.11.1.3 4.11.1.3 Total atmospheric deposits

Sampling of total atmospheric deposition samples (sedimentable dust and precipitation) is done daily from an area of 0.3 square meters, the sampling duration being 24 h. The level of global beta radioactivity upon immediate measurement of atmospheric deposition samples is shown in figure 4.123

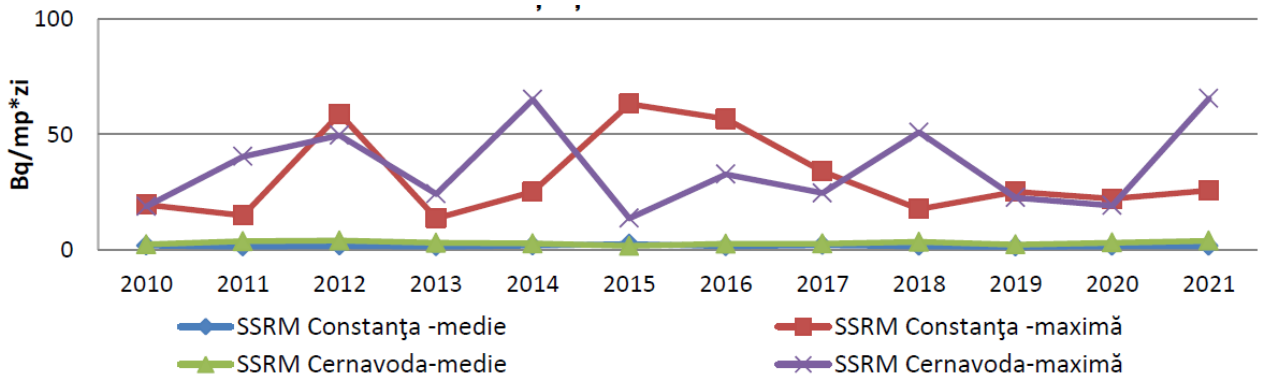

Figure 4.123 Level of global beta radioactivity in immediate measurement of atmospheric deposition samples

The annual maximum was 25.75 Bq/m²*day at SSRM Constanța, recorded on 28.05.2021, and at SSRM Cernavodă the maximum value was 65.55 Bq/m²*day, recorded on 02.07.2021. There were no exceedances of the warning level. The warning limit for the immediate global beta activity of atmospheric deposition (according to OM no. 1978/2010) is 200 Bq/m2*day.

In the year 2022, the annual average regarding the evolution of the average global beta activity in the immediate measurement of atmospheric deposition, was 1,483 Bq/m^2 *day and in the first quarter of 2023 of 1,553 Bq/m^2 *day.

radionuclide of cosmogenic origin Be-7 was detected and measured in all total atmospheric deposition samples accumulated monthly. Its concentration varied between 0.156 Bq/m^2*day (SSRM Cernavodă, in March and SSRM Galati, in November) and 6.256 Bq/m^2*day (SSRM Sfântu Gheorghe, in June).

radionuclide Pb-210 was highlighted in almost all samples of total accumulated monthly atmospheric deposition. Its concentration was between 0.4.3039 Bq/m^2*day (SSRM Cernavodă, in December) and 0.428Bq/m^2*day (SSRM Sfântu Gheorghe, in June).

radionuclide Cs-137 was determined in atmospheric deposition samples from May at SSRM Tulcea (0.003 Bq/m^2*day) and at SSRM Galați in June and July 2021 (0.005 Bq/m^2* day, respectively 0.007 Bq/m^2*day). The current source for Cs-137 in the atmosphere is the soil contaminated as a result of the Chernobyl NPP accident. The mechanism by which soil radionuclides reach the atmosphere is the resuspension of fine particles from the surface soil layer.

4.11.2 Radioactivity of waters

Surface water samples from the Black Sea are taken weekly by SSRM Constanța and monthly by SSRM Sfântul Gheorghe. The global artificial beta radioactivity of the Black Sea water samples is shown graphically in figure 4.124,

In 2021, at SSRM Constanța the highest value was recorded in December of 4.19 Bq/l.

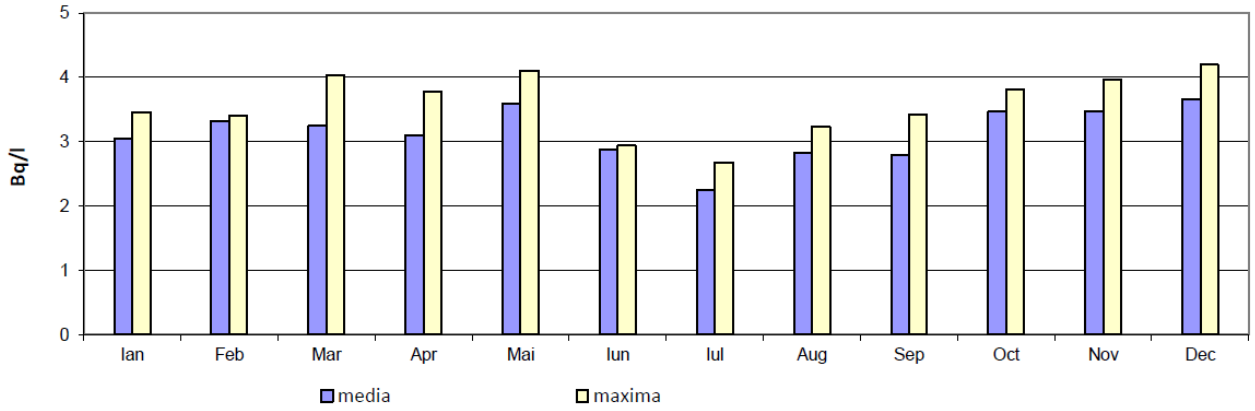

Figure 4.124 Global beta-specific activity in Black Sea surface water, monthly averages/maximums in 2021

The results of the high-resolution gamma spectrometric analyses indicate the Chernobyl accident as the main source of artificial radioactivity for the studied samples. The artificial radionuclide identified was Cs-137, a fission product released into the environment during the accident.

Figures 4.1255 and 4.126 show the level and distribution of the concentrations of radionuclides Cs-137 and K-40, radionuclides with an important contribution to the radioactivity of the studied samples.

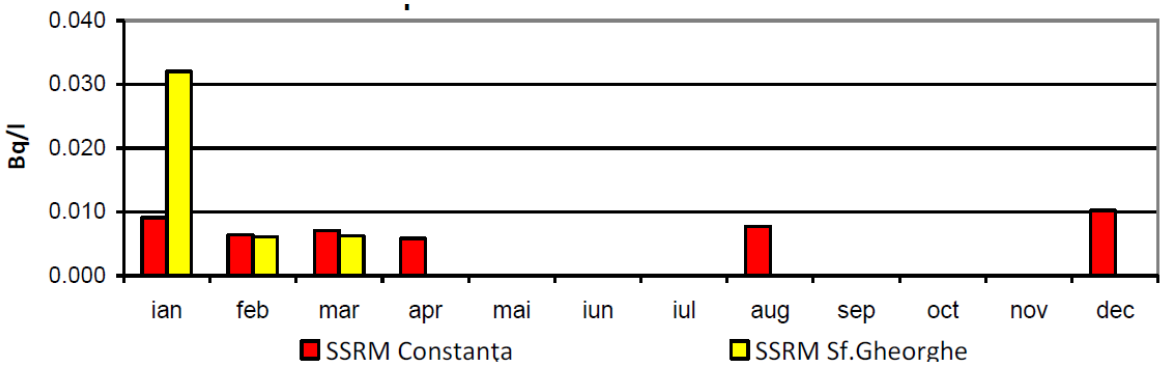

Figure 4.125 Concentrations of Cs-137 in the Black Sea

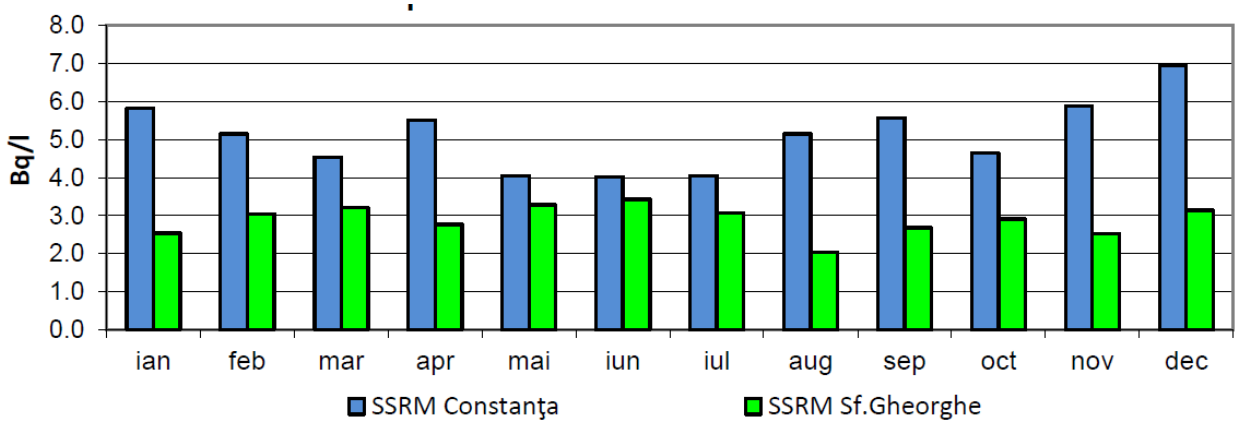

Figure 4.126 Concentrations of K-40 in the Black Sea

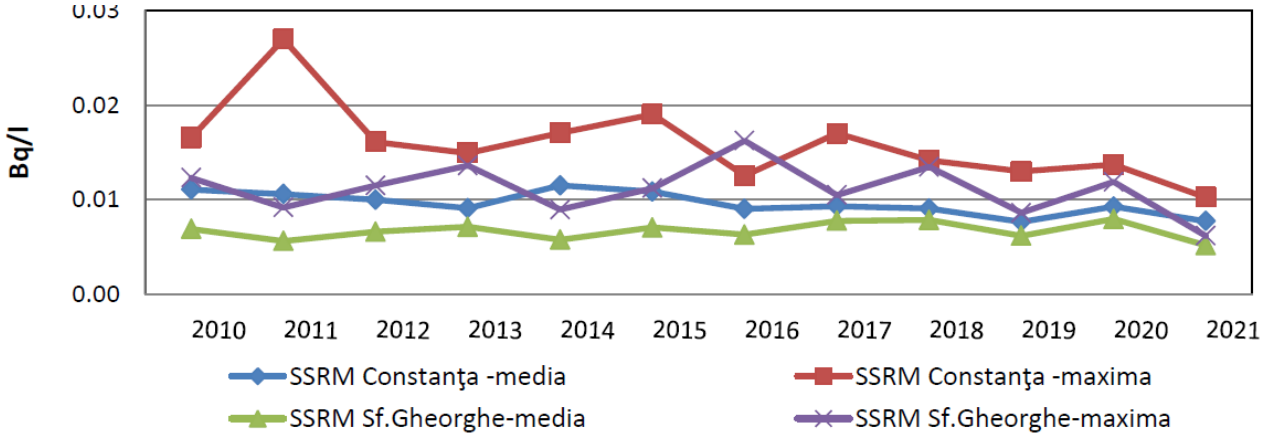

Figure 4.127 Multiannual variation of Cs-137 concentration in the Black Sea

In the year 2022, the global artificial beta radioactivity of surface water samples from the Black Sea varied between 2857.48 and 3711.86 Bq/l, the annual average being 3412.803 Bq/l.

In the first quarter of 2023, the global artificial beta radioactivity of surface water samples from the Black Sea ranged between 2912.8 and 3313.33 Bq/l, the annual average being 3175.94 Bq/l.

4.11.3 Soil radioactivity

Artificial global beta activity in non-cultivated soil samples ranged from 262.80-1072.5 Bq/kg

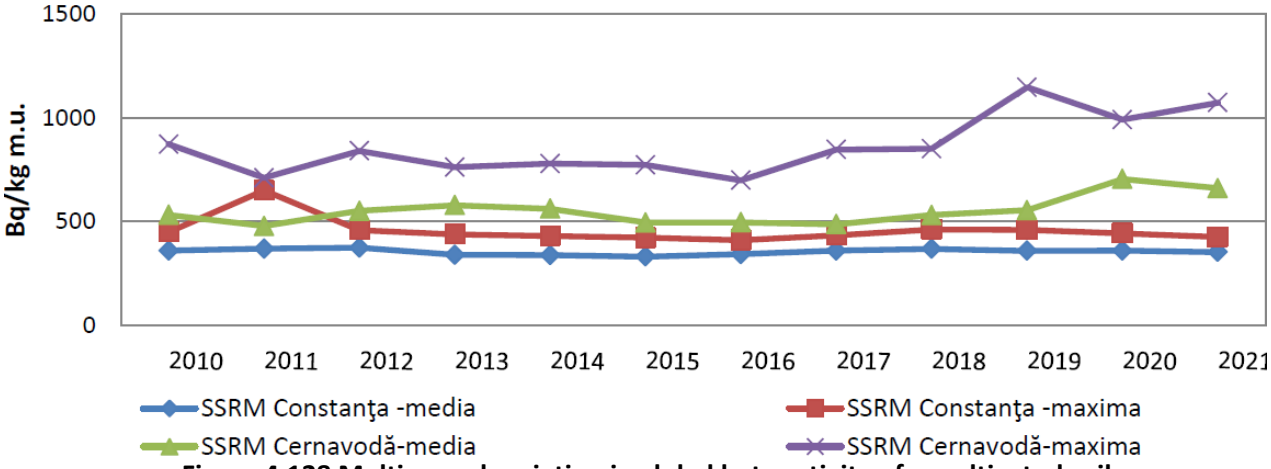

Figure 4.128 Multiannual variation in global beta activity of uncultivated soil

As part of the monitoring program for the Năvodari and Vadu areas, SSRM Constanța annually took uncultivated soil samples from the Mamaia Sat, Năvodari, Lumina, and Vadu locations respectively (in the area of influence of the former rare metals enterprise). The samples were analyzed gamma spectrometrically for the identification of gamma-emitting radionuclides, and the results are reported in Bq/kg dry mass.

Radionuclides from the natural radioactive series, K-40 and Cs-137, were identified in the analysed samples. The concentration level of the natural radionuclide K-40 is in the range of 82.21 - 565.36 Bq/kg, with uncertainties associated with the measurement varying between 3-9%. The artificial radionuclide Cs-137, whose presence in the soil is due to the Chernobyl accident, was identified in almost all samples. The concentrations of Cs-137 in the soil were between 0.37 – 16.65 Bq/kg, with uncertainties associated with the measurement varying between 4-35%.

Within the monitoring program in areas with anthropogenically modified background, SSRM Constanța annually took arable soil samples from the Constanța, Mamaia Sat, Năvodari, Lumina and Vadu locations. Radionuclides from the natural radioactive series and K-40 were identified in the analysed samples. The level of concentrations of the natural radionuclide K-40, which has the largest contribution to external irradiation, was between 446.86 and 53.18 Bq/kg, with measurement uncertainties of 3%. The artificial radionuclide Cs-137 was identified in the soil samples, whose presence in the soil is due to the Chernobyl accident. Cs-137 concentrations in soil ranged from 1.64 to 8.98 Bq/kg, with measurement uncertainties of 5-22%

In 2022, the annual average regarding the evolution of the average global beta activity of the soil varied between 321.02 and 368.48 Bq/kg, the annual average being 344.6 Bq/kg and in the first quarter of 2023 the artificial beta radioactivity of varied between 315.55 -372.05 Bq/kg and the quarterly average was 340.11 Bq/kg

4.11.4 Radioactivity of vegetation[19]

Spontaneous vegetation samples were taken with a weekly frequency, between April and October, from the site perimeter of each SSRM.

The artificial global beta radioactivity in spontaneous vegetation samples in 2021 varied in the range of 103.24 – 405.91 Bq/kg green mass (gm). The annual maximum at SSRM Constanța was 323.40 Bq/kg gm.

In the year 2022, the global artificial beta radioactivity in the samples of spontaneous vegetation in the year 2021 varied in the range of 197.43 – 264.54 Bq/kg green mass (gm).

4.11.5 Data collection and investigation methods

For the elaboration **of Section 4.11 – Description of the existing situation regarding radiation,** the method of reviewing data and information of a scientific and technical nature was applied within the annual and monthly reports of Constanța County regarding the state of the environment 2022-2023

The sources of information for the identification, description of **the existing radiation situation** (specialized literature, reports) was the following:

- County report on the state of the environment, year 2021, chapter IX Environmental radioactivity http://www.anpm.ro/ro/web/apm-constanta/rapoarte-anuale1 , accessed 09/4/2023.
- Monthly reports on the state of environmental factors in Constanța County, 2022-2023 http://www.anpm.ro/ro/web/apm-constanta/rapoarte-lunare1 / , accessed 09/4/2023.
- Radioactive Waste Material from Oil and Gas Drilling, https://www.epa.gov/radtown/radioactive-waste-material-oil-and-gas-drilling , accessed 09/06/2023.

[19]Idem18.