ENVIRONMENTAL IMPACT ASSESSMENT

PROJECT:

NEPTUN DEEP

PROJECT TITLEHOLDERS:

OMV Petrom S.A

Romgaz Black Sea Limited

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

CHAPTER 6 – DESCRIPTION OF THE SIGNIFICANT EFFECTS THAT THE PROJECT MAY HAVE ON THE ENVIRONMENT

Revision history

Revision no	Date	Description	Author	CHECKED	APROVED
00	03.04.2023	Document drafting	Blumenfield® Working group	Cristiana Crapcea	F.Gabriela Stanciu
01	17.07.2023	Internal issue	Blumenfield® Working group	Cristiana Crapcea	F.Gabriela Stanciu
02	24.10.2023	Issued for authorities	Blumenfield® Working group	Cristiana Crapcea	F.Gabriela Stanciu

DOCUMENT REFERENCE: BMF – ND – EIA – 06 -002

Company	Project	Study type	Chapter	Revision
BMF	**Neptun Deep**	**EIA**	**6**	**02**

Contents

List of tables

List of figures

CHAPTER 6 DESCRIPTION OF THE SIGNIFICANT EFFECTS THAT THE PROJECT MAY HAVE ON THE ENVIRONMENT

In this chapter, the description of the significant effects that the project may have on the environment is presented. The impact assessment considers, in the first instance, the baseline environment as described in Chapter 4 and how the effects resulting from the activities of the project in all phases may constitute potential impacts on the environment.

The environmental impact assessment is based on a systematic assessment approach, developed, and applied for the Neptun Deep project, with the following objectives:

- Identifying and assessing the potential impacts that the Neptun Deep project can have on the physical, chemical, biological, and socio-economic factors;
- Description of measures to avoid, prevent and/or reduce any negative impact to an acceptable level for the environment.

This EIA is conducted in accordance with the requirements established by the impact assessment methodological guide, approved by MMAP Order no. 262/2020, and the requirements of Directive 2014/52/EU, transposed into national legislation by Law no. 292/2018 regarding the assessment of the impact of certain public and private projects on the environment.

In addition, the EIA meets with the relevant European legislation for the protection of the marine environment, transposed into the national legislation by GEO No. 71/2010 on the establishment of the Strategy for the Marine Environment - approved by Law no. 6/2011 with subsequent additions and amendments (Law no. 205/2013, Law no. 279/2018).

In order to identify, describe and evaluate the significant effects, the following steps were taken, as outlined below and assessed in detail in the following sections:

- Defining the scope of the evaluation, identifying and evaluating the effects;
- Characterization of resources and the receiving environment potential to be affected by the project (Chapter 5);
- Description of the significant effects that the project may have on the environment;
- Forecasting and evaluating the importance of effects;
- Establishing measures to avoid, prevent, reduce any potential significant impact;
- Assessment of potential impacts in a cross-border context;
- Assessment of potential cumulative impacts.

6.1 DEFINING THE SCOPE OF ASSESSMENT, IDENTIFYING AND ASSESSING EFFECTS

6.1.1 Identification of environmental receptors/factors that may be affected by project implementation

In this stage, the purpose of the assessment is defined by identifying the area of environmental and socio-economic components, resources and receptors that will be the subject of the assessment, as well as the spatial scale (zone of direct influence) and time in which potential impacts may occur.

The environmental and socio-economic resources, respectively the receiving environment that the Neptun Deep project would have the potential to affect during the project stages (construction, operation, decommissioning) are identified in table 6.1 below.

Table 6.1 Resources and receivers

Environmental Factors		Resources or receivers
ENVIRONMENTAL FACTORS	Physical factors	Soil
		Marine Sediment
		Water
		Air and Climate
		Hydrological conditions
		Hydrogeological conditions
	Biological factors	Planktonic communities
		Benthic communities
		Marine habitats
		Ichtyofauna
		Marine mammals
		Avifauna
		Terrestrial fauna (without birds)
		Flora, vegetation, and terrestrial habitats
SOCIO-ECONOMIC FACTORS	Socio-economic factors	Population and population health
		Landscape
		Material goods and natural resources
		Cultural heritage
		Ships and naval traffic
		Commercial fishing

Although noise and radiation are not a resource or receptor and are therefore not included in the above list, they are mentioned in the guidance as relevant aspects to be included in the impact assessment. Noise and radiation have been assessed in relation to the resources and receptors listed above, as appropriate.

For the assessment of the impact of the Neptun Deep project on biodiversity, the appropriate assessment procedure has been established. Thus, the conclusions of the Adequate Assessment Study are in Section 6.2.15.

The project's potential impact on human health was the subject of the Population Health Impact Assessment Study. The conclusions of this study are inserted in Section 6.2.14.

6.1.2 Defining the area of influence and the temporal extent of the project

The Neptun Deep project consists of two components: onshore activities related to the metering station and CCR, and offshore activities related to the drilling of production wells, installation of subsea systems, installation and operation of the Neptun Alpha production platform, and the installation of the gas production pipeline and microtunelling.

The project's area of influence has been defined taking into consideration all project phases (construction, operation, decommissioning). The potential environmental impact has considered the sources of impact and the environmental effects resulting from each activity/intervention/work involved in the project (Table 6.7).

Additionally, when defining the direct area of influence, software modeling was used to quantify cause-and-effect relationships (Table 6.2) by simulating real environmental conditions. Regarding ecosystem distribution, Geographic Information Systems (GIS) and a biodiversity database collected as a result of field studies were utilized.

6.1.3 Software modeling for quantifying cause-effect relationships

In the process of defining the scope of the assessment, one of the important stages involved determining the propagation of the characteristic physical changes resulting from the activities of the Neptun Deep project. Thus, the following, were carried out: modeling of the dispersion of pollutants in the air, modeling of noise propagation in the ambient and underwater environment, modeling of the sediment plume as a result of works at sea, modeling of the planned discharge of effluents from the production platform, modeling of accidental hydrocarbon pollution.

Air emissions were calculated based on the technical details in the project.

Table 6.2 Software modeling for quantifying cause-effect relationships

Modeling type	Brief modeling description	Area of influence of the direct effect	Receiving environment
Sediment dispersion modeling	Simulations show the transport, deposition, and re-suspension of fine sediments (and sediment mixtures) under the action of waves and currents in trench excavation works	2-3 km from the source	Sea water, Sediments, Marine Biodiversity

Modeling type	Brief modeling description	Area of influence of the direct effect	Receiving environment
Ambient noise modeling during construction and operation	The simulations show the propagation and indicate the sound pressure level at a different distance from the source during construction work as well as during maintenance work and emergency situations at the NGMS	50 m from the source during construction 2 km from the source during maintenance work and emergency situations	Population
Underwater noise modeling during the drilling of wells, installation works of the production platform, and subsea infrastructure	The simulations depict the propagation and indicate the noise level at different distances from the generating source.	920 meters from the source during dredging and installation of subsea infrastructure 100 meters for drilling production wells 19 kilometers for the installation of the drilling platform	Marine Biodiversity
Modeling the dispersion of air pollutants in the terrestrial area during the operational phase	The simulations depict the dispersion of pollutants at varying distances from the source, estimating pollutant concentrations over a averaging period, during the depressurization of pipelines during maintenance work at the NGMS	Max 1 km	Air, Population
Modeling the dispersion of air pollutants in the marine area during the operational phase	The simulations depict the dispersion of pollutants at varying distances from the source, estimating pollutant concentrations over an averaging period both under normal operating conditions and abnormal operating conditions.	40 km under normal operating conditions 80 km in abnormal operating conditions	Air
Modeling the dispersion of chemical pollutants in the water from the discharge of pipeline testing fluids	The simulations depict the dispersion of chemical pollutants in water both horizontally and vertically from the discharge of pipeline testing fluids at a depth of 950 meters in the marine environment	5 km from the source horizontally and 100 m vertically	Water
Modeling the dispersion of chemical pollutants in the seawater from the discharge of the production effluent	The simulations depict the dispersion of chemical pollutants in the water from the discharge of water at a depth of 90 meters in the marine environment.	7 km from the source	Sea water, Sediments, Marine Biodiversity

Detailed reports on the results of the modeling presented in the table above can be found in Annex M.

6.1.4 Impact assessment methodology

Impact assessment methodology is a method of characterizing identified impacts and assessing their global significance. Impacts include direct and indirect impacts as well as cumulative and transboundary impacts.

6.1.4.1 Magnitude of impact

The magnitude of the impact that is given by the characteristics of the project and the effects generated by it, such as:

- **Nature of the effect:** negative, positive or both;
- **Type of effect:** direct, indirect, secondary, cumulative;
- **Reversibility of the effect:** reversible, irreversible;
- **Extending the effect:** local, regional, national, cross-border;
- **Effect duration:** temporary, short term, long term;
- **Effect intensity:** low, medium, high.

The magnitude of the impact can be low, medium, or high depending on the above characteristics.

Nature of impact

- Negative – an impact that involves a negative (adverse) change in the initial conditions or introduces a new, undesirable factor.
- Positive – an impact that involves an improvement of the initial conditions or introduces a new, desirable factor.
- Both – an impact that involves a negative (adverse) but at the same time a positive change in the initial conditions.

The type of impact

- **Direct** – impacts resulting from the direct interaction between a plan activity and an environmental factor (e.g. occupation of a habitat during construction);
- **Indirect** – impacts resulting from other activities or as a consequence or circumstance of the project (e.g. intensification of road traffic in the project area);
- **Secondary** – direct or indirect impact as a result of repeated interaction between project components and environmental factors (e.g. direct secondary impact – an impact on fauna due to collisions; indirect secondary impact – impact on fauna due to habitat loss);
- **Cumulative** - impact that acts together with another impact (including the impacts of other plans/projects/activities), affecting the same environmental factor or receptor (e.g. the combined effect of other similar projects in the area of influence).

Reversibility of impact

- **Reversible** – an impact is reversible when the affected environmental factor (the receptor) can return to its original state (before the impact action), e.g. water turbidity can return to the original after the cessation of the cause of turbidity – construction activities);

- **Irreversible** – an impact is irreversible if the environmental factor cannot return to its original state (e.g. permanent land occupation).

Expanding impact

- **Local** – Impacts are limited to the area where the activity is carried out and do not exceed a radius of up to 5 km;
- **Regional** – impacts affecting receptors (environmental factors) within a radius of approx. 5 – 40 km from the source and have a regional extension;
- **National** – The impact affects the environmental factors at the national level and of the EEZ Romania, the Black Sea;
- **Cross-border** – The impact manifests outside the national borders and outside the Romanian EEZ, the Black Sea.

Duration of impact

- **Temporary** – the impact manifests itself for a short period of time and possibly intermittent/occasional (e.g. temporary deposits of earth during the execution of the works)
- **Short-term** – the impact is expected to be active for a limited, short period of time and to cease entirely when the activity causing it is complete (eg noise and vibration generated during construction). Also, the impact is short-lived if it is eliminated by appropriate measures or the environmental factor is restored (e.g. shutting down an installation if the noise produced by it affects receptors);
- **Long-term** – the impact manifests itself over a long period of time (throughout the lifetime of the facility – estimated to be more than 25 years), but ceases with the closure of the project (e.g. noise produced by the facilities, emissions, etc.). Also, the impact has a long duration even if it is intermittent, but manifests itself throughout the life of the project (e.g. disturbance of biodiversity during maintenance operations of the facility);
- **Permanent** – the impact manifests itself in all phases of the project and remains active even after the closure of the project. In other words, it causes permanent changes to biotic and abiotic resources or receptors (e.g. destruction of a priority habitat).

Impact intensity

- **Low** – when the environmental factor has a low value and/or sensitivity. The impact can be predicted but is usually at the limit of detection and does not lead to permanent changes in receptor structures and functions. In other words, the effects of the impact manifestation fall within the receiver's natural limits of variability, without the need to rebuild the receiver.
- **Medium** – when the environmental factor has an Medium value and/or sensitivity. Receptor structures and functions are affected but the underlying structure/function is not affected. In other words, the effects of the impact manifestation exceed the natural variability limits of the receiver, and the recovery time is medium (<2 years).
- **High** – when the environmental factor has a high value and/or sensitivity (e.g. Natura 2000 sites). Receptor structures and functions are completely affected. Loss of structures/functions is visible. In other words, the effects of impact manifestation exceed the natural limits of variability, causing irreversible or reversible disturbances over long periods of time (>2 years).

Criteria for determining the magnitude of impact differ for physical, biological and social environmental factors.

Table 6.3 Characterization of the magnitude of an impact

The magnitude of the impact	Physical environmental factors	Biological environmental factors	Social environmental factors
Negligible	The impact does not generate quantifiable (visible or measurable) effects in the natural state of the environment		Barely visible temporary impact on a socio-economic resource/receptor that does not lead to perceptible changes.
LOW	Temporary or short-term impact on physical receptors (resources), localizable and detectable, which causes changes beyond the natural variability, without changing the functionality or quality of the receptor (resource). The environment returns to its pre-impact state after the activity causing the impact ceases.	Impact on a species that manifests itself only at the level of a group of individuals for a short period of time (one generation or less), but does not affect other trophic levels or the population of that species.	Impact on a specific group/community or on material assets (cultural, tourism, etc.) over a short period of time, which does not extend and does not generate disruptions to the population or resources.
MEDIUM	Temporary or short-term impact on physical receptors (resources) that may extend beyond the local scale and produce changes in the quality or functionality of the receptor (resource). However, the long-term integrity of the receiver (resource) or any dependent receiver is not affected. If the extent of the impact is large, then the magnitude can also be large.	Impact on a species that occurs at the level of part of the population and may cause changes in abundance and/or a reduction in distribution over one or more generations, but does not affect the long-term population integrity of the species or other dependent species. The cumulative nature and magnitude of the consequences are important. If the extent of the impact is large, then	Impact on a specific group/community or on material assets that may generate long-term changes but does not affect the overall stability of groups, communities or material assets. If the extent of the impact is large, then the magnitude can also be large.

The magnitude of the impact	Physical environmental factors	Biological environmental factors	Social environmental factors
		the magnitude can also be large.	
HIGH	Impact on receptors (resources) that may cause irreversible changes and beyond permissible limits, on a local or larger scale. Changes may alter the long-term character of the receptor (resource) and other dependent receptors. An impact that persists after the cessation of the activity that produces it has a high magnitude.	Impact on a species that affects the entire population and causes declines in abundance and/or changes in distribution beyond the limit of natural variation, with no possibility of recovery or return, or that occurs over several generations.	Impact on a specific group/community or on one or more material assets that causes long-term or permanent changes and affects their general stability and condition.

6.1.4.2 Receiver sensitivity

The sensitivity of a resource or receptor describes how it can be more or less susceptible to a particular impact. Sensitivity assessment has adopted a qualitative classification of low, medium, or high, based on the following two criteria.

- **Resistance to change,** which describes the degree to which a resource or receptor is resistant to change (that is, a lower sensitivity) with respect to the specific source of impact. Determining resistance to change includes assessing the adaptive capacity of the specific resource or receptor, its diversity and its existence in the area affected by the project activity, that is, a certain source of impact interacts with it. Resistance to change is therefore a characteristic of a resource or receptor, but not inherent to it, as it is also influenced by the nature of the impact to which it is subjected.
- **Importance**, which describes the qualities of the resource or receptor or its importance, as recognized for example by its conservation status (e.g. IUCN, protection or priority under EU legislation, plans, policies, etc.), its importance ecological, cultural and social or economic value or by its identification by stakeholders with a valid interest in the project. The importance of a receiver is an inherent characteristic regardless of project activities.

Table 6.4 Establishing receiver sensitivity

Value/sensitivity of the receiver	Environmental factors (receptors) physical	Environmental factors (biological receptors)	Social environmental factors (receptors)
LOW	A receptor / resource that is not important to the	A species or habitat that is not protected or listed. It	The material goods and socio-economic elements

Value/sensitivity of the receiver	Environmental factors (receptors) physical	Environmental factors (biological receptors)	Social environmental factors (receptors)
	functioning of ecosystems or services, or that is important but resistant to change (in the context of the proposed activities) and will quickly naturally return to its pre-impact state once the impacting activity stops.	is common or abundant; is not critical to ecosystem functions or other ecosystems (e.g. prey on other species or predator of rodent species); they do not represent key elements for ecosystem stability.	affected are not considered significant from the point of view of resources, and do not have a high economic, cultural or social value.
MEDIUM	A receptor / resource that is important for the functioning of ecosystems / services. It may be less resistant to change but can be returned to its original state through specific actions, or it can regenerate naturally over time.	A species or habitat that is not protected or listed; it is spread globally but is rare in the plan/project area. It is important to the functioning and stability of the ecosystem and is threatened or the population is in decline.	The affected socio-economic elements are not significant in the general context of the analyzed area, but they have a great local significance.
HIGH	A receptor/resource that is critical to ecosystems/services, is not resistant to change and cannot be restored to its original state.	A species or habitat that is protected by relevant directives or international conventions. It is listed as rare, threatened or vulnerable (IUCN); it is critical for ecosystem stability and functionality.	The affected socio-economic elements are specifically protected by national or international legislation and are significant for communities in the project area or at regional/national level.

6.1.4.3. The general significance of the impact

To determine the overall significance of the impact, the following key elements are taken into account:

- The magnitude of the impact (nature, extent, duration, intensity, etc.)
- Receiver value/sensitivity.

Table 6.5 Establishing the significance of the impact according to the magnitude and sensitivity of the receiver

	The magnitude			
	Negligible	**Low**	**Medium**	**High**
Low value/sensitivity	**No impact**	**Minor**	**Minor**	**Moderate**
Medium value/sensitivity	**No impact**	**Minor**	**Moderate**	**Major**
High value/sensitivity	**No impact**	**Moderate**	**Moderate**	**Major**
Meaning of impact				
Without or insignificant impact	The impact does not generate quantifiable (visible or measurable) effects in the natural state of the environment. The impact is insignificant.			
Minor significance	The impact is of Low magnitude, falls within the standards and/or is associated with receptors of low or medium value/sensitivity. Medium-magnitude impact affecting low-value receptors. The impact is insignificant.			
Moderate significance	Impact that falls within the limits, low magnitude affecting high value receptors, or medium magnitude affecting medium value receptors, or high magnitude affecting medium value receptors. These impacts may or may not be significant, depending on the context, and therefore additional mitigation may be required to avoid or reduce impacts to insignificant levels.			
Major meaning	Impact that exceeds limits and standards and is of high magnitude affecting medium value receptors or medium magnitude affecting high value receptors. The impact is considered significant.			

Positive impacts were not assessed using the framework set out above, but rather described qualitatively.

If, following the assessment, no impact is anticipated, this is stated, and no further discussion is provided.

6.1.5 Establishing measures to avoid, prevent, reduce any potential significant impact

Impacts were assessed without implementing measures to avoid, prevent, reduce any potential significant impact.

Mitigation measures will be established for minor, moderate and major impacts.

After the application of the intended mitigation measures, these impacts will be assessed, and if the residual impact is major or moderate, they will be subject to ongoing management and monitoring during the various stages of the project.

Table 6.6 Establishing the category of measures according to the significance of the impacts

Significance of impacts	Necessary measures
Without or insignificant impact	No mitigation measures are required Recommendations for keeping the impact at an insignificant level can be identified.
Minor significance	Prevention and avoidance measures are not necessary. Recommendations for keeping the impact to a minimum can be identified.
Moderate significance	Impact mitigation measures are required.
Major meaning	Adequate impact reduction measures are required (modification of technological solutions, change of project location, etc.)

6.1.6 Cross-border impact

The impacts generated from the construction, operation and decommissioning of the Neptun Deep project will generally be in Romania's EEZ, they may extend in some cases to the EEZ of neighboring countries, i.e. they may give rise to cross-border impacts.

The assessment of transboundary impacts is based on the prior identification of all potential impacts associated with the activities of the Neptun Deep project and that they have been rigorously and consistently assessed in accordance with the methodology described in the sections above. Therefore, the assessment presented in Section 6.2 specifically identifies areas where impacts may be transboundary in nature. All these transboundary impacts are then assessed in Section 6.3 to help communicate the transboundary impacts to each affected party.

6.1.7 Cumulative impact

There is the potential for interactions between impacts arising from Neptun Deep project activities with those of other existing or planned projects that do not yet exist but are likely to be under construction or have been completed by the time the Neptun Deep project is constructed or is operational. These other projects may generate their own insignificant individual impacts, but when considered in combination with the impacts from the Neptun Deep project, they could constitute a significant cumulative impact. Potential cumulative impacts are described in Section 6.4, following the same assessment methodology described above.

6.1.8 Description of the significant effects that the project may have on the environment

6.1.8.1 Construction and existence of the project, including, if applicable, demolition works

The proposed activities for the Neptun Deep project identified as having the potential to generate impacts are presented in the table below:

Table 6.7 Effects generated by the activities of the Neptun Deep Project

<table>
<tr><th>Type of intervention</th><th>Environmental factor</th><th>Effects</th><th>Direct impacts</th></tr>
<tr><td colspan="4">I.A. - CONSTRUCTION STAGE - LAND AREA</td></tr>
<tr><td colspan="4">I.A1 Arrangement of temporary access road</td></tr>
<tr><td rowspan="21">Arrangement of temporary access road, which consists of the following works:
-Stripping and storage of topsoil
-Excavation and storage of soil
-Soil compaction
-Deposition and compaction of layers of soil, ballast and crushed stone
-Transport traffic, loading / unloading materials and operation of construction equipment
- arrangement of the affected area upon completion of the works</td><td rowspan="2">Air and climate</td><td>Increased concentration of dust and pollutants in the air</td><td>Change in air quality</td></tr>
<tr><td>Greenhouse gas emissions</td><td>Contributing to climate change</td></tr>
<tr><td rowspan="5">Soil</td><td>Stripping topsoil layer</td><td>Possible impairment of soil fertility and land productivity</td></tr>
<tr><td>Physical changes in soil and subsoil stratification</td><td>Damage to soil and subsoil structure</td></tr>
<tr><td>Soil compaction and degradation of its structure</td><td>Damage to soil structure and soil water regime</td></tr>
<tr><td>Accidental oil pollution</td><td>Change in soil quality</td></tr>
<tr><td>Introduction of potentially invasive alien plant species</td><td>Change in the structure of local phytocenosis</td></tr>
<tr><td rowspan="2">Population health</td><td>Increased noise level</td><td>Noise discomfort</td></tr>
<tr><td>Increased concentration of dust and pollutants in the air</td><td>Possible increase in incidence or worsening of respiratory diseases in the human population</td></tr>
<tr><td rowspan="3">Biodiversity</td><td>Increased noise level</td><td>Disturbance of bird activity</td></tr>
<tr><td>Stripping topsoil layer</td><td>Habitat loss of food</td></tr>
<tr><td>Accidental mortality due to road traffic and machine operation</td><td>Population reduction</td></tr>
<tr><td>Material goods</td><td>Impairment of material goods</td><td>Population discomfort</td></tr>
<tr><td>Landscape</td><td>Presence of machinery</td><td>Visual impact</td></tr>
<tr><td>Natural resources</td><td>Use of natural resources</td><td>Depletion of natural resources</td></tr>
<tr><td rowspan="2">Land use</td><td>Change in land use</td><td>Reduction of agricultural land area</td></tr>
<tr><td>Land occupation</td><td>affecting areas larger than the actual footprint of the project's constructions and installations</td></tr>
<tr><td>Cultural heritage</td><td>Damage to cultural heritage</td><td>Potential harm to cultural heritage</td></tr>
<tr><td>Human settlements</td><td>Change in land use</td><td>Change the landscape of the area</td></tr>
<tr><td rowspan="2">Socio-economic</td><td>Demographic changes due to project works</td><td>Increase of residents during works</td></tr>
<tr><td>Changes in the economy</td><td>opportunity to develop other investments and socio-economic activities</td></tr>
<tr><td colspan="4">I.A2 Site organization arrangement</td></tr>
<tr><td rowspan="5">Arrangement of site organizations, which consists of the following works:
-Stripping and storage of topsoil
-Excavation and storage of soil
-Soil compaction</td><td rowspan="2">Air and climate</td><td>Increased concentration of dust and pollutants in the air</td><td>Change in air quality</td></tr>
<tr><td>Greenhouse gas emissions</td><td>Contributing to climate change</td></tr>
<tr><td rowspan="3">Soil</td><td>Stripping topsoil layer</td><td>Possible impairment of soil fertility and land productivity</td></tr>
<tr><td>Physical changes in soil and subsoil stratification</td><td>Damage to soil and subsoil structure</td></tr>
<tr><td>Soil compaction and degradation of its structure</td><td>Damage to soil structure and soil water regime</td></tr>
</table>

Type of intervention	Environmental factor	Effects	Direct impacts
-Deposition and compaction of layers of soil, ballast and crushed stone -Transport traffic, loading / unloading materials and operation of construction equipment - arrangement of the affected area upon completion of the works		Accidental oil pollution	Change in soil quality
		Covering affected areas with topsoil	Increased soil productivity
	Human health	Increased noise level	Noise discomfort
		Increased concentration of dust and pollutants in the air	Possible increased incidence or worsening of respiratory diseases in the human population
	Biodiversity	Increased noise level	Disturbance of bird activity
		Stripping topsoil layer	Habitat loss of food
		Accidental mortality due to road traffic and machine operation	Population reduction
	Landscape	Presence of machinery	Visual impact
	Cultural heritage	Damage to cultural heritage	Potential harm to cultural heritage
I.A3 Arrangement of temporary level crossing with railway			
Arrangement of the temporary level crossing with the railway, which consists of the following works: *-Stripping and storage of topsoil -Excavation and storage of soil -Soil compaction -Deposition and compaction of layers of soil, ballast and crushed stone for arranging road connection -Installation of prefabricated tiles - Transport traffic, Loading/unloading materials and operation of construction equipment -Arrangement of the affected area upon completion of works*	Air and climate	Increased concentration of dust and pollutants in the air	Change in air quality
		Greenhouse gas emissions	Contributing to climate change
	Soil	Stripping topsoil layer	Possible impairment of soil fertility and land productivity
		Physical changes in soil and subsoil stratification	Damage to soil and subsoil structure
		Soil compaction and degradation of its structure	Damage to soil structure and soil water regime
		Accidental oil pollution	Change in soil quality
	Human health	Increased noise level	Noise discomfort
		Increased concentration of dust and pollutants in the air	Possible increased incidence or worsening of respiratory diseases in the human population
	Biodiversity	Increased noise level	Disturbance of bird activity
		Stripping topsoil layer	Habitat loss of food
		Accidental mortality due to road traffic and machine operation	Population reduction
	Material goods	Potential harm to material goods	Damage to material goods
I.A4 Build/Install NGMS and CCR			
Build/Install NGMS and CCR, which consists of the following works: *-Stripping and storage of topsoil -Excavation and storage of soil -Soil compaction -Realization of concrete platforms - Construction of interior roads - Installation of NGMS components*	Air and climate	Increased concentration of dust and pollutants in the air	Change in air quality
		Greenhouse gas emissions	Contributing to climate change
	Soil	Stripping topsoil layer	Possible impairment of soil fertility and land productivity
		Physical changes in soil and subsoil stratification	Damage to soil and subsoil structure
		Soil compaction and structure degradation	Damage to soil structure and soil water regime
		Accidental oil pollution	Change in soil quality
		Introduction of potentially invasive alien species	Change in the structure of local phytocenosis
	Human health	Increased noise level	Noise discomfort

Type of intervention	Environmental factor	Effects	Direct impacts
- Building CCR *- Transport traffic, Loading/unloading materials and operation of construction equipment* *-Restoration of the environment at the completion of the works Green space arrangement*		Increased concentration of dust and pollutants in the air	Possible increased incidence or worsening of respiratory diseases in the human population
	Biodiversity	Increased noise level	Disturbance of bird activity
		Stripping topsoil layer	Habitat loss of food
		Accidental mortality due to road traffic and machine operation	Population reduction
	Land use	Change in land use	Reduction of agricultural land area
		Land occupation	affecting areas larger than the actual footprint of the project's constructions and installations
	Cultural heritage	Damage to cultural heritage	Potential harm to cultural heritage
I.A5 Installation of gas production pipeline and fiber optic cable on dry land			
Installation of gas production pipeline and fiber optic cable on land, which consists of the following works: *-Stripping and storage of topsoil* *-Excavation of trench, pipe laying and storage of excavated soil* *-Excavation of entrance and exit enclosures for horizontal drilling of undercrossing roads and railways* *-Installation of gas production pipeline and fiber optic cable* *- Ditch sealing* *-Transport traffic, loading / unloading materials and operation of construction equipment*	Air and climate	Increased concentration of dust and pollutants in the air	Change in air quality
		Greenhouse gas emissions	Contributing to climate change
	Soil	Stripping topsoil layer	Possible impairment of soil fertility and land productivity
		Physical changes in soil and subsoil stratification	Damage to soil and subsoil structure
		Soil compaction and structure degradation	Damage to soil structure and soil water regime
		Accidental oil pollution	Change in soil quality
	Human health	Increased noise level	Noise discomfort
		Increased concentration of dust and pollutants in the air	Possible increased incidence or worsening of respiratory diseases in the human population
	Biodiversity	Increased noise level	Disturbance of bird activity
		Stripping topsoil layer	Habitat loss of food
		Accidental mortality due to road traffic and machine operation	Population reduction
	Land use	Change in land use	Reduction of agricultural land area
	Land use	Land occupation	affecting areas larger than the actual footprint of the project's constructions and installations
	Cultural heritage	Damage to cultural heritage	Potential harm to cultural heritage
	Material goods	Affecting their material goods	Discomfort on the population
I.A6 Sub-shore crossing (microtunnel construction)			
Shore undercrossing (microtunnel construction) consisting of the following works: *-Construction of the launch pit* *-Execution of tunneling works*	Air and climate	Increased concentration of dust and pollutants in the air	Change in air quality
		Greenhouse gas emissions	Contributing to climate change
	Soil and subsoil	Physical changes in soil and subsoil stratification	Damage to soil and subsoil structure
	Water	Increased turbidity	Changes in physico-chemical and biological parameters of water

Type of intervention	Environmental factor	Effects	Direct impacts
-Construction of the exit manhole into the sea and execution of the transition trench (pipeline installation and laying) -Recovery of tunnel drilling at sea; -Installation of GPP and FOC by pulling from the shore through the microtunnel; -Filling the tunnel with water and plugging the trench and exit manhole with excavated material		Temporary and local increase in nutrients and possibly pollutants present in sediments due to sediment resuspension	Changes in chemical parameters of water
	Sedimentary substrate	Physical disturbance at sedimentary substrate level	Damage to sedimentary substrate
		Change in sediment quality as a result of suspension and re-sedimentation process	Change in sediment quality
	Biodiversity	Terrestrial noise emissions	Disturbance of bird activity
		Relocation of substrate with living organisms	Damage to benthic organisms by burial or extraction with substrate
		Turbidity	Qualitative and quantitative change in phytoplankton
			Harm to the algal population
		Temporary and local increase in nutrients and possibly pollutants present in sediments due to sediment resuspension	Qualitative and quantitative change in phytoplankton
			Damage to bivalve (filtering organism) populations
		Underwater noise emissions	Disturbance of fish and marine mammals
		Crushing and/or denudation of hard substrate populated with marine organisms as a result of the placement of ship anchors used for installation	Damage to benthic habitats
	Human health	Increased noise level	Noise discomfort
		Increased concentration of dust and pollutants in the air	Possible increase in incidence or worsening of respiratory diseases in the human population
	Socio-economic	Establishment of the 500 m safety zone around ships	
I.A7 Installation of fiber optic pipe and cable from platform to shore			
Work on the installation of the pipeline and fiber optic cable from platform to shore will consist of: - Installation of the pipeline by S-lay method - Installation of fiber optic cable with special underwater equipment that digs the trench, installs the cable and plugs the trench	Air and climate	Increased concentration of pollutants in the air	Change in air quality
		Greenhouse gas emissions	Contributing to climate change
	Sedimentary substrate	Physical disturbance at sedimentary substrate level	Morphological changes in substrate
		Change in sediment quality as a result of suspension and re-sedimentation process	Change in sediment quality
	Water	Increased turbidity	Changes in physico-chemical and biological parameters of water
		Temporary and local increase in nutrients and possibly pollutants present in sediments due to sediment resuspension	Changes in chemical parameters of water
		Impairment of water quality by controlled effluent discharge	Changes in chemical parameters of water

Type of intervention	Environmental factor	Effects	Direct impacts
	Biodiversity	Underwater noise emissions	Disturbance of fish and marine mammals
		Increased turbidity as a result of fiber optic cable installation	Damage to zoobenthos
			Qualitative and quantitative change in phytoplankton
		Relocation of substrate and benthic organisms	Damage to benthic organisms by burial or extraction with substrate
	Cultural heritage	Cultural heritage	Damage to cultural heritage
I.A8 Restoration of land upon completion of land construction			
Restoration of land upon completion of construction in the land area of the project site	Soil	Introduction of potentially invasive alien plant species	Change in the structure of local phytocenosis
I.B MARINE AREA CONSTRUCTION STAGE			
I.B1 Drilling of production wells			
The drilling of production wells will consist of the following activities: *-Mobilization of MODU;* *- Digging 10 wells* *- Support ship traffic*	Air and climate	Increasing the concentration of pollutants in the air from naval and air traffic	Change in air quality
		Greenhouse gas emissions	Contributing to climate change
	Water	Increased turbidity	Changes in physico-chemical and biological parameters of water
		Temporary and local increase in nutrients and possibly pollutants present in sediments due to sediment resuspension	Changes in chemical parameters of water
		Accidental MGO fuel pollution	Changes in chemical parameters of water
		Impairment of water quality by controlled effluent discharge	Changes in chemical parameters of water
	Sedimentary substrate	Physical disturbance at sedimentary substrate level	Morphological changes in substrate
		Physical disturbance at sedimentary substrate level	Physical disturbance at sedimentary substrate level
		Physical disturbance at sedimentary substrate level	Physical disturbance at sedimentary substrate level
	Marine subsoil	Unplanned well drilling events - e.g. drilling difficulties and geological hazards associated with well digging (gases in surface formations, areas with possible drilling difficulties, etc.)	Geomorphological changes in the formation
	Biodiversity	Underwater noise emissions	Disturbance of fish and marine mammals
	Socio-Economic	Establishment of the 500 m safety zone around the platform	Change shipping routes

Type of intervention	Environmental factor	Effects	Direct impacts
I.B2 Neptun Alpha platform installation			
Installation of the platform Neptun Alpha, which consists of the following works: *-Transport jacket and superstructure at installation site* *- Installation of jacket by fixing pillars by beating with pneumatic hammer* *- Welding installation of the superstructure* *- Installation of gas processing equipment*	Air and climate	Increased concentration of pollutants in the air from vessel traffic	Change in air quality
		Greenhouse gas emissions	Contributing to climate change
	Water	Increased turbidity	Changes in physico-chemical and biological parameters of water
		Temporary and local increase in nutrients and possibly pollutants present in sediments due to sediment resuspension	Changes in chemical parameters of water
		Accidental MGO fuel pollution	Changes in chemical parameters of water
		Impairment of water quality by controlled effluent discharge	Changes in chemical parameters of water
	Biodiversity	Underwater noise emissions	Fish and marine mammals affected
	Socio-economic	Establishment of a safety zone for ship maneuvers	Change shipping routes
I.B3 Installation of underwater systems including transmission pipelines and umbilical systems from drilling centers to platform			
Installation of underwater systems including transmission pipelines and umbilical systems from drilling centres to platform	Air and climate	Increased concentration of pollutants in the air	Change in air quality
		Greenhouse gas emissions	Contributing to climate change
	Water	Increased turbidity	Changes in physico-chemical and biological parameters of water
		Temporary and local increase in nutrients and possibly pollutants present in sediments due to sediment resuspension	Changes in chemical parameters of water
		Impairment of water quality by controlled effluent discharge	Changes in chemical parameters of water
	Biodiversity	Underwater noise emissions	Fish and marine mammals affected
	Sedimentary substrate	Physical disturbance at sedimentary substrate level	Morphological changes in substrate
		Change in sediment quality as a result of suspension and re-sedimentation process	Change in sediment quality
	Socio-Economic	Establishment of a safety zone for ship maneuvers	Change shipping routes
I.B4 Production pipeline check before commissioning			
Production pipeline check before commissioning	Water	Impairment of water quality by controlled effluent discharge	Changes in chemical parameters of water
I.B5 Commissioning checks of platform equipment			
Checks from commissioning of equipment on the platform	Air and climate	Increased emissions of pollutants to air from testing flare systems, diesel generators, main generators	Change air quality

Type of intervention	Environmental factor	Effects	Direct impacts
		Greenhouse gas emissions	Contributing to climate change
II. OPERATION STAGE			
II.A – OPERATION PHASE OF NGMS AND CCR			
Functioning of the NGMS and CCR *Maintenance at the NGMS station, once every 4 years* *Presence of NGMS and CCR*	Population health	Increased temporary noise levels during maintenance and emergencies	Noise discomfort
		Artificial lighting	Discomfort generated by artificial lighting
	Socio-Economic	Establishment of the safety zone 200 m from the axis of the pipeline	Population discomfort
	Landscape	Presence of NGMS and CCR	Visual aesthetic impact
	Biodiversity	Increased noise level	Disturbance of bird activity
	Material goods	The risk of major accidents accompanied by explosions and/or fires that would spread and affect the material assets of the local community	Affecting the population, material goods
II.B – OPERATION STAGE OF NEPTUNE ALPHA			
Operating the Neptun Alpha platform/ The actual presence of the platform	Air and climate	Increased concentration of pollutants in the air	Change in air quality
		Greenhouse gas emissions	Contributing to climate change
	Water	Impairment of water quality by controlled effluent discharge	Changes in physicochemical parameters of water
		Local metal ion emissions from sacrificial anodes providing cathodic protection of the pipeline	Changes in chemical parameters of water
	Sedimentary substrate	Increasing the concentration of sediment quality parameters by sedimentation of chemical compounds from the planned discharged effluent	change in sediment quality
		Local metal ion emissions from sacrificial anodes providing cathodic protection of the pipeline	change in sediment quality
	Biodiversity	Emissions to offshore marine waters of chemical compounds that have the potential to affect the aquatic environment	Damage to zooplankton populations
			Damage to planktonic and benthic organisms Damage to pelagic and demersal fish
	Radiation	Natural radionuclide emissions	Natural radionuclide emissions
	Radiation	Light radiation emissions	Disturbance of bird activity
	Socio-Economic	Establishment of the safety zone around the 500 m platform	Change shipping routes
	Natural resources	Natural gas exploitation	Depletion of natural resources
	Landscape	The presence of the drilling rig	Visual impact

Type of intervention	Environmental factor	Effects	Direct impacts
III. DECOMMISSIONING PHASE			
III.A Decommissioning of onshore installations			
Decommissioning of installations under NGMS and CCR, which consists of the following works: *Dismantling NGMS installations;* *Demolition of concrete structures;* *Decommissioning of the RCC;* *Disposal of materials and waste* *Land restoration after decommissioning*	Air and climate	Increased concentration of dust and pollutants in the air	Change in air quality
		Greenhouse gas emissions	Contributing to climate change
	Soil	Soil compaction and degradation of its structure	Damage to soil structure and soil water regime
		Accidental oil pollution	Change in soil quality
		Introduction of potentially invasive alien plant species	Change in the structure of local phytocenosis
	Biodiversity	Increased noise level	Disturbance of bird activity
		Accidental mortality due to road traffic and machine operation	Population reduction
	Human health	Increased noise level	Noise discomfort
		Increased concentration of dust and pollutants in the air	Possible increased incidence or worsening of respiratory diseases in the human population
	Terrain	Land clearance	Positive impact
III.B Decommissioning in the marine area			
Decommissioning Neptun Alpha platform and underwater installations *Abandonment of production wells* *Emptying pipes and installations* *Dismantling equipment from the platform* *Dismantling of the superstructure* *Jacket removal* *Recovery of underwater installations* *Transport of all components ashore for recovery/disposal*	Air and climate	Increased concentration of pollutants in the air	Change in air quality
		Greenhouse gas emissions	Contributing to climate change
	Water	Increased turbidity	Changes in physico-chemical and biological parameters of water
		Impairment of water quality by controlled effluent discharge	Changes in chemical parameters of water
	Biodiversity	Underwater noise emissions	Fish and marine mammals affected
	Sedimentary substrate	Physical disturbance at sedimentary substrate level	Morphological changes in substrate
		Change in sediment quality as a result of suspension and re-sedimentation process	Change in sediment quality
	Marine area	Liberation of marine area	
	Cultural heritage	Damage to cultural heritage	Damage to cultural heritage
	Socio-economic	Presence of platform of ships used for decommissioning	Change routes

6.1.8.2 Use of natural resources, especially land, soil, water and biodiversity

According to the definition in GEO 195/2005 on environmental protection, natural resources represent all the natural elements of the environment that can be used in human activity: non-renewable resources - minerals and fossil fuels, renewable - water, air, soil, flora, wildlife, including those inexhaustible - solar, wind, geothermal and wave energy.

A series of studies and reports present global analyzes of non-renewable natural resources [1], including sand, gravel and barite. The latter being included in the European List of critical raw materials according to the "Study on the Critical Raw Materials for the EU 2023 Final Report" [2].

Other non-renewable natural resources are the natural gas extracted from the Black Sea, which is the main objective of the Neptun Deep project.

The non-renewable natural resources used during construction are as follows:

- Sand, gravel and ballast used in road construction, site organization and concrete production. The estimated quantity to be used is 74,305 m^3 .
- Bentonite, barite used in the production of the drilling fluid required for drilling production wells. The estimated amount of barite required is 50,600 tons and of bentonite 2,200 tons.

During the construction period, the renewable natural resources used are the following:

- The land temporarily occupied during construction will be approximately 52.451 m^2.
- The topsoil that will be removed will be temporarily stored on site and fully reused in landscaping after the construction of the onshore components is completed.
- Excavated soil will be temporarily stored on site and used as backfill material after construction of the onshore components is completed. If there is excess excavated soil, the remaining quantity will be shipped to authorized operators to be used as backfill material.
- Both fresh water and sea water will be used to carry out the works. The total volume of water estimated to be used is 207,815 m3.

During the operating period, sea water will be used to cool the gas. The water will be treated with sodium hypochlorite, after cooling, the water is discharged into the sea, through the produced water discharge caisson at a depth of 90 m.

During operation, the land definitively occupied by constructions and installations will be 28,132 m^2, respectively 20 ha of green space. According to the regulations in force, a safety zone of 200 m width

[1] https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en accessed 27.07.2023

[2] https://www.researchgate.net/publication/260432075_Assessment_of_resource_efficiency_indicators_and_targets_Final_report_prepared_for_the_European_Commission_DG_Environment/link/633d76049cb4fe44f30597fe/download, accessed 27.07.2023

is established on each side of the underground pipeline measured starting from the axis of the pipeline.

Diesel generators will be used to produce electricity during the construction period. The estimated fuel consumption during the construction period for the production of electricity is approximately 14,985 tons (diesel).

During the operation period, the electricity supply to the onshore components of the project (NGMS, CCR, etc.) will be made from the network of the local energy supplier through a transformer station that will be installed in the eastern part of the NGMS site. A back-up diesel generator, equipped with an automatic power transfer switch, will provide power reserve for the CCR and NGMS in the event of a power outage.

The electricity needed to operate the infrastructure at sea (the Neptun Alpha platform, underwater systems, lighting systems, etc.) will be produced by gas turbine generators. The fuel source is natural gas from the production pipeline. Gas consumption is estimated at 2251 kg/h, 30.66 MW, respectively 268640 MWh/year.

Also, the platform is equipped with backup Diesel generators that will provide electricity in the event that the main generators do not work. The estimated Diesel fuel consumption is 38,376 tons/year, considering 104 h/year of operation with a specific consumption of 319 kg/h for the essential generator and 50 kg/h for the backup generator.

The assessment of the impact associated with the use of natural resources both during the project implementation and during the operation phase is presented in the Section 6.2.9 .

6.1.8.3 Emission of pollutants, noise, vibration, light, heat and radiation, creation of negative effects and disposal and recovery of waste

Pollutant emissions, waste generated associated with the construction and operation of the project are presented in Section 2.7.

Pollutant emissions into the air were identified in Section 2.7 and were also estimated here, by calculating the amount of pollutants emitted into the air, during the construction and operation stage. The effects of air pollutant emissions are presented in table 6.7 on interventions and activities.

Effluent emissions are identified in Section 2.7 and here too, the amount of effluents was estimated by calculation during the construction and operation stage. The effects of effluent emissions are presented in table 6.7 on interventions and activities.

The effects related to the increase in the noise level are presented in table 6.7 interventions and activities.

6.1.8.3.1 Effects of thermal radiation from the flare

Radiation is the phenomenon of heat transmission by means of electromagnetic waves emitted by a warm body in all directions. The unit of measure for this type of energy transfer is the kilowatt per square meter (kW/m^2). For example, the summer sun radiates around $1kW/m^2$.

The flame represents a mass of gases that emits electromagnetic radiation, as a result of some exothermic reactions that produce a rapid increase in temperature.

Torch systems have been designed so that thermal radiation does not endanger the lives of workers on the platform (when on it) or damage the equipment.

The flare system consists of two flares mounted on the same arm, installed on the upper platform, inclined at an angle of 45^0. The LP (low pressure) flare system has continuous emissions and the HP (high pressure) flare system generates emissions only in abnormal operating situations.

In order to verify the dispersion of thermal radiation, modeling of thermal radiation was carried out in 2 scenarios respectively, intermittent emissions from the HP torch system in case of abnormal operation in the situation when the gases come from the primary separator and when there is no more energy supply electrical equipment.

The effects of thermal radiation on equipment and workers are as follows:

Table 6.8 Effects of thermal radiation on equipment and workers

Thermal radiation (kW/m^2)	Effects
37.5	Destruction of process equipment. 100% deaths at 1 minute exposure.
25.0	100% fatal for 1 minute exposure, serious injury for 10 second exposure.
5	Second degree burns after 1 minute exposure.
2	Causes pain after 1 minute exposure.

The color legend of the thermal radiation contour according to the American Petroleum Institute (API) is as follows:

Figure 6.1 Thermal radiation color code according to the American Petroleum Institute

The thermal radiation contour modeled for the HP flare system for the primary separator emission scenario is shown in figure 6.2 below.

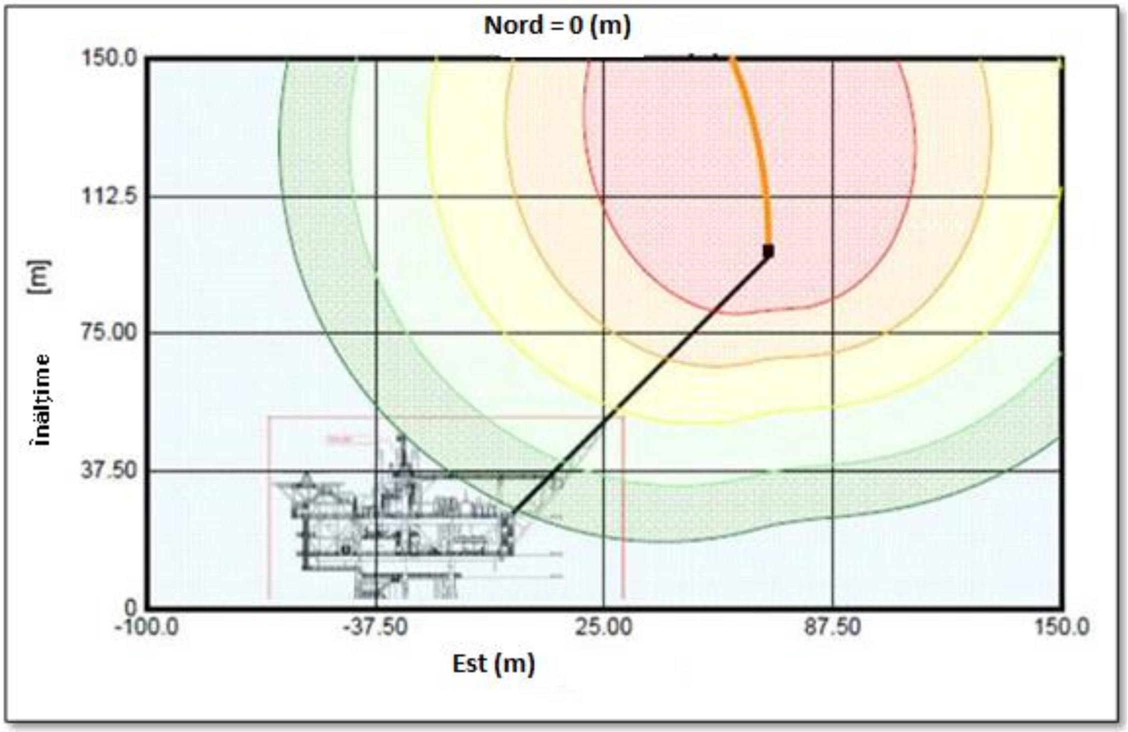


Figure 6.2 Thermal radiation contour in abnormal operating situations at the HP torch system

The assessment of the impact associated with the use of pollutant emissions, noise, radiation both during the implementation of the project and during the operation phase is presented in Section 6.2.8.

6.1.8.3.2 Effects of radioactivity

a) Generalities

Ionizing radiation are particles or electromagnetic waves with a maximum wavelength of 100 nanometers (a frequency of at least 3 × 1015 Hertz) capable of producing ions, directly or indirectly - X-rays, gamma rays, cosmic rays.

Ionizing radiation occurs when there is a source of radiation.

The sources of ionizing radiation are grouped as follows:

- natural sources - radioactive materials that exist naturally in the environment and
- artificial sources - artificially produced radioactive materials or radiation generators - devices capable of generating ionizing radiation, such as X-rays, neutrons, electrons or other charged particles.

Radioactivity is the property of unstable nuclei to disintegrate and spontaneously emit radiation.

Naturally occurring radioactive material, sometimes known as NORM (Naturally Occurring Radioactive Material), is the term used to describe any radioactive substance that exists naturally in the environment.

NORM is found everywhere in the environment, including soil, rocks, water, air and vegetation. It is also present in the human body and in all living tissues. They are usually found in very low concentrations.

NORM consists mainly of uranium, thorium and potassium, which have been present since the formation of the Earth about 4.5 billion years ago. These radioactive elements spontaneously decay and yield a number of other radioactive elements known as decay products, such as radon and radium.

b) *Information on the risk associated with ionizing radiation*

The natural radionuclides associated with the exploitation of oil and gas deposits belong to the decay chains of the primordial radionuclides ^{238}U (uranium) and ^{232}Th (thorium). These parent radionuclides have very long half-lives and are ubiquitous in the earth's crust with activity concentrations that depend on the rock type.

The radioactive decay of ^{238}U and ^{232}Th produces several series of radioisotopes of different elements such as radium (^{228}Ra, ^{226}Ra) and radon (^{222}Rn) , with physical characteristics, half-lives, decay modes and types and the energies of the emitted radiation are different in relation to the parent radionuclides .

A very small amount of these can dissolve in the reservoir fluid (often below detection limits) and be transported from the reservoir to the surface. It then accumulates in solid deposits on pipes, sludge, and detritus.

The reservoir fluid contains cations of group II (periodic table), strontium, barium and radium dissolved from the reservoir rock, consequently, it contains the radium isotopes ^{226}Ra of the ^{238}U series and ^{228}Ra and ^{224}Ra of the ^{232}Th series. The decay of radium results in radon.

According to studies, natural radionuclides can appear in formation water, but in very small quantities, below detection limits, as previously specified. The risk associated with certain natural radionuclides that can be transported by some salts in the formation water, under certain conditions, is represented by accumulation over long period of time in the form of scale on the interior of pipes and installations, if measures are not taken to prevent this. Based on the analyzes performed on the reservoir fluid, the following composition of the reservoir water is estimated:

Parameter	Minimum annual concentration (ppm)	Medium annual concentration (ppm)	Maximum annual concentration (ppm)
Total Dissolved Solids (TDS)	7,500	-	17,950
Chloride	-	5,412	9,807

Parameter	Minimum annual concentration (ppm)	Medium annual concentration (ppm)	Maximum annual concentration (ppm)
Sulphates (expressed as SO_4)	15	22	54
Barium	-	6	14
Iron	0.05	0.13	0.22
Magnesium	100	117	188
Strontium	2	9	19
Acetic acid	100	148	423
Formic acid	1	3	6
Propionic Acid	5	15	44
Sodium	1,000	2,690	4,866

According to studies, natural radionuclides can appear in produced water, deposition in the form of crust on the inside of pipes and installations, detritus.

b.1) Scale deposits on the inside of pipes and installations

In the activity of exploiting the gas field, deposits inside the pipelines accumulated over long periods of time can represent a radiological risk in some cases.

Typically, deposits are the result of mineral impurities that build up due to evaporation, pressure changes and/or temperature drops. The material is either a precipitate of barium/strontium sulfate ($Ba(Sr)SO_4$) or calcium carbonate ($CaCO_3$). Radium isotopes accompany barium and strontium as well as calcium in water/gas mixtures and coprecipitate. The activity concentration is highly dependent on technological parameters such as pressure and temperature variations in the plant.

The level of NORM accumulations depends on multiple factors such as the geological formation, reservoir, well, and conditions (pressure, temperature), which influence the scale accumulation potential trends of sulfate and carbonate.

From the monitoring of the technological parameters, any changes in the thermodynamic conditions (pressure, temperature) as well as, exceedances of the sulfate and carbonate saturation ratio can be observed, which indicate the potential of scale depositing.

To prevent internal deposits on pipes, a deposit inhibitor is usually used. Following the results of efficiency tests conducted on multiple products, OMV Petrom opted to use the product SCAL13370A from the manufacturer Champion X, which indicated the best results for the specific parameters of Domino and Pelican South reservoirs.

From the design phase, in order to determine the types of solid deposits that may occur, in 2017, Exxon Mobil conducted a study on the possible deposits from the fluid in the Domino and Pelican South deposits (FEED Inorganic Scale Analysis ROND-EW- *YRFLO-00-0001)*. The results and conclusions of the study are as follows:

- Risk of Calcium Carbonate deposition

Deposition is possible but unlikely in reservoirs, boreholes, or pipelines with a low amount of deposition.

The severity of the risk of deposition is low to medium at the inlet separator from the platform to the point of water discharge, with a quantity of deposition of low severity.

- Risk of barium sulfate deposition

  Deposit is possible but unlikely in the reservoir, wellbore with a low amount of deposit.

  Reduced Severity Deposit Index for Pipes and Inlet Separator to Water Point.

- Scale inhibitors

  Even if the occurrence of scaling is unlikely, in order to eliminate any risk, it was decided to inject scale inhibitor to protect against the possible but unlikely formation of scale in the well or at the subsea control valve (SSCV). This will also cover the inhibitor needed to prevent scale deposits in the pipelines on the platform.

  The inhibitor must be selected to prevent both calcite and barite, as both can form deposits.
- Monitoring program
  - It is recommended to monitor the concentration of inorganic parameters (including Na^+, Cl^-, Ca^{2+} and Ba^{2+}) as the main indicator of reservoir water occurrence, reservoir water changes and the potential of scaling.
  - Na^+ and Cl is monitored, the changes will be easier to detect.
  - Scaling forecasts will be updated if necessary, using data after the occurrence of reservoir water to optimize scale inhibitor injection rate.

b.2) Discharging produced water into the sea

The produced water mixed with cooling water and water from the open drain system will be discharged into the sea at a depth of 90 m.

The concentration of radium activity in the produced water is expected to be below the detection limit.

Studies on natural radioactivity in the water produced by the oil & gas industry conclude that, usually, radium being soluble will precipitate or remain in solution depending on salinity, temperature and pressure. In the precipitation situation (low temperature and pressure), radium co-precipitates with barium, strontium, calcium in the form of sulfates or carbonates inside pipes and equipment. In the produced water, discharged into the sea, it is possible to find in extremely low concentrations (below the detection limit) the non-precipitating radium [3].

Other papers state that the potential presence of natural radionuclides, such as ^{226}Ra and ^{228}Ra, could lead to increased concentration of Ra activity in sediment and water near the discharge site. [4]Studies have shown that due to the high density of barium, particles of radium associated with barium will settle in the vicinity of the discharge site.

The results of a study carried out in the North Sea in which produced water and sediments and the exposure dose of marine biota were analyzed, concluded the following (Erikson et al, 2009) [5]:

- Concentrations of ^{226}Ra from produced water in North Sea water and biota are generally low (below hazard limits) but are more varied in sediments. The cause of the variations seems to be related to the size of the sediment particles, thus correlated with the depth of the sea floor.
- Scale inhibitors, present in produced water alter the properties for barium and radium.
- Ba (Ra)SO_4 is much more difficult to precipitate in seawater than expected due to dilution, and scale inhibitors enhance this effect, thus reducing considerably the risk.
- The current level of produced water discharges represents a very low risk to biota and humans.

b.3) Conclusions

The activity concentration of natural radionuclides is estimated to be below the detection limit. Accumulation of scale deposits on the inside of pipes and installations can lead to a higher activity concentration, if no mitigation measures are implemented. To prevent scales in the technological process, a scale inhibitor is injected into the well. Following the results of efficiency tests conducted on multiple products, OMV Petrom opted to use the product SCAL13370A from the manufacturer Champion X, which indicated the best.

During the operational phase, produced water, sea water and sediments in the production platform area will be monitored to determine the effects of the discharge of produced water into the marine environment.

Based on the information provided, it is concluded that there is no potential risk of increasing the concentration of natural radionuclides in the Black Sea. As such, there will not be associated risks of

[3]KP Smith, AN OVERVIEW OF NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM) IN THE PETROLEUM INDUSTRY, https://www.osti.gov/servlets/purl/6594778

[4]Faraaz Ahmad, Radionuclide Fate in Naturally Occurring Radioactive Materials (NORM) in the Oil and Gas Industry, https://pure.manchester.ac.uk/ws/portalfiles/portal/188962035/FULL_TEXT.PDF\ accessed 22.09.2023

[5]Eriksen, D.Ø., Sidhu, R., Ramsøy, T., Strålberg, E., Iden, KI, Rye, H., Hylland, K., Ruus, A., and Berntssen, MHG 2009. Radioactivity in produced water from Norwegian oil and gas installations – concentrations, bioavailability, and doses to marine biota"

technogenic increase of ionizing radiation that could lead to the contamination of marine waters, coastal waters and implicitly of surface and/or subsurface waters from the terrestrial area, both on Romanian and Bulgarian territory.

In the decommissioning stage, thanks to the measures implemented to prevent scale in the pipelines, there is no risk of natural radionuclides concentration increase.

6.1.8.4 Risks to human health, cultural heritage, or the environment (for example due to accidents or disasters)

For the Neptun Deep project, the risks associated with the construction works and the activities in the operation phase were identified and assessed during the early design stage into detailed design The project implemented safety and environmental critical elements (SECE), which are safety barriers, as defined in Directive 2013/30/EU, "the purpose of which is to prevent or limit the consequences of a major accident or whose failure could cause or substantially contribute to a major accident ".

Risk assessment is a necessary tool for the prevention and control of technological accidents, or in case of natural disasters, the framework and minimum requirements for risk management being concretely defined in the HSSE risk management standard of the OMV Group.

Since risks to human health and the environment can occur in the event of major accidents, the Neptun Deep project will comply with the provisions of Law 165/2016 on the safety of offshore oil operations, for development projects - exploitation of oil deposits natural gas from the Romanian sector of the Black Sea, it being necessary to draw up the Report on Major Hazards (RoMH) and go through the procedure for obtaining the approval issued by the Competent Authority for the Regulation of Offshore Petroleum Operations in the Black Sea (ACROPO).

From the perspective of natural disasters, the potential risks (earthquakes, floods, landslides) were evaluated based on the geotechnical studies carried out in the location of the project i, the results being integrated in the design stage of the Neptun Deep project. The project location is in low (minimal) earthquake risk areas and is not in flood or landslide risk areas. These aspects are detailed in **Chapter 9, Section 9.1**.

The description of the major accident hazard scenarios identified for the Neptun Deep project, and the presentation of significant adverse environmental effects is presented in **Chapter 9 , Section 9.2.**

The effects on human health as a result of the implementation of the Neptun Deep project, was the subject of a Health Impact Assessment Study [6]. The description of the impact of the project on human health, considering the activities carried out at each stage of the project, including in case of major accidents, is presented in detail in **Section 6.2.14.**

Archaeological diagnostic studies were carried out in the project implementation area both on land and at sea. The archaeological sites identified are presented in detail in **Chapter 4, Section 4.7.**

[6]SC Vest Medical Impact SRL - Impact assessment study on the health and comfort of the population in relation to the "NEPTUN DEEP" project, September 2023.

The conclusions of the Archaeological Diagnostic Report drawn up by the Museum of National History and Archeology in Constanța (MINAC) were that the land site *of* the project is located in an area with Low archaeological potential and without conclusive archaeological traces.

The location in the offshore area of the project is partially located in the archaeological protection zone of the Romanian continental platform on the Black Sea coast **LMI Code Underwater archaeological site "Continental Platform of the Romanian Black Sea Coast" CT-lsA-02561.**

Based on non-intrusive investigations conducted, an area of 383 km² has been identified that could be affected by the Neptun Deep project and approved for archaeological excavation, while maintaining safety zones in accordance with Archaeological Load Discharge Certificate No. 60/2022 issued by the County Directorate for Culture of Constanța County.

The works of the Neptun Deep project will be designed in such a way as to prevent and avoid the risks of the degradation of archaeological objectives during the construction period. No additional risks were identified for the cultural objectives during the operation period.

6.1.8.5 Accumulation of effects with those of other existing and/or approved projects

Cumulative effects are the effects due to interactions between the effects of the proposed project and the effects of existing and planned (reasonably foreseeable) developments in the project area

Cumulative impacts may result from the interaction of several developments/projects.

The evaluation of the cumulative impact associated with the implementation of the project as well as in the operation phase are presented in **Section 6.4.**

6.1.8.6 Project climate impact and project vulnerability to climate change

According to the Communication of the European Commission no. 2021/C 373/01 regarding technical guidelines regarding the immunization of the infrastructure against climate change in the period 2021-2027 and the guidance on environmental issues that must be analyzed in RIM, issued by APM Constanța with number 1632/11.08.2023, the recommendations and communications of the European Commission must be integrated in the impact assessment report.

Climate immunization is a process that integrates climate change mitigation and adaptation measures into the development of infrastructure projects.

The climate change immunization assessment comprises two pillars (mitigation, adaptation) and each pillar has two stages (examination, detailed analysis). The first stage is the examination, and the result determines whether it is necessary to perform the second stage.

Annex IV to the EIA Directive includes a direct reference to climate and climate change in two provisions. The focus is on two distinct aspects of the climate change issue:

- *Climate Change Mitigation:* this takes into account the impact that the project will have on climate change, primarily through greenhouse gas emissions.

- *Climate Change Adaptation:* this takes into account the project's vulnerability to future climate changes and its capacity to adapt to the impact of climate change, which may be uncertain. Assessing vulnerability and climate risks remains the basis for identifying, evaluating, and implementing climate change adaptation measures.

The National Strategy on Climate Change 2016-2020 addresses two directions of action: the process of reducing greenhouse gas emissions in order to reach national targets and adapting to the effects of climate change. From the perspective of the new Technical Guidelines for the period 2021-2027, the immunization of the project against climate change is done from the design stage and refers to the evaluation of the project from the point of view of ensuring climate neutrality (mitigation of climate change) for the life of the project and the resilience of the project to climate change (adaptation to climate change).

6.1.8.6.1 Climate change mitigation (climate neutrality)

a) Examination - Stage 1 (mitigation)

The studied project is included in Table 2 Examination list - carbon footprint from the COMMUNICATION OF THE COMMISSION - Technical guidelines regarding the immunization of the infrastructure to climate change in the period 2021-2027, (2021/C 373/01) - Natural gas transport infrastructure projects, for which it is necessary to calculate the carbon footprint.

Infrastructure projects with absolute and/or relative emissions of more than 20 000 tons CO2e/year (positive or negative) must be subject to both stage 1 (examination) and stage 2 (detailed analysis), steps in the process of climate change immunization for climate change mitigation.

b) Detailed analysis - Stage 2 (mitigation)

The detailed analysis step consists of quantifying and comparing GHG emissions in a typical operating year with thresholds for absolute and relative lifetime emissions from construction and operation to decommissioning.

The method of the European Investment Bank (EIB) was used to calculate the carbon footprint in the operating stage [7].

Greenhouse gases included in the EIB's carbon footprint methodology include the seven gases listed in the Kyoto Protocol, namely: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); sulfur hexafluoride (SF_6); and nitrogen trifluoride (NF_3).

[7] *EIB Project Carbon Footprint Methodologies, version 11.3, January 2023.*

Under the Kyoto Protocol, in 1997 the Conference of the Parties standardized international reporting, deciding by Decision 2/CP.3 that the GWP values calculated for the IPCC's Report should be used to convert the various greenhouse gas emissions of greenhouse in comparable CO2 equivalent.

Table 6.9 GWP values for converting GHGs into CO2e-Kyoto Protocol

Direct greenhouse gas	Chemical formula	GWP value of transformation into CO2eq
Carbon dioxide	CO_2	1
Methane	C_4	28
Nitrous oxide	N_2O	265

According to IPCC reports, 2014, for the estimation of CO [8] $_2$ equivalent emissions, the equivalence factors between GHG and CO_2 defined for a given period of time of 100 years, based on a global warming potential (GWP) will be 1.28 and 265 for CO_2, CH_4, and N_2O, respectively.

The GWP values for the transformation of GHGs into CO_2eq were significantly modified on the occasion of the IPCC reports, but having a degree of uncertainty, the present project was opted for the values established at the national level, GEO 80/2018 with subsequent updates and changes to implement the EU Regulation 525/2013 and EU Regulation 2018/842 *regarding the mandatory annual reduction of greenhouse gas emissions by the member states in the period 2021-2030 in order to contribute to the climate actions to comply with the commitments assumed under the Paris Agreement)*.

b 1.1 Calculation of GHG emissions for the Neptun Deep project

Within the RIM, the direct and indirect emissions of greenhouse gases generated by the project's activities during its construction and operation stage, during the life of the project, were calculated. The sources of GHG emissions during the project construction/installation and operation phases are given by:

- Fuel consumption during drilling and the construction/installation phase;
- Fuel consumption during operation;
- Electricity consumption in the operating phase;
- Emissions during the operating phase.

b 1.1.1 Calculation of GHG emissions during the construction phase

The sources of emissions during the project construction/installation phase is the fuel consumption.

The calculation of air emissions was presented in **Chapter 2, Section 2.5.3,** so the GHG emissions during the well construction and operation period are as follows:

[8]AR4 Fourth Assessment Report, 2007, AR5 Fifth Assessment Report, 2014 and AR6 Sixth Assessment Report, 2023. Source: https://www.ipcc.ch/pdf/assessmentreport/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf (pp. 73-79), accessed July 26, 2023.

Table 6.10 GHG Emissions Neptun Deep Project in the construction phase

Project stages	Execution period	GHG (t/year)	CO2 _	N 2 O	CH 4	TOTAL (y/y)
Offshore area	trim 3,2024- quarter 2, 2026	Direct greenhouse gases	240,998	0	134.25	241,132
Drilling execution Drilling Centers Domino 1, Domino 2 and Pelican South	quarter 1 2025- quarter 4 2026	Direct greenhouse gases	549,634	0	0	549,634
Onshore area	quarter 3, 2024 quarter 2 2026	Direct greenhouse gases	8,862	0	0	8,862
TOTAL			799,494		134.25	799,628

Note: N_2O and CH_4 values listed as 0 in the table above are extremely low.

Table 6.11 Amount of CO_2 equivalent in the construction stage

Pollutants	GWP	Pollutant emissions y/y	Amount of CO_2 e y/y
CO_2	1	799,494	799,494
CH_4	28	134.25	3,759
N_2O	265	0	0
CO_{2e}			803,253

b1.1.2 Calculation of GHG emissions in the operating stage

Greenhouse gas emissions come physically from sources exploited by the project.

Table 6.12 Total GHG emissions Neptun Deep Project in the operating stage

Project stages	Operating period	GHG (to/year)	CO2 _	N 2 O	CH 4	TOTAL to/year
Offshore	2027-2046	Direct greenhouse gases	89,198	0.012	22.18	89,220.20
Onshore	2027-2046	Direct greenhouse gases	9.3	-	9.66	18.96
Total			89,207.3	0.012	31.84	89239.152

Table 6.13 Pollutant emissions and amount of CO_{2e} t/year

Pollutants	GWP	Pollutant emissions t/year	Amount fo CO_{2e} t/year
CO_2	1	89,207.3	89. 207.3
CH_4	28	31.84	891.52
N_2O	265	0.012	3.18
CO_{2e}	-	-	90,102

b 1.1.3 GHG emissions in the decommissioning stage

For the decommissioning stage, the calculation of air pollutant emissions, including GHG emissions, will be based on the closure project, which will be developed in order to obtain the environmental agreement for decommissioning/abolition.

b 1.1.4 Calculation of the carbon footprint of the project

The Neptun Deep project is part of the category of projects for which it is necessary to calculate the carbon footprint according to Table 2 of the COMMUNICATION OF THE COMMISSION - Technical guidelines regarding the immunization of the infrastructure against climate change in the period 2021-2027, (2021/C 373/01) - Projects of Natural gas transport infrastructure.

It is assumed that the entire production of gas resulting from the exploitation of the deposits in Perimeter IX Neptun will be used for the production of electricity, in order to reduce the emissions resulting from the burning of fossil fuels from coal or other fossil fuel plants.

The calculation of the carbon footprint of the project results from the following table:

Table 6.14 Calculation of the carbon footprint of the project

Emissions	Quantity of GN m^3/day	Electricity MWh/day	Conversion factor	CO_2 to CO_2e /day emissions
Emissions when using NG extracted from the ND deposit for electricity generation	19,000,000	65,432	1.9 kg $CO2/m^3$	36,100
Equivalent emissions from coal-fired power generation		65,432	850 $kgCO_2$/ MWh	55,617.20
Relative emissions from the Neptun Deep Project				- 19,517.2
Emissions resulting from the drilling phase of the Neptun Deep Project (approx . 701 days)				227.73
Emissions resulting from the operating phase of the Neptun Deep project (at most 20 years)				1,757.18
The carbon footprint of the Neptune Deep Project				-17,532.29

The result is a negative carbon footprint of the project, which ensures the compatibility of the project in relation to the climate objectives at the national and European level in terms of mitigating GHG emissions.

b 1.2 Fictitious cost of carbon for the Neptun Deep Project

For the Neptun Deep project, it will take a period of 33 months (726 days) of project execution, and then it will be exploited starting in 2027, for a period of maximum 20 years. The project plan foresees emissions for each year of operation. For the first year of operation, emissions are valued at 199 EUR/ton. The estimated value of emissions in 2030 is 250 EUR/tone CO_2e. If the project is estimated to generate emissions in 2046, they are valued at 688 EUR/tone CO_2e.

Table 6.15 Fictitious cost of carbon emitted per year in EUR/t CO2e for the Neptun Deep project

Year	EUR/t CO2e	Fictitious cost of carbon emitted over the life of the project EUR
2020	80	0
2021	97	0
2022	114	0
2023	131	0
2024	148	18,737,984
2025	165	112,509,705
2026	182	101,058,958
2027	199	127,633,227
2028	216	138,536,568
2029	233	149,439,909
2030	250	160,343,250
2031	278	178,301,694
2032	306	196,260,138
2033	334	214,218,582
2034	362	232,177,026
2035	390	250,135,470
2036	417	267,452,541
2037	444	284,769,612
2038	471	302,086,683
2039	498	319,403,754
2040	525	336,720,825
2041	552	354,037,896
2041	579	371,354,967
2043	606	388,672,038
2044	633	405,989,109

Year	EUR/t CO2e	Fictitious cost of carbon emitted over the life of the project EUR
2045	660	423,306,180
2046	688	441,264,624
2047	716	0
2048	744	0
2049	772	0
2050	800	0

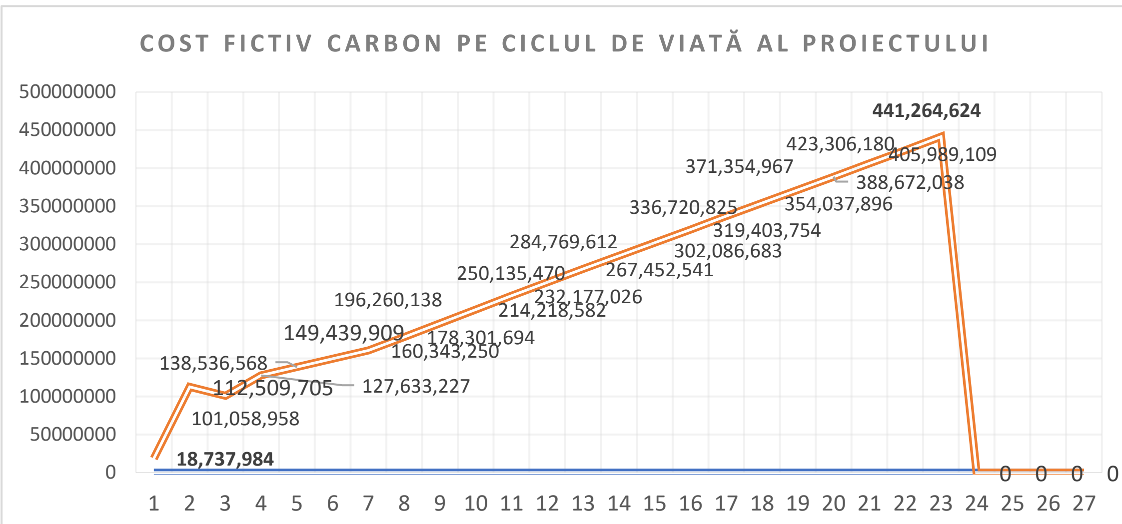


Figure 6.3 Fictitious carbon cost over the life cycle of the project

The period 2024-2026 represents the construction stage of the project, the period 2027-2046 represents the life cycle of the project, and in 2050 GHG emissions will be 0, when the climate neutrality target is established at European and national level.

b 1.4 Verification of project compatibility with a credible GHG trajectory until 2050

According to the climate change immunization strategy, the project owner verifies from the design stage, the compatibility of the project with a credible trajectory in line with the EU's objectives of reducing greenhouse gas emissions until 2030 and until 2050 and with the objectives of the Paris Agreement and of the European Climate Law.

The context of the project takes place in a period in which targets are set at national and European level regarding the mitigation of GHG emissions, in steps of reducing GHG emissions defined from a strategic point of view by 50% (to European level) until 2030 and reaching climate neutrality with "0" GHG emissions in 2050.

Romania's GHG emission reduction target for 2030 (compared to 2005) is -12.7 **%** , with the goal of becoming climate neutral by 2050, reaching a **99% reduction in net emissions in 2050** , compared with the 1990 level.

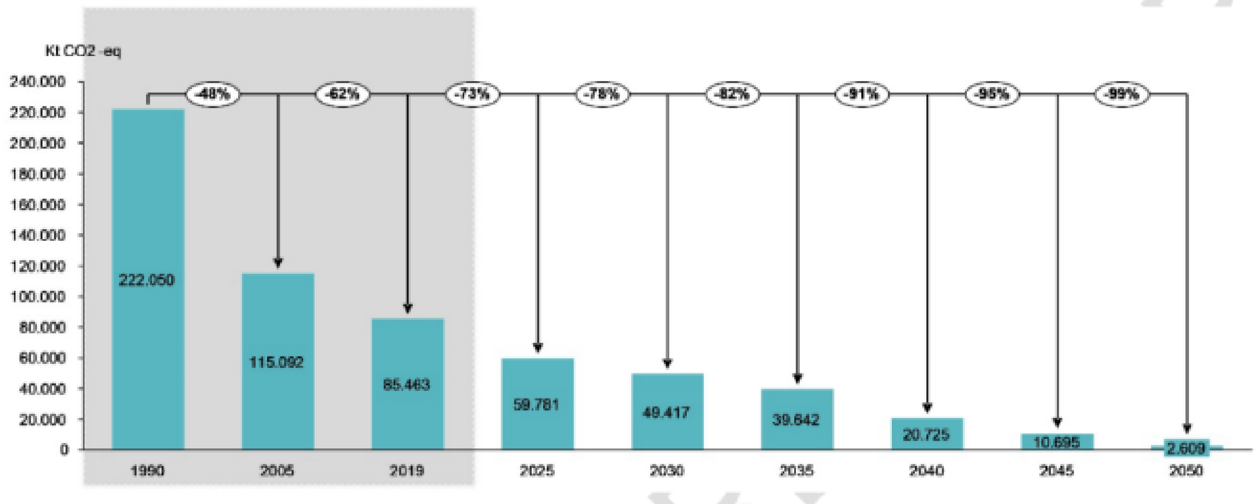


Figure 6.4 GHG emission reduction targets established at national level

According to the National Inventory of Greenhouse Gas Emissions (INEGES) aggregated GHG emissions and absorptions (net emissions) in 2019 at the national level were 85.46 Mt CO_2-eq.

The GHG emission reduction trajectories are designated as RCP the representative trajectories of the CO2 concentration evolution, namely, RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5, which represent (RCP). Figure 6.5 shows the projection of global warming to 2100 (compared to the period 1986-2005, for which average global warming is about 0.6 °C above pre-industrial levels.

Most simulations for AR $_5$ were performed with prescribed CO $_2$ concentrations reaching 421 ppm (RCP 2.6), 538 ppm (RCP 4.5), 670 ppm (RCP 6.0), and 936 ppm (RCP 8.5) by 2100.

RCP2.6 starts with the year 2020 and represents the trajectory in which the radiative forcing reaches peak values of about 3 W/m ^{2} and then decreases, limiting itself to 2.6 W/m ^{2} in 2100 (Extended trajectory of the corresponding concentration evolution, or ECP, has constant emissions after 2100).

RCP4.5 starts with the year 2040 and together with RCP6.0 represents two intermediate stabilization trajectories where the radiative forcing is limited to about 4.5 W/m ^{2} and 6.0 W/m ^{2} in 2100 (the corresponding ECPs have constant concentrations after 2150).

RCP8.5 starts with the year 2100 and is the upper trajectory leading to > 8.5 W/m ^{2} in 2100 (the corresponding ECP has constant emissions after 2100 to 2150 and constant concentrations after 2250).

The RCP2.6, RCP4.5, RCP6.0, RCP8.5 projections of global warming by 2100 are shown in the following figure:

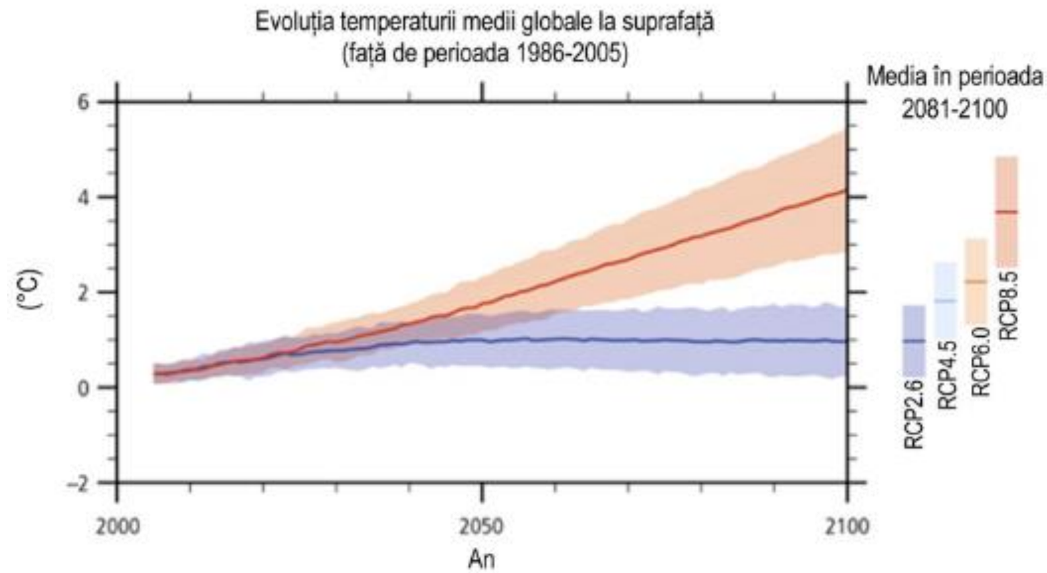


Figure 6.5 The evolution of the Medium global surface temperature according to the simulations carried out based on the established GHG reduction objectives, until 2100

The execution calendar of the project works is expected to take place in the period included in the quarter. II 2024 until quarter IV 2026, with the project's operating period and the first gas production starting, respectively expected in the quarter. 1, 2027.

The main design features for the project's operational period are as follows:

- Lifetime of the installation: maximum 20;
- Availability: > 95%;
- Estimated average annual amount of gas production: 19,000,000 m ^{3} /day;
- Onshore connection pressure to SNT (National Transport System): minimum 50 bar and maximum 63 bar.

Flows will decrease over the life of the project due to fine sediment deposits in the flow lines, reaching below 10,735,811 m^3/day for the Domino field and below 2,825,213 m^3/day for the Pelican field towards the end of the operational life.

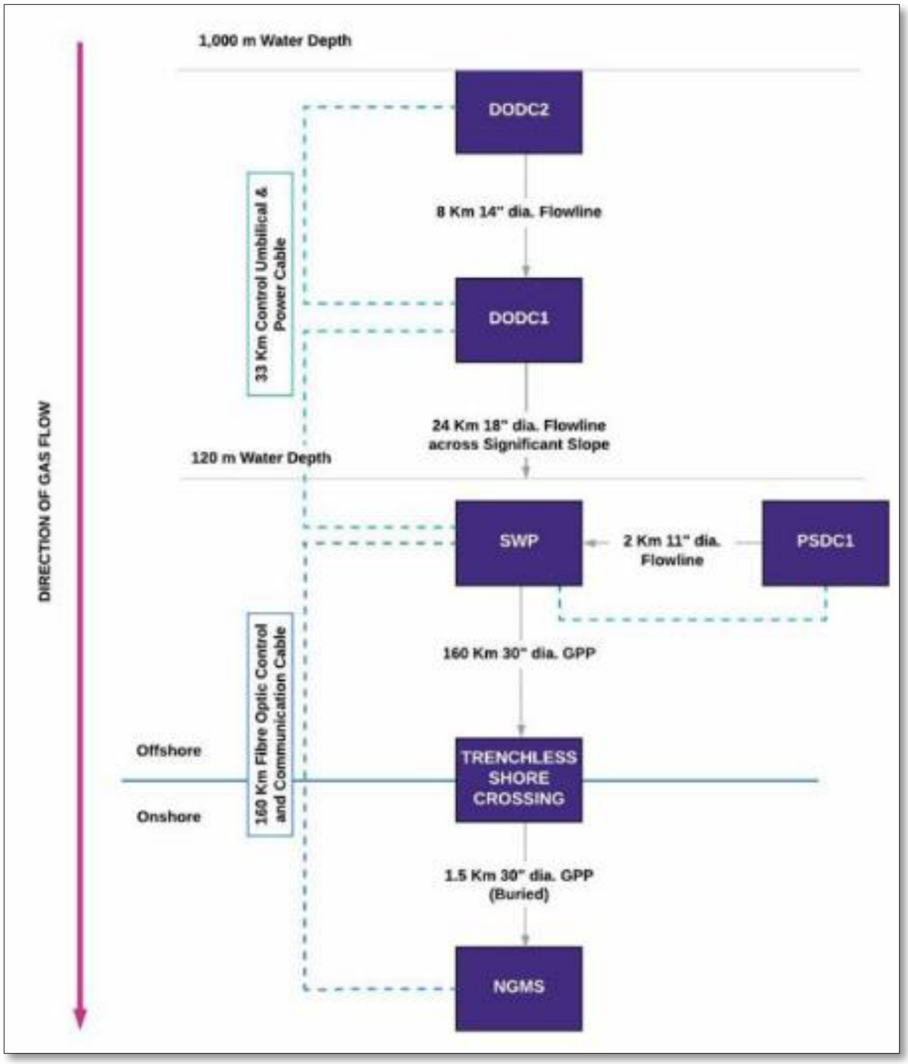


Figure 6.6 Main components of the Neptun Deep project

According to the surveys carried out, the composition of the methane gas from the Pelican South and Domino deposits was analyzed with the following results:

Table 6.16 Medium composition of methane gas from the Domino and Pelican South fields

Compound	Medium molar composition A (Domino deposit)	Medium molar composition B (Domino deposit)	Medium molar composition A (Pelican South deposit)
	mole %	mole %	mole %
No_2	0.12	0.18	0.11
CO2 _	0.02	0.08	0.07
H2S _ _	0.00	0.00	0.00
C1 – Methane	99.76	99.59	99.63
C2 – Ethane	0.05	0.06	0.07

Compound	Medium molar composition A (Domino deposit)	Medium molar composition B (Domino deposit)	Medium molar composition A (Pelican South deposit)
	mole %	mole %	mole %
C3 – Propane	0.02	0.01	0.04
iC4 – Isobutanes	0.01	0.01	0.02
nC4 – Normal butane	0.00	0.00	0.00
iC5 – Pentanes	0.00	0.01	0.01
nC5 – Normal pentane	0.00	0.01	0.01
C6 – Hexanes	0.00	0.00	0.03
C7 - Heptanes	0.00	0.00	0.00

The objective data resulting from the analysis of the existing gas in the Neptun Deep block, revealed the quality of the existing gas in the Domino and Pelican Sud fields:

- high concentrations of the methane gas fraction, 99.59%-99.76%, the rest of the fractions considered impurities being below 0.1%,
- the very low CO_2 content, between 0.02 and 0.07%,
- the gas is free of hydrogen sulphide, a toxic and corrosive chemical compound, which would require additional occupational health and safety measures and additional technology to remove this component from the production gas, should H_2S be present.

The composition of the production gas will be analyzed throughout the life of the project both at the entrance to the dehydration facility on the Neptun Alfa production platform and at the exit, as the gas must be brought up to the quality standard imposed by the Transgaz National Transport System Romania.

The GHG emissions quantified in CO_2 resulting from the project during the life cycle are revealed in the following table compared to the objectives established at the national level by the Neutral RO Scenario regarding GHG reduction until 2050.

Table 6.17 GHG emissions in relation to the GHG emissions reduction trajectory for the period 2019-2050 according to the RO-Neutral Scenario

Year	2019	2025	2030	2035	2040	2045	2050
kTo CO_2e Neptun Deep Project	0	681,877 (1.14% of target)	641,373 (1.29%)	641,373 (1.6%)	641,373 (3.09%)	457,772 (4.2%)	0
kTo CO_2e RO Neutral	85,463	59,781	49,417	39,642	20,725	10,695	2,609

It can be appreciated that the compatibility of the Neptun Deep project with a credible GHG trajectory until 2050, in relation to the climate objectives for the years 2030 and 2050, is achieved, namely:

- CO_2 emissions resulting from the existence of the Neptun Deep project represent 1.14% of the amount of CO2eq established according to the Neutral RO Scenario;
- for the year 2050, the equivalent CO_2 emissions due to the Neptun Deep project will be "0".

- greenhouse gas emissions generated by the project are limited in accordance with Romania's general objectives for 2030 and 2050, GHG emissions for the established stages (2030 and 2050) falling within the planned reduction trajectory.

The assessment of carbon dioxide emissions generated by the project is to be included throughout the entire project development cycle.

As gas production and gas treatment takes place on the Alpha Neptun Production Platform, most of the project's gaseous emissions will occur offshore at the Production Platform.

From the calculation, a potential negative carbon footprint of the project resulted, namely -17,532.29 to CO_2 e/day, which can ensure the reduction of GHG emissions at the national and European level, by using methane gas for energy production in instead of using fossil fuels that produce much higher GHG emissions.

6.1.8.6.2 Adaptation to climate change (climate resilience)

Climate vulnerability and risk assessment remains the basis for identifying, evaluating, and implementing climate change adaptation measures.

a. Stage 1 – Examination (adaptation)

a.1 Identification of potential climate risks for the Neptun Deep project area

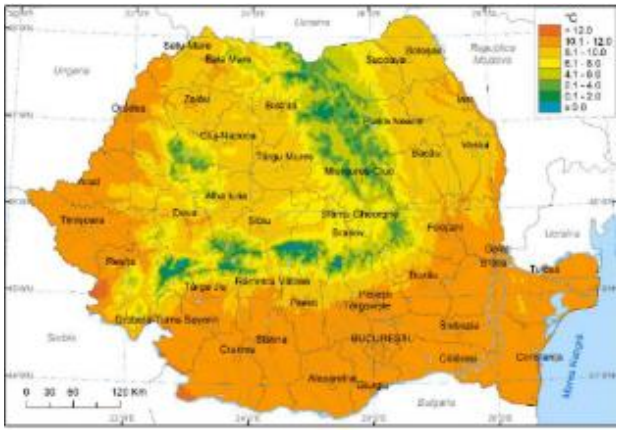
The analysis of the sensitivity, exposure and vulnerability of the project can be carried out in the context of the analysis of climatic factors and the expected climatic changes for the project area.

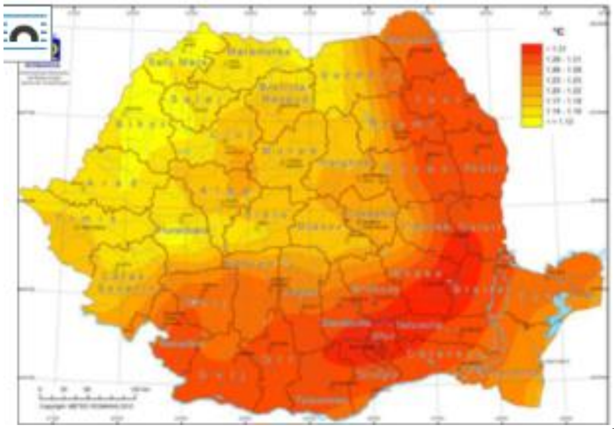
a.1.1 Onshore area

In Romania's 8th National Communication on climate change, the evolution of the climate variables of temperature and precipitation over Romania is presented as follows:

a.1.1.1 Temperature in the dry area

The average annual temperature varies with latitude and altitude, from 8 °C in the north to 11 °C in the south, and from about 2.6 °C in the mountains to 11.7 °C in the plains. Between 1901 and 2021, the average annual air temperature increased by more than 1° C. The upward trend was stronger, especially since the 1980s.





*

Figure 6.7 Multiannual Medium temperature for the period 1961-2021

Figure 6.8 Multiannual mean temperature projection 2011-2040

For the summer of 2023, the public data provided by the National Meteorological Administration [9]can mention the following:

Compared to the median of the standard reference interval (1991-2020), the deviation of the average air temperature in July 2023 was positive throughout the country, less so in the extreme east of the Danube Delta. The highest values of the positive deviation, ≥ 2 ^{0}C, were recorded at 29 meteorological stations located in Muntenia, in the south-east of Oltenia, south-west of Dobrogea and isolated, in Banat and in the mountain area. At 83 meteorological stations, the average temperature deviation had a value of ≥ 1.5 °C. The maximum value was recorded at the meteorological station Alexandria, 2.9 °C. The only negative deviation in the country was recorded at the Sulina weather station (0.1°C).

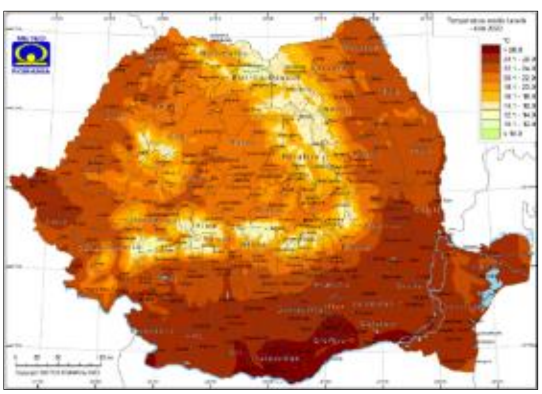


Figure 6.9 Medium monthly temperature – July 2023

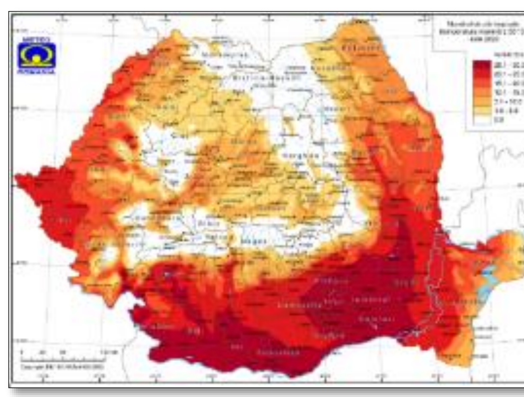


Figure 6.10 Number of tropical days since July 2023 versus the mean of the standard reference interval (1991–2020)

Analysis of the deviation of the number of tropical days from the mean of the standard reference interval (1991-2020) shows a positive anomaly in almost the whole country. The highest deviations,

[9] https://www.meteoromania.ro/ accessed on September 23, 2023.

of 8 - 12 days, were mainly in the hilly areas of Muntenia, Oltenia and Dobrogea, the south of Moldova and locally in the west of the country. Isolated, in the south of Dobrogea, they exceeded 12 days.

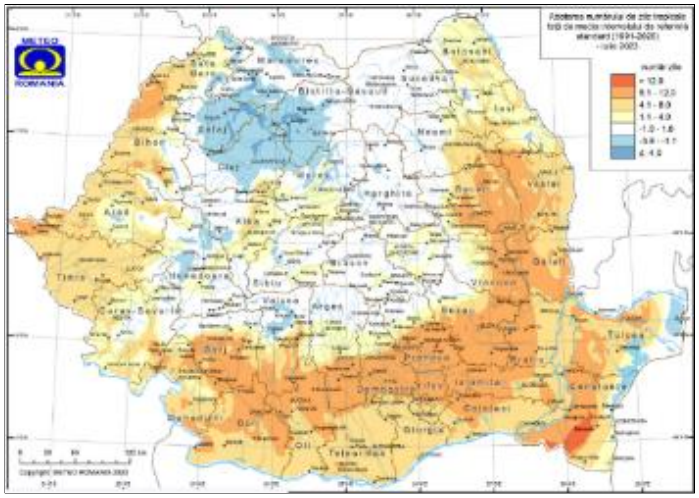


Figure 6.11 Deviation of the number of tropical days in July 2023 from the mean of the standard reference interval (1991-2020)

In the onshore area of the Neptun Deep Project, the climate is warm and temperate with hot summers. It is also completely humid, due to the coastal environment adjacent to the Black Sea. Relative humidity is in the range of 80% and 88% in August and December, respectively, with low monthly variation. The mean monthly maximum and minimum temperature ranges from -2.1°C in January to 26.3°C in July, while the annual mean temperature is 11.7°C.

- the average temperature of July is > 26.0°C,
- the number of tropical days with temperatures > 30 °C in July 2023 was between 5-10 days, with a positive deviation between 1.1 and 4 days compared to the standard reference interval (1991-2020),

In the land area, the prevailing winds blow from the west and north, with average annual speeds between 4 – 6.5 m/s.

a.1.1.2 Precipitation regime in the dry area

Average annual rainfall amounts generally vary between values below 400 mm and above 1200 mm. The average annual precipitation is 406.9 mm, with a minimum in February (26.8 mm) and a maximum in November (44.4 mm). The average maximum number of days with precipitation are recorded in December (10.3 days), while the average maximum number of days with snow are recorded in January (5.4 days).

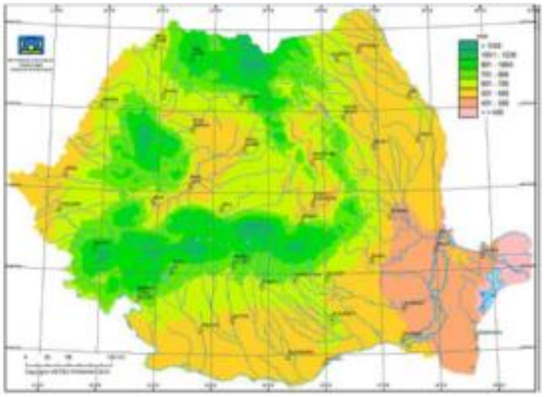


Figure 6.12 Multiannual precipitation level 1961-2012

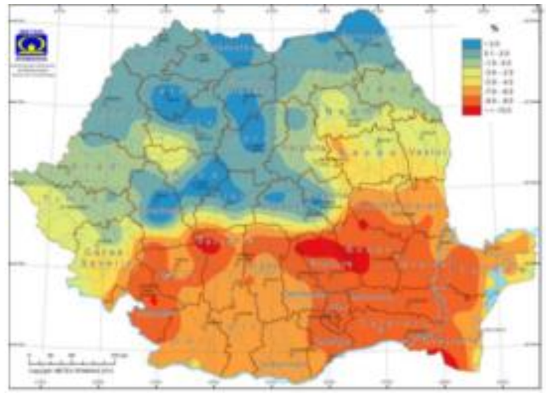


Figure 6.13 Projection of the multiannual amount of precipitation 2011-2040

In July 2023, the lowest level of precipitation in the whole country was recorded in southern Dobrogea, <20 mm (15.4 mm, at Amzacea Meteorological Station - Constanța County).

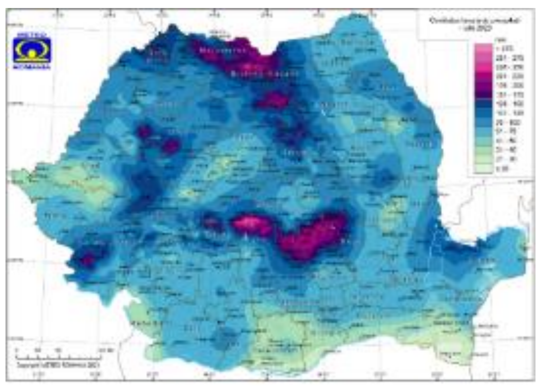


Figure 6.14 Amount of precipitation recorded in July 2023

The increasing trend of extreme events is also reflected in the climate pattern of extremely wet and dry years, indicating a doubling of their frequency over the last century.

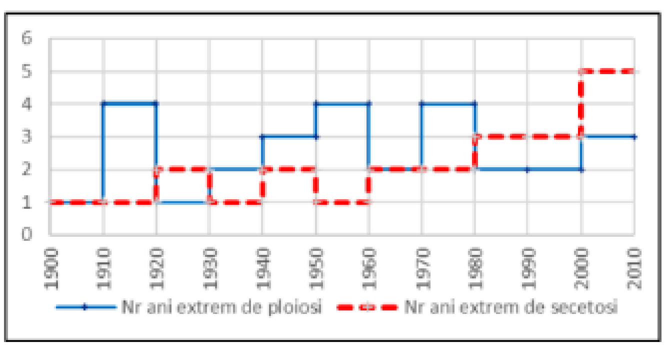


Figure 6.15 Trend of extreme events - frequency of wet and dry years over decades

<u>In the context of increasing summer temperatures and drought durations, the associated phenomena for the analyzed area may be the increased frequency of convective precipitation, storms, intensified winds and tornadoes that seem to have become more frequent in the region near the Black Sea.</u>

a1.2 Offshore area - Climate changes in the Black Sea area

For the Black Sea area where the Neptun Deep Project offshore area is also located, climate change data were extracted from various reports and publications available online for a 100-year projection period.

Due to the significant distance that the Neptun Deep Project site extends within the Black Sea, 813,607 m^2 , the offshore project area was divided into five regions and for each of these, the evolution of the metocean criteria was separated according to the water depth of the five regions.

- Region 1 - the region covering the project area with water depth < 40 m.
- Region 2 - represents the area from 28.8° to 29° east longitude.
- Region 3 - represents the area from 29° to 29.3° east longitude.
- Region 4- represents a larger area located from 29.3° to 30.7° east longitude
- Region 5- represents the Neptun Deep Block area with water depth > 300 m.

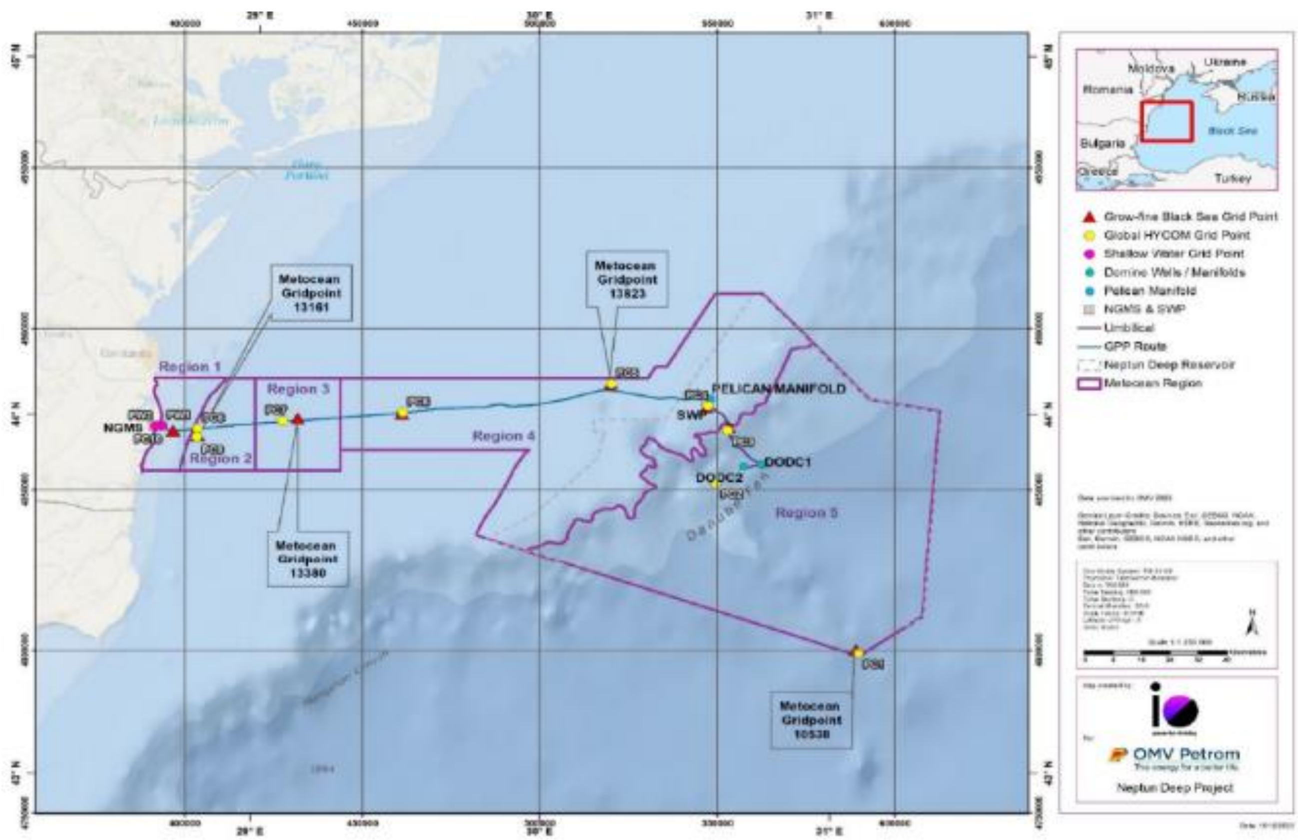


Figure 6.16 Neptun Deep Project - Map of the offshore components - classification of the regions related to the offshore area from a climatic and oceanographic point of view

Note: Red triangles indicate GROW-FINE BS grid points used for wind and wave modeling in Regions 2 to 5. Yellow circles indicate HYCOM grid nodes from bottom current modeling by water depth. Purple circles indicate grid points where waves are estimated in shallow water areas.

Climatic parameter values were determined based on specific models from the nodes of the GROW-FINE BS network for modeling wind and waves for Regions 2 to 5 and from the HYCOM network for modeling bottom currents as a function of water depth, as well as from NEMO-BLS in to improve the horizontal resolution along the production pipeline route compared to that of points PC1-PC10.

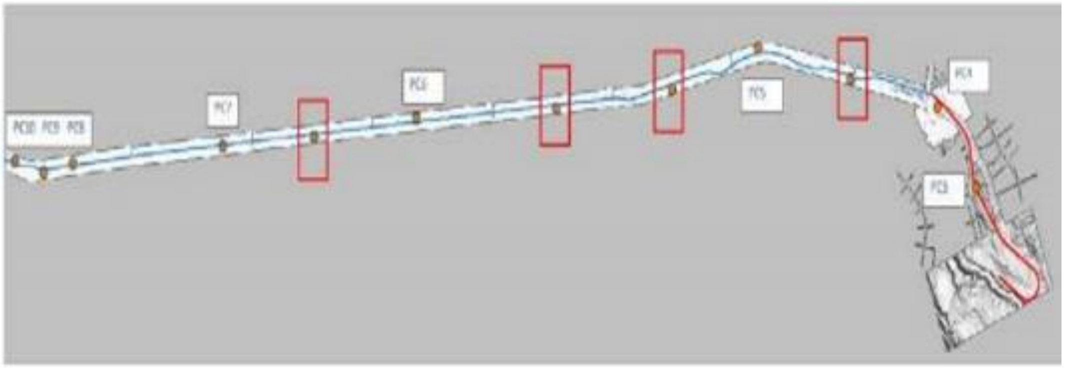


Figure 6.17 Production pipeline route

a1.2.1 Medium Sea surface temperature

Statistical data regarding the temperature of the Black Sea water were taken from Miladinova et al, 2016[10], the increasing trend of temperatures being highlighted in figure 6.18 below.

Thus, the trend of temperature increase at the water surface is presented:

- in the winter months of December-March, an increasing trend of approx. 1 degree is highlighted;
- the annual Medium also shows an increasing trend at 16°C.

<u>It is estimated that the increase in water temperature will contribute to some extent to the intensification of extreme events in the Neptun Deep project area, in the wider meteorological-oceanographic context.</u>

[10] S. Miladinova, A. Stips, E. Garcia-Gorriz, D. Macias Moy - JRC Technical Reports – Changes in the Black Sea physical properties and their effect on the ecosystem, EU-MC project 33764 SIMSEA, 2016

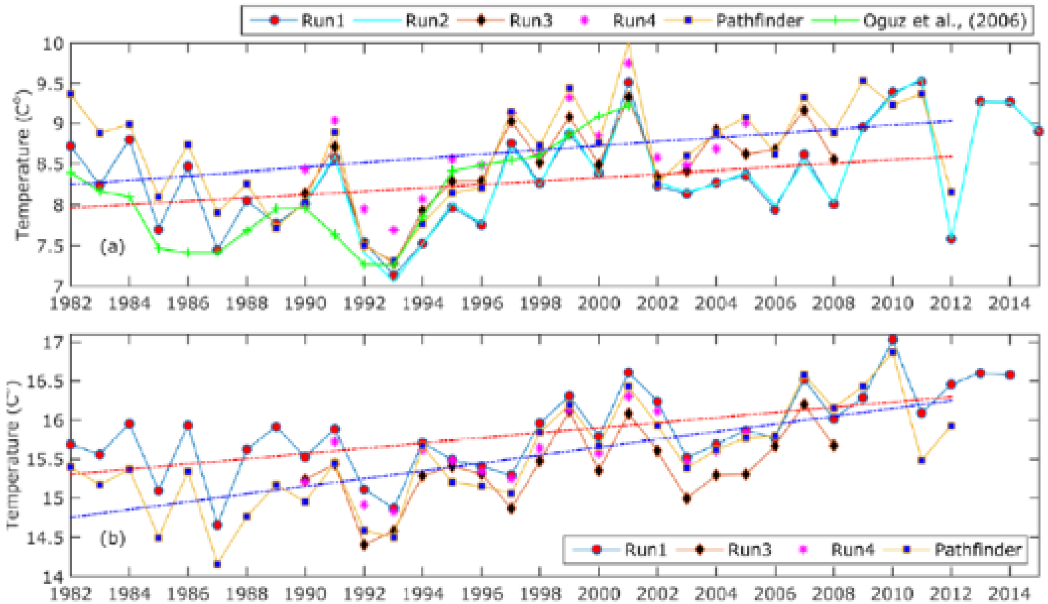


Figure 6.18 Seawater temperature inside the 1500m isobath in the Neptun Deep project area

a.1.2.2 Wind speed

The data in the following figures show the spatial distribution of the average value for the period 1980-2019 of the wind speed variable at 10 m above sea level, the average value for a 6-hour interval and the maximum annual trend of this variable for the periods 1980-2019 and 2021- 2060 for scenarios related to the periods of the emission reduction trajectories RCP2.6, RCP4.5 and RCP8.5.

The positions of the areas of maximum annual wind speeds in the Black Sea basin are slightly different between the three working scenarios, but in the western part they remain quite close to the project location [11].

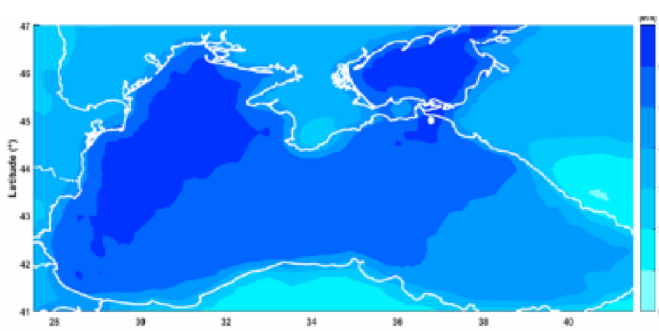


Figure 6.19 Wind speed at 10 m above sea level, Medium over 6 hours of monitoring period 1980-2019

[11]The spatial results were taken from the information source: Wind climate in the Black Sea until the end of the 21st century, Eugen Rusu, Ro. J. Techn. Sci. - Appl. Mecanica, Vol. 66, N° 3, P. 181–204, Bucharest, 2021.

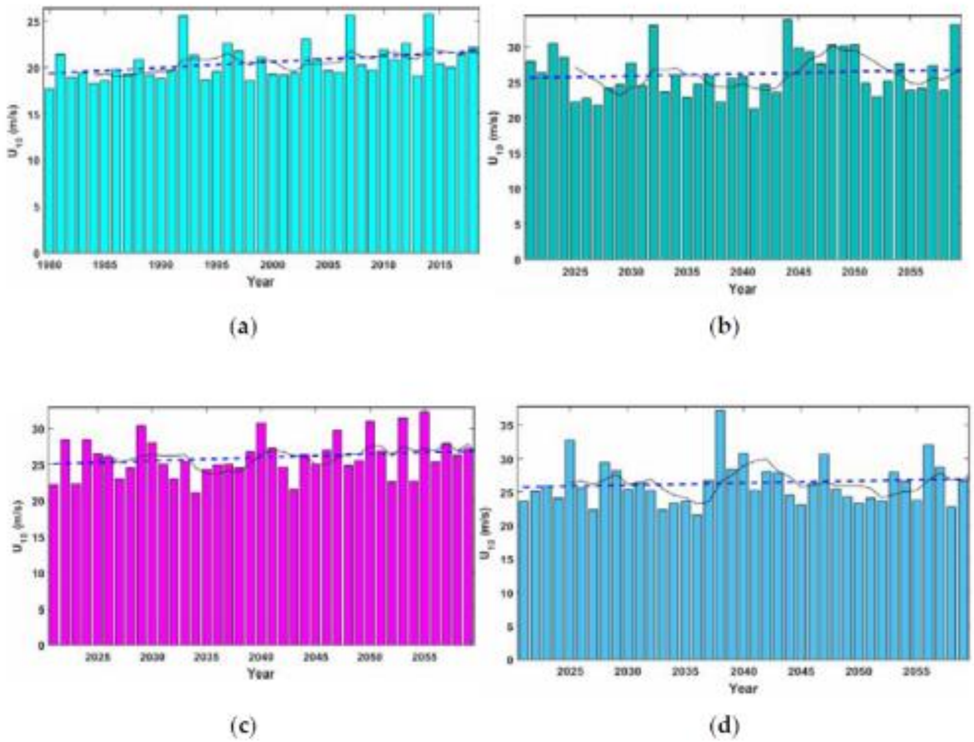


Figure 6.20 Wind speed at 10 m above sea level, Medium over 6 hours of monitoring period a) 1980-2019, b) 2021-2060 scenario RCP2.6, c) 2021-2060 scenario RCP 4.5, d) 2021-2060 RCP scenario 8.5

For the period 1980-2019, the maximum wind speed is 25 m/s, while for the period 2019-2060 it is expected to exceed 30 m/s in the RCP2.6 and RCP4.6 scenario and reach 35 m/s in the RCP8.5 scenario, i.e. increases of over 20% and 40%, respectively, but in different areas of the Black Sea, the closest increase to the Neptun Deep project area being for the RCP4.6 scenario.

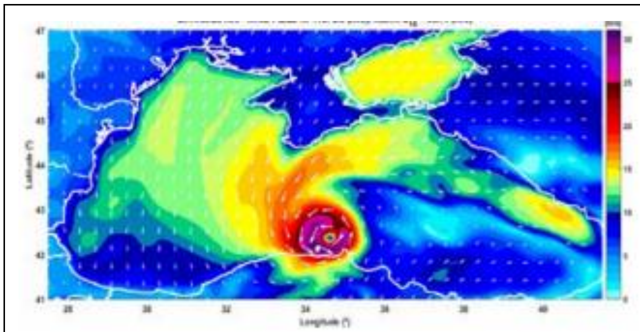
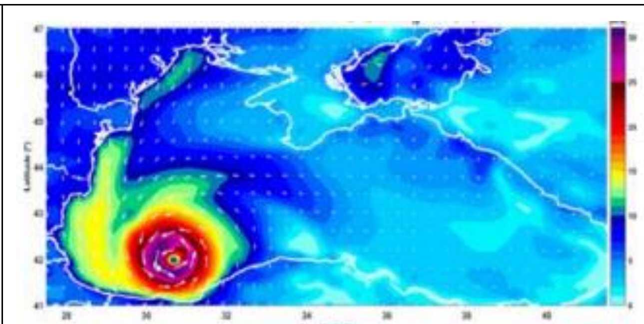
	

Figure 6.21 Spatial distribution Max. speed. annual wind for the RCP 2.6 projection scenario	**Figure 6.22 Spatial distribution Speed max. annual wind for the RCP 4.5 projection scenario**

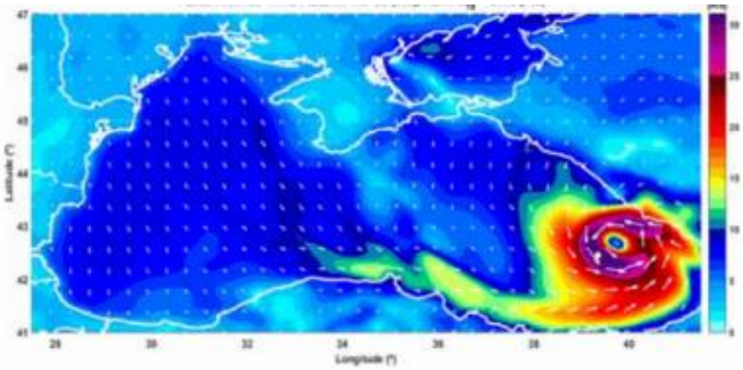


Figure 6.23 Spatial distribution - maximum annual wind speed for the RCP 8.5 projection scenario

- The maximum annual wind speed would occur in the RCP 2.6 projection scenario on 23.09.2044 in the south-eastern area of the Black Sea;
- The maximum annual wind speed would occur in the RCP 4.5 projection scenario, on 18.09.2055 in the south-western area of the Black Sea;
- Maximum annual wind speed in the RCP 8.5 projection scenario, on 6.11.2038 in the eastern area of the Black Sea.

<u>The variability with distance is non-linear, it can be assumed that the effect felt in the project area would be 7-10% for extreme winds and about 3% for normal wind values.</u>

a.1.2.3 Wind speed and wave height

According to the obtained data, it is predicted that with an increase in wind speed of 7-10% that will be taken over by surface currents, the height of the waves will be 10-14% higher, with the highest values in Regions 4 and 5, where would reach up to 8.3 m. Wave heights will be up to 7.6 m for Region 3, up to 7.6 m for Region 2 and up to 6.5 m for Region 1.

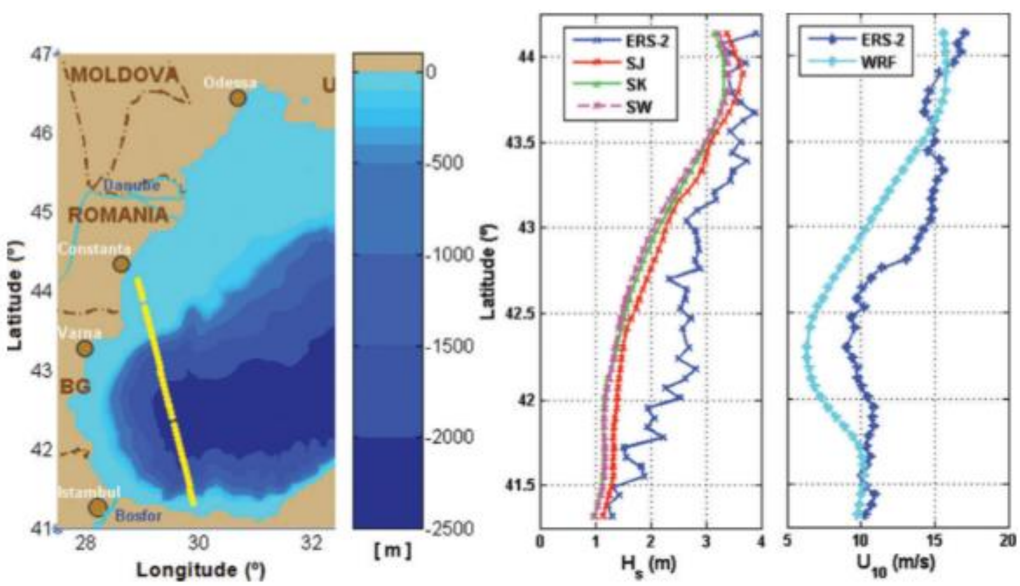


Figure 6.24 Influence of wind speed for wave height in the project area

a.1.2.4 Surface currents and wave height

The results related to the waves modeling in the coastal area were obtained based on the WRF (Weather Research and Forecasting) model and the SWAN (Simulating Waves Nearshore) model, in a convenient area for the Neptun Deep project at latitude 44° N in a direction that corresponds satisfactorily to the project, respectively to the R2 region in the project area [12].

The speed of surface currents will increase by 13% in R1, 24% in R2 and about 12% in R3-R5.

The speed of surface currents will reach values of 0.9 m/s in R5, 0.81 m/s in R4, 0.94 m/s in R3, 1.5 m/s in R2 and 1.3 m/s in R1.

For bottom currents, the highest velocity increases will be in R1 at depths of about 10 m, up to values of 1.1 m/s for a return period of 100 years, and in regions R3-R5 will be 0.32 -0.47 m/s. These values will not exceed the manageable limit of ~1.5 m/s indicated for the production pipeline area.

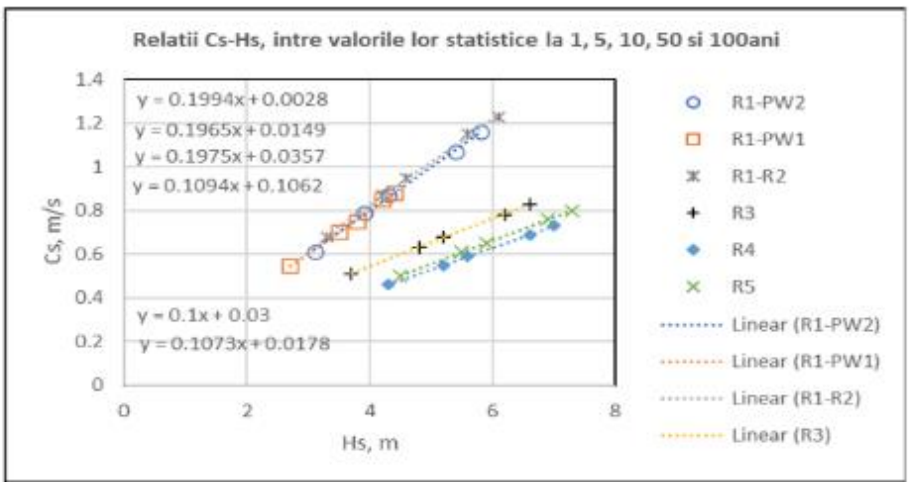


Figure 6.25 Surface currents and wave height in the project area

a1.2.5 Climatic characterization of the offshore area of the project - the current phase, which was taken into account in the design of the structural components of the Neptun Deep project.

<u>- Wind speed in the project development area</u>

The prevailing wind directions, for all locations in the project development area, are from the northern sectors and can reach extreme values of 22 m/s in R1 and R2 regions, 23 m/s in R3 and 24 m/s in regions from the project area R4 and R5. Extreme wind values that can be recorded once every 100 years are 36 m/s in regions R1, R2, 34 m/s in R3 and R5 and 37 m/s in R4.

[12] Wind and wave modeling in the Black Sea, L. Rusu, M. Bernardino, C. Guedes Soares, Journal of Operational Oceanography, Dec. 2014

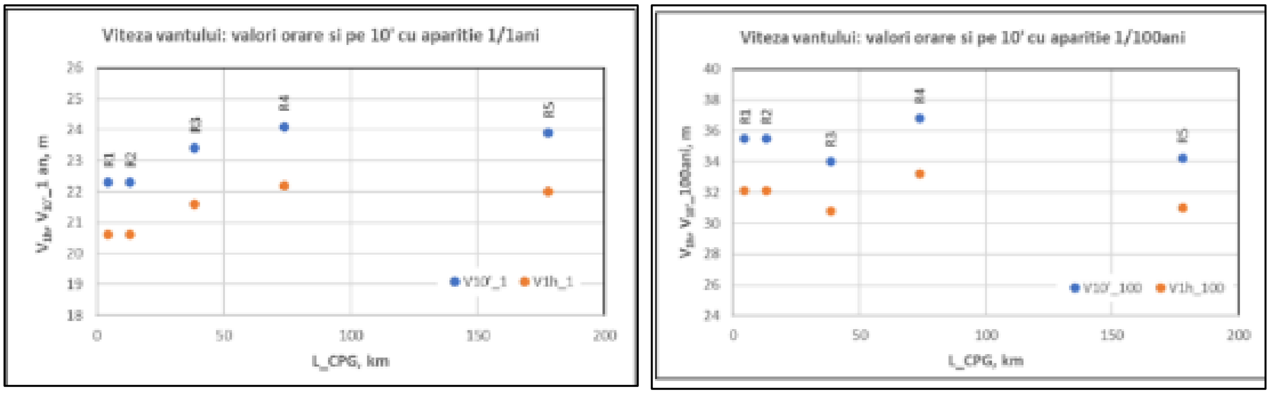


Figure 6.26 Extreme wind values for regions R1, R2, R3, R4, R5 with probability of occurrence once a year and once every 100 years

<u>- Extreme waves in the project development area</u>

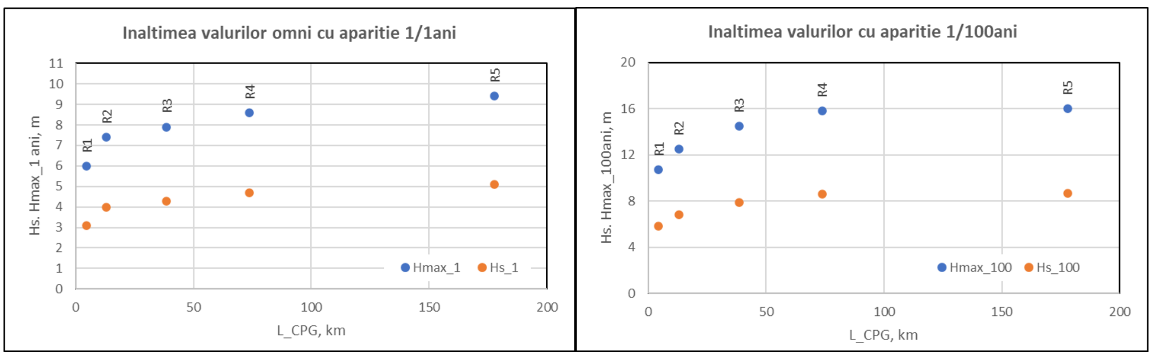


Figure 6.27 Height of extreme waves with probability of occurrence once a year and once every 100 years

<u>- Surface currents in the project development area</u>

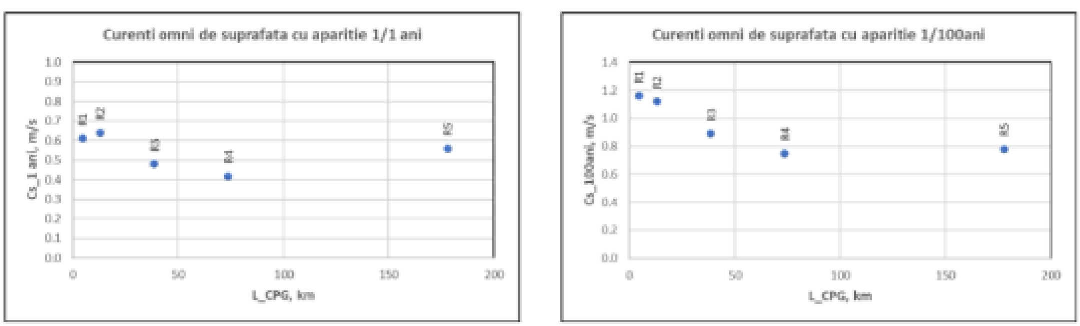
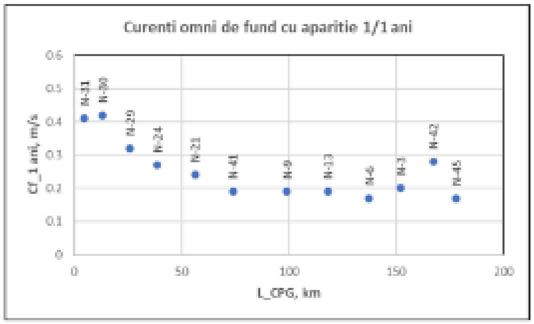


Figure 6.28 Surface currents in regions R1, R2, R3, R4, R5 with probability of occurrence once a year and once every 100 years

- Currents on the bottom of the water in the project development area



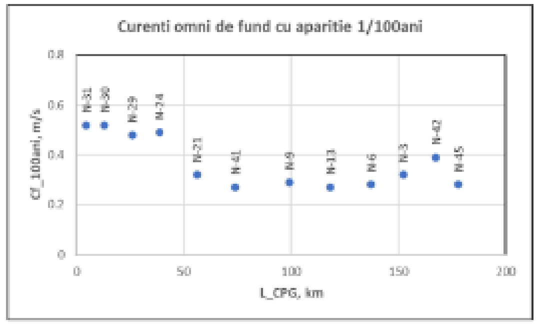


Figure 6.29 Speed of bottom currents in regions R1, R2, R3, R4, R5 with probability of occurrence once a year and once every 100 years

- The surface level of the Black Sea in the project development area

Water levels in the western Black Sea are mainly influenced by wind and atmospheric pressure. Variations in tidal water level are marginal. The Medium amplitude of spring tides is 0.02 m in the coastal area.

Table 6.18 Black Sea water level in the offshore area

Metoceanic points	Location	Water depth	Maximum sea level (m) for return period (years)				
			1	5	10	50	100
PC2	Domino reservoir (Region 5)	816 m	0.17	0.19	0.19	0.21	0.22
PC3	Slope (region 5)	300	0.18	0.21	0.21	0.24	0.25
PC4	Production platform location and Pelican South reservoir (region 4)	126	0.2	0.22	0.24	0.26	0.27
FP6	Midway between production platform and shore (region 4)	50	0.32	0.41	0.44	0.52	0.56
PC9	Near the Shore (Region 2)	30	0.5	0.66	0.73	0.89	0.96
PC10	Shore	20	0.52	0.69	0.77	0.93	1

- Air temperature in the offshore area

Available offshore air temperature statistics (annual minimum, 1% non-exceeded, mean, 99% non-exceeded and maximum air temperatures) at the Gloria oil platform, Black Sea, which is located 130 km northwest of the Domino field and can be considered applicable for the location of the Neptun Alfa production platform. The data used for the air temperature statistics were taken from the National Meteorological Centre.

Table 6.19 Air temperature in the offshore area

Value	Air temperature (°C)
Minimal	-17.8
1% non-exceedings	-4.4

Value	Air temperature (°C)
Medium	11.7
99% non-exceeding	27.2
Maximum	34.4

a1.2.6 Physico-chemical characteristics of sea water

Water temperature and salinity statistics were taken from the World Ocean Atlas (WOA). Profiles were collected using two methods: high-resolution conductivity profiles and temperature profiles. Statistics show the water temperature near the seabed at the indicated water depth.

Table 6.20 Black Sea water temperature

Water depth (m)	Temperature		
	Min (°C)	Medium (°C)	Max (°C)
0–40	4.0	10.3	23.9
40–50	4.0	6.7	10.0
50–100	5.1	6.9	9.4
100–200	6.6	8.0	8.7
200–500	8.4	8.8	9.0
500–1,000	8.7	8.9	9.2
1000+	8.4	9.0	9.0

Vertical salinity profiles from all data measured in *practical salinity units* (PSUs) indicate that areas with water depths of 100 m or less have lower surface salinities, most likely due to freshwater discharge from proximity to the shore. Basically, the salinity increases with the depth of the sea water.

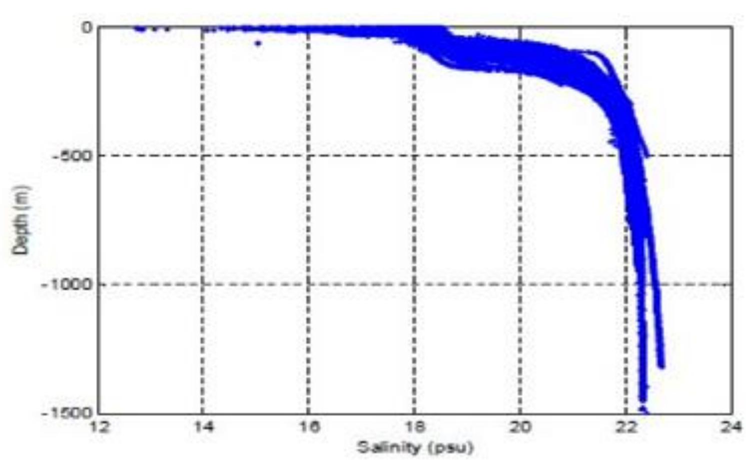


Figure 6.30 Salinity of the Black Sea

a.1.2.7 Density of water

Table 6.21 Representative values of the density of Black Sea water

Water depth (m)	Density of sea water (kg/m ^{3})
0	1013
150	1018
1000	1027

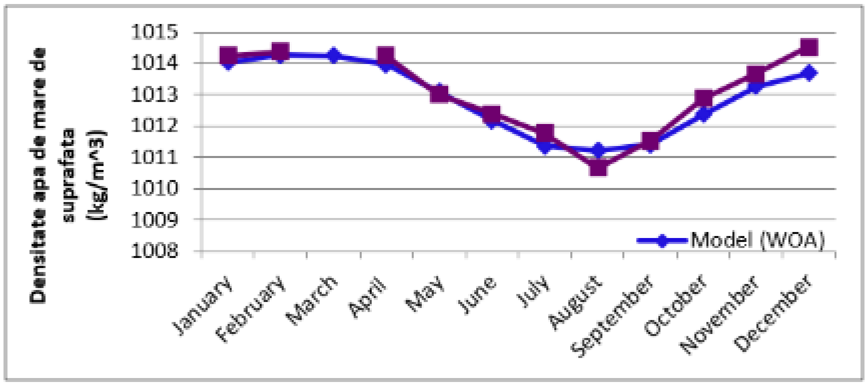


Figure 6.31 Black Sea water density in the area of the production platform

a.1.2.8 Distribution of oxygen and hydrogen sulphide content

The Black Sea is characterized by a sufficiently strong stratification so that in the absence of exchange between layers, anoxic waters are encountered from a certain depth. Typically, the thickness of the surface oxic layer varies between 120 m and 200 m and lies outside the deep cyclonic zones.

The oxygen-free and hydrogen sulfide-free layer is located between 130 meters and 145 meters in depth. Above this level, the oxygen content increases, and below this level, the hydrogen sulfide content increases.

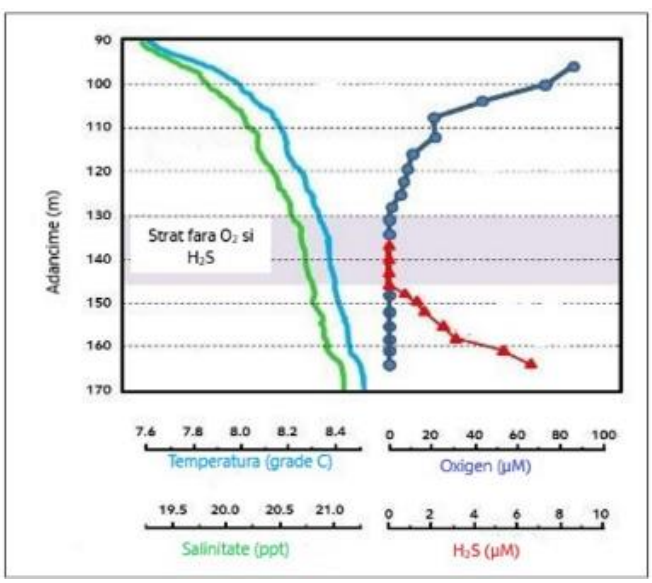


Figure 6.32 Salinity level, temperature, oxygen, and H_2S content

According to the data provided on the website of the Ministry of the Environment, the climate changes in the Black Sea are as follows:

- the water level rises annually by 1.7 millimeters - keeping this rate would lead to medium levels rising to about 0.8 meters in 50 years or 1.7 meters in the next hundred years
- the Black Sea water temperature has a tendency to increase by 0.01 units/year
- sea water reaches a Medium of 12-14° Celsius, 2-3 degrees Celsius more than the Medium air temperature
- the salinity of the sea in the western part falls below 10 mg ‰.

The extreme meteorological phenomena that have been felt in the coastal area, in recent years, are a consequence of the greenhouse effect on the surface water masses and the characteristics of the physico-chemical parameters, such as the increase in surface water temperature, the decrease in salinity, the decrease water temperature in the cold season, which leads more and more often to the occurrence of freezing of sea waters at the coast, decreases in the oxygen level in deep waters.

a.1.2.9 The structural components of the project that may present vulnerability to the effects of climate change

The structural components of the project that may be vulnerable to the effects of climate change <u>are the following:</u>

Table 6.22 Structural components of risk, Neptun Deep project in the Offshore area

No. crt.	Project component	Risk factors
1.	Gas production pipeline	-sea currents, -extreme waves in the area with deep waters up to 20 m.
2.	Neptun Alfa production platform (jacket)	extreme winds, extreme waves, sea currents
3.	Drilling rig Domino Drilling centers: DODC1 and DODC2 South Pelican: PSDC1 10 Gas production wells for the 3 drilling centers.	extreme winds, extreme waves, sea currents

a1.2.9 Sizing the risk structures of the project according to the climatic risk factors in the project area.

The main climatic and hydraulic risk factors identified for the dimensioning of the structural components of the project that may present vulnerability to the effects of climate change are: **wind speed, wave height increase**, **speed of surface and bottom currents**.

Among the project components, the most exposed areas will be:

- production platform in Region 4,

- the drilling platform located in Regions 4 and 5
- production pipeline from Region 1 and 2.

- <u>Neptun Alfa production platform</u>

The dimensioning of the height of the deck above the sea was done according to the height of the waves at the return period of 2000 years increased by the height of the storm surge and the height of the tide, which is negligible in this case. Thus, the minimum deck height at the production platform resulted in a value of 13.74 m, composed of 12.74 m wave crest height + 1 m storm surge height.

For the Production Platform the designed sizing values are higher than those predicted for climate change.

<u>- Drilling platform</u>

Following the metocean data collected, the drilling platform will have to be able to meet the following conditions:

- stability conditions (weather conditions in which the platform will stop activities to wait for weather improvement):
    - maximum wind speed of 30.6 m/s,
    - wave height of 6.8 m,
    - surface current speed of 0.67 m/s (values that would correspond to an average return period of 50 years);
- the average lifetime per year is 95%.

The Stability conditions of the drilling platform will exceed the predicted values for maximum wind speed (34 m/s vs. 30.6 m/s), wave height (8 m vs. 6.8 m) and surface currents (>0.8 m/ s vs. 0.67m/s).

<u>- Production pipeline</u>

Risk factors for production pipeline stability/installation are return period 1:100 years for surface currents of ~3 m/s and bottom currents of ~1.5 m/s in areas with depths up to 20 m (region R1).

The projected increases in surface and bottom current velocities are well below the stated risk values (1:100-year surface currents of ~3 m/s and bottom currents of ~1.5 m/s in areas with depths of 20 m from the R1 area).

Project vulnerability assessment

Global climate model projections include a range of changes in temperature and precipitation patterns on a general trend of aridity and intensification of extreme events.

For the coastal area, the effects are related to a reduction in the intensity of winter phenomena with a slight increase in the amount of liquid precipitation in the winter season, and in the summer season they are related to an increase in drought periods and the frequency of convective precipitation severe associated with the formation of flash floods on restricted areas with high erosion capacity.

For the offshore area, in the context of global warming, in addition to the direct effects on water temperature and sea level rise (**negligible values in the Black Sea area**), there will be an intensification of atmospheric circulation with secondary effects and risk factors:

1. wind intensification,
2. high wave heights
3. increased speed of surface currents
4. increased speed of bottom currents
5. reduction of the average period of use per year.

	Low		Medium		High

Figure 6.33 Sensitivity/exposure/vulnerability level matrix

For the evaluation of ***the sensitivity*** *of* the project to climate change, the 5 Regions were used as detailed factors, for the evaluation of the variables mentioned above.

Region R1 is the area of potential risk to the stability of the shore and nearshore facilities, and Regions R4 and R5 are the most sensitive areas in risk situations (Table below).

Table 6.23 Sensitivity matrix of the Neptun Deep project to the impact of climate change

Project Sensitivity Evaluation (R1,R2-R3.R4,R5)/ climate change effects	R1	R2-R3	4	5	Total score
Direct effects					
Average annual/seasonal temperature	low	low	low	low	low
Extreme temperatures	low	low	low	low	low
Medium annual/seasonal precipitation	low	low	low	low	low
Extreme precipitation	low	low	low	low	low
Side effects - Climate change danger					
1 Wind intensification	low	low	medium	medium	medium
2 High wave height	medium	low	medium	medium	medium
3 Increased speed of surface currents	medium	low	low	low	medium
4 Increased speed of bottom currents	low	low	low	low	low
5 Medium period of use per year	low	low	medium	low	medium

Assessment of the project's exposure to climate change for the current phase and the future phase.

Table 6.24 Exposure matrix of the Neptun Deep project to the impact of climate change

Exposure	Current phase	Next phase
Direct effects		
Medium annual/seasonal temperature	low	low
Extreme temperatures _	low	low
Medium annual precipitation / season	low	low
Extreme precipitation _ _	low	low
Side effects - Climate change danger		
1 Wind intensification	low	medium
2 High wave height	low	medium
3 Increased speed of surface currents	low	medium
4 Increased speed of bottom currents	low	low
5 Medium period of use per year	low	medium

The vulnerability of the project to the impact of climate change is obtained from the relationship:

Vulnerability = Sensitivity x Exposure,

applied to the two-time horizons, the current state and the future state, actually involving the combinations from the previous tables:

- minor x minor = minor,
- minor x moderate = moderate
- moderate x moderate = moderate of the above.

The results obtained are presented for the current vulnerability of the project to climate change and for the future vulnerability of the project to expected climate change.

Table 6.25 The current vulnerability matrix of the Neptun Deep project to the impact of climate change

		Current phase exposure level		
		1. Low	**2. Environment**	**3. Raised**
Sensitivity	**1. Low**	Bottom currents		
	2. Medium	Wind intensification Wave height Increased speed of surface currents Medium period of use per year		
	3. High			

Table 6.26 Future vulnerability matrix of the Neptun Deep project to the impact of climate change

		Future exposure		
Sensitivity		**1. Low**	**2. Environment**	**3. Raised**
	1. Low	Bottom currents		
	2. Medium		Wind intensification Wave height Increased speed of surface currents Medium period of use per year	
	3. High			

For the analyzed area, from the perspective of climate change, the Neptun Deep project presents a low vulnerability in terms of bottom currents, but presents an average vulnerability to wind intensifications, wave height, surface current speed increases and as an average period of use of drilling rigs per year.

b. Stage 2 - Detailed analysis (adaptation)

The qualitative risk level of the project is determined with the classic relationship:

Risk = C x P, where C is the value of the consequence/severity level and P is the probability of occurrence.

This assessment is a qualitative assessment, using a 5-level grading system and combining C and P levels on either side of the main diagonal, as in the matrices below:

Table 6.27 Qualitative risk matrix

	C- severity	P-probability	Risk
	Negligible	Rare	Negligible
	Minor	Low probability	Low
	Moderate	Moderate	Medium
	Major	Probable	High
	Catastrophic	Almost sure	Extremely

Table 6.28 Risk assessment of the Neptun Deep Project to climate change current phase

		Probability				
		Rarely	Low probability	Moderate	Probable	Almost sure
Severity	1 Negligible	1	2	3	4	5
	2-Minor	2	4 Avoid bottom currents	6 Wind intensification Wave height Surface currents	8	10
	3-Moderate	3	6 Medium period of use per year	9	12	15
	4-Major	4	8	12	16	20
	5-Catastrophic	5	10	15	20	25

Table 6.29 Risk assessment of the Neptun Deep Project to climate change - future phase

		Probability				
		Rarely	Low probability	Moderate	Probable	Almost sure
Severity	1 Negligible	1	2	3	4	5
	2-Minor	2	4 Avoid bottom currents	6 Surface currents medium period of use per year Wind intensification Wave height	8	10

		Probability				
		Rarely	Low probability	Moderate	Probable	Almost sure
	3-Moderate	3	6	9	12	15
	4-Major	4	8	12	16	20
	5-Catastrophic	5	10	15	20	25

b.2 Assessing the scope and need for periodic monitoring and follow-up, for example of critical assumptions regarding future climate change.

The project risk evaluation indicates a low risk to climate change, both in construction and operation phase, due to considering in the design of the facilities extreme weather events (once in 100 years) projected from the collected metocean data.

In this context, adaptation measures are not necessary for ensuring the resilience of the project to the effects of climate change.

Table 6.30 Action plan with measures to adapt and reduce the project's vulnerability to critical climate change scenarios

No. crt.	Scope of action	Description	Term	Responsible
1	**Drilling rig/Production platform**	The selected drilling rig and the production platform design will consider the optimum parameters for carrying our safe activities even in the case of extreme meteorological conditions.	During selection and/or design process	Project owner
2.	**Production pipeline**	Pipeline integrity periodical monitoring.	It will be included in the monitoring program of the project	Project owner
3.	**Onshore installations (microtunnel area)**	Visual monitoring of the cliff integrity in the microtunnel area.	It will be included in the monitoring program of the project	Project owner
4.	**Re-evaluation of project risk to climate change**	Appointment of a Climate Change Immunization Officer to ensure monitoring of the project throughout the project life cycle. During the life cycle of the Neptun Deep project, currently assessed for maximum of 20 years of the exploitation and maintenance of the infrastructure, it will	It will be included in the monitoring program of the project	Project owner

No. crt.	Scope of action	Description	Term	Responsible
		be necessary to monitor the GHG emissions and the vulnerability of the project, so that once every 5-10 years a re-evaluation of the project's risk to climate change, depending on their evolution.		
5.	**Assessment of carbon dioxide emissions**	Monitoring of carbon dioxide emissions (calculated based on consumption of fuel or volume of gas) must be included throughout the entire project development cycle to ensure the project's compatibility with the GHG emission reduction trajectory.	It will be included in the monitoring program of the project	Project owner
6.	**Monitoring of climate risk factors and monitoring of vulnerable project components**	The monitoring of climate risk factors and the monitoring of the project's vulnerable components to climate change must be included throughout the entire project development cycle to ensure the resilience of the project (in the operational phase) to the adverse effects of the climate in the project area.	It will be included in the monitoring program of the project	Project owner

b.3 Verification of the coherence of the infrastructure project with EU and, where appropriate, national, regional and local strategies and plans on adaptation to climate change, as well as with other relevant strategic and planning documents

The Neptun Deep project is proposed as an infrastructure project for the production and transportation of natural gas originating from the Neptun Deep field in the southwestern Black Sea region and is assessed for the operating period at a average production rate of 19,000,000 m^3/day.

Romania's domestic gas production covers 80-90% of the country's consumption, but with the exploitation of the Neptun Deep field, Romania will not only gain energy independence, but will also have the potential to become a gas exporter in the future. Therefore, the Government of Romania recognizes the need to transform its energy infrastructure and change the mix of energy sources in order to achieve energy independence.

The natural gas sector is an emerging sector that can stimulate the Romanian economy and industry, and local communities can also benefit from capacity building and long-term skills generation.

According to the assessments shown in the fourth IPCC Report, Romania expects an average annual warming of the same magnitude as that projected at the European level compared to the base period 1980-1990, with small differences between models from the first decades of the 21st century and much higher towards the end of the century: between 0.5°C and 1.5°C for the period 2020-2029 and between 2.0°C and 5.0°C for 2090-2099, depending on the scenario.

The long-term national strategy for reducing greenhouse gas emissions (GHGs) is based on EU Regulation 2018/1999, which, in Article 15, requires each member state to describe how it will contribute to achieving the objectives of the Paris Agreement. At EU level, the Energy Strategy has 5 dimensions: (1) energy security, (2) internal energy market, (3) energy efficiency, (4) decarbonization of the economy and (5) research, innovation, and competitiveness.

The key instruments for implementing the strategy are the National Energy and Climate Plans (National Integrated Energy and Climate Change Plan 2021-2030 – PNIESC, in the case of Romania), which cover ten-year periods, starting from 2021-2030, which together with long-term EU and national strategies to reduce greenhouse gas (GHG) emissions cover a 30-year horizon.

For the Energy Security Dimension, commitments are centered around the process of ensuring higher energy security of countries' energy systems. In this sense, policies, actions and measures have been proposed to ensure the diversification of energy supply sources, decreasing dependence on energy imports (of all types), in parallel with supporting the development of domestic energy sources. In addition, in the scope of this dimension, policies, actions and measures have been proposed by introducing and integrating into the national electricity systems efficient and sustainable energy storage and market coupling technologies.

In this context of promoted policies, the implementation of the Neptun Deep project ensures coherence with Romania's long-term National Strategy for the reduction of greenhouse gas emissions (GHG). The domain of the Neptun Deep project is part of Romania's strategic domains, namely ensuring Romania's energy security, so that through its implementation, the operation of the project will represent an input of electricity, according to the expected daily production of 19,000,000 m^3 GN $^/$ day, of 65,432 MWh/day. This production will represent a reduction in CO_2 emissions of approx. 19,517.2 t CO_2 /day (by replacing coal-type fossil fuels with natural gas), with a positive impact in terms of reducing GHG emissions and climate change.

It is estimated that through the adaptation measures proposed to reduce the vulnerability of the project to the climate risk factors identified for the project area, climate change will not affect the project during the expected life cycle.

The assessment of carbon dioxide emissions will be included throughout the entire project development cycle and will be used as a tool for ranking and selecting options in order to promote low carbon variants and options, as well as the principle of "energy efficiency above all”.

6.1.8.7 Technologies and substances used

The technology of drilling production wells involves the use of chemicals to prepare the drilling fluid and to cement the columns.

Natural gas exploitation and treatment technology usually uses chemical products.

Also, in order to test the production pipeline before commissioning and to preserve the production wells, it involves the use of chemicals.

The chemicals used are shown in Appendix G.

Details regarding the technological processes necessary for the execution and operation of the project, as well as the substances that will be used, are presented in Chapter 2 of this report.

In order to select chemical products, suppliers were asked to specify whether or not their products may contain substances listed in Annex II of Directive 2013/39/EU - amending Directives 2000/60/CE and 2008/105/CE, in regarding priority chemicals in the field of European water protection framework policies.

The owner of the activity, through an SR EN 17025:2018 accredited laboratory, requested the performance of tests to test whether the chemical products selected for use in the activity carried out contain priority substances listed in the Water Law no. 107/1996 and in Directive 2013/39 /EU *amending Directives 2000/60/EC and 2008/105/EC regarding priority substances in the field of water policy.* The Directive lays down the technical specifications for chemical analysis and monitoring of water status in accordance with Article 8(3) of Directive 2000/60/EC.

Following the analytical testing, it was possible to specify that all the chemical products used do not contain priority substances and thus will not contribute to changing the chemical state of the water in the water body.[13]

In addition, for the selection of chemicals (corrosion inhibitor, scale inhibitor and antifoam) used during operation, for pipeline protection and to aid in processing, chemicals from different manufacturers were studied and after evaluation chemicals were chosen of the company Champion X. Alternatives for the chemical products used during the operation period are presented in Chapter 3.

6.2 ASSESSMENT OF SIGNIFICANT IMPACTS ON THE ENVIRONMENT

6.2.1 Land use

The activities carried out within the project that could affect the use of the land are closely related to the work areas and the soil footprint onshore and sedimentary substrate of the constructions and installations related to the offshore component of the project.

The effects on land use during the construction, operation and decommissioning stages of the project are presented in table 6.31.

Table 6.31 Effects with potential impact on land use in all stages of the project

Effects with impact potential	Construction stage	Operation stage	Decommissioning stage
Change of land use	x	-	-
Occupation of the land and the surface of the marine substrate	x	x	-
Release of the land/marine substrate occupied by the project components	-	-	x

[13] Tech Centre & Lab Report – Neptun Deep production chemicals, April 28, 2023

The evaluation criteria for assessing sensitivity and magnitude are as follows:

Evaluation criteria

Magnitude criteria

Magnitude	Description
Negligible	The impact does not generate quantifiable (visible or measurable) effects in the natural state of the environment.
Low	The impact is for a short period of time which, however, does not extend and does not generate disturbances in the use of the land.
Medium	The impact may generate long-term changes but does not affect the overall stability of the land use.
High	Impacts that cause long-term or permanent changes and affect their overall stability and condition.

Sensitivity criteria

Sensitivity	Description
Low	The land use is not considered significant for the community in the project area, and they do not have a high social value.
Medium	Land use and properties are not significant in the general context of the analyzed area but have local significance.
High	Land use and properties are specifically protected by national or international legislation and are significant to communities in the project area or regionally/nationally

Land use sensitivity

Based on the information related to the current state, the environmental component - land use, was assessed as having low sensitivity due to the fact that the lands affected by the works were included in the "intravillan - construction yards" category through the PUZ approval of which CL Tuzla through HCL no. .100/ 16.11.2020, at the same time being permanently removed from the agricultural circuit by the favorable opinion 293974/ 22.12.2001 issued by the Ministry of Agriculture and Rural Development.

The land is the property of OMV Petrom, it does not involve the definitive occupation of lands belonging to the local population, nor the alteration or irreparable loss of natural resources on which local communities depend.

6.2.1.1 Evaluation of the impact during the construction stage on land use

6.2.1.1.1 Change of land use

The implementation of the project will involve changes regarding the final use of some land areas owned by OMV Petrom SA. This aspect will not affect, however, the use of the lands located in the vicinity of the project's onshore location, which will have the same destination as at present.

The lands with a total area of 138,184 square meters, having the cadastral codes 109659, 109729 100819 corresponding to the S3 and S4 lands mentioned in this document, according to the decision of the Constanța County Agriculture Directorate no. 10385/3.10.2022, were permanently removed from the agricultural circuit.

The modification of the previous use of the land, respectively from "*non-village arable land, communication roads, railways, orchards, non-productive*", was approved by HCL Tuzla no. 100/ 16.11.2020 for the introduction in the inner city with the destination " *Establishment of natural gas measurement station and Control Centre, construction of road and route of underground pipelines, natural gas transport* ", the change of land use being in accordance with the legal regulations.

Change in the destination/use of the land produces effects on the environment in terms of **the production potential of the land and the reduction of the surface of the land on which agriculture is practiced in the area**, with the corresponding surface being the private property of OMVP which was the object of removal from the agricultural circuit.

The production potential of the land is given by its quality class, under the conditions of the application of appropriate technologies and cultivation with agricultural plants adapted to the climatic conditions of the area. The production potential of the lands is classified according to the soil, relief, climate, groundwater, based on the natural rating for arable land.

According to the pedological study, the area related to the agricultural land included in the project site has the 3rd creditworthiness class, corresponding to lands with medium-fertile, deep or moderately deep, medium-textured, medium-coarse or fine soils moderately affected by degradation phenomena (salinity, acidification, erosion, excess moisture, etc.), located on flat or medium-sloping surfaces, in climatic conditions of temperature and precipitation moderately favorable for crops.

This category of lands, moderately favorable for crops, in the absence of an irrigation system, as is the land in question, are poorly productive.

In this context, the significance of the impact on land use is insignificant, under the conditions of a low sensitivity class and a magnitude estimated to be negligible.

6.2.1.1.2 Occupancy of land and the surface of the marine substrate

The implementation of the Neptun Deep project is to take place on land privately owned by OMV Petrom SA, and as regards the natural gas exploitation and production facilities, they are located in the Romanian sector of the EEZ, the Black Sea, the area where the state, through the Agency National Mineral Resources, administers natural resources.

During construction, the temporarily occupied surfaces in the land area are only on the site owned as property by OMV Petrom, the existing exploitation roads in the area will be used and the lands in the vicinity of the site will not be affected.

The total area estimated to be temporarily occupied during construction in the land area is 52,451 sq m, of which an area of 28,132 sq m will remain permanently occupied upon completion of the works.

Construction work in the land area is estimated to last 8 months, and installation of facilities in the NGMS and construction of the CCR will take approximately 12 months.

As for the areas occupied by the installations of the offshore component of the Neptun Deep project, they are located starting from the coastal area, respectively the route of the production pipeline over a length of approximately 160 km, occupying an area of 638,080 m2, in the Romanian sector of the Black Sea, where the Domino and Pelican South drilling centers and the Neptun Alpha production platform are located. The total area occupied by the offshore components of the project is 813,607 sq m.

During the construction period, around the drilling platform as well as in the work areas for the installation of the pipeline, a safety zone with a radius of 500 m will be established, to ensure maneuvering space.

In this context, the impact on the use of land and the surface of the marine substrate is reflected by affecting areas larger than the actual footprint of the constructions and installations of the project, including those areas temporarily occupied by construction sites and work areas.

At the completion of the construction phase, these temporarily occupied surfaces will be restored or will return to their original state (in the case of the marine substrate), as a result of the cessation of work and the withdrawal of equipment, machinery, materials, waste, the decommissioning of the site organization, the vessels used.

From this perspective, the significance of the impact on land use is insignificant, under the conditions of a low sensitivity class, and a negligible impact magnitude, with local extension, temporary and reversible, with a low intensity.

6.2.1.2 Evaluation of the impact in the operation stage on land use

6.2.1.2.1 Land occupation and marine substrate surface

During the operation period, the land occupation coincides with the areas permanently occupied by constructions and installations, presented in Section 6.2.1.1.2.

During operation, the built surfaces, in the land area, are only those occupied by NGMS and CCR, since the gas production pipeline is underground. The total built area occupied during the operation period in the land area is 28,132 sq m, the rest of the area being arranged as green space.

During operation, the area occupied by the Neptun Alpha platform at the level of the sea surface is 3,547 sq m, to which will be added a safety zone with a radius of 500 m.

As for the area occupied at the seabed level by the facilities, it is divided between the Pelican South and Domino drilling centers, which will occupy an area of 28,496 m^2 at the seabed level, while the underwater systems (supply pipes and systems umbilical's) will occupy an area of 143,484, and 638,080 m^2 will be occupied by the 30-inch (762 mm) natural gas production pipeline and fiber optic cable. In total, an area of 810,060 square meters will be occupied at the level of the seabed.

Regarding the impact, during the operation stage no impact is expected on the use of land and the marine substrate, as the occupation of the surfaces will be appropriate to the proposed project and in accordance with the authorization conditions of the project, as well as the normative acts that regulate the industry sector of offshore natural gas exploitation.

6.2.1.3 Forecasting the impact in the decommissioning stage on land use

<u>6.2.1.3.1 Release of the land as a result of the decommissioning of the project components</u>

In the situation where the decision to decommission NGMS and CCR is taken, OMV Petrom will decide what use the land will have.

In the land area, after the demolition and evacuation of materials, waste, installations from the land, landscaping works will be carried out in order to restore the environment.

Decommissioning work in the land area is estimated to take 12 months.

The decommissioning of production facilities on the seabed will involve dismantling the structures, partial removal of the underwater infrastructure and transport to shore for recovery and/or disposal. The entire decommissioning process will take approximately 18 months.

From the perspective of the change in land use as a result of the decommissioning of the project components and the restoration of the affected areas, a positive, direct, local, permanent impact will be felt, with a low intensity.

6.2.1.4 Summary of impacts on land use and marine substrate

The assessment of potential negative impacts on land use and the marine substrate during the project stages is presented in the table below.

Table 6.32 Impact assessment matrix on land use and marine substrate

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
Construction stage						
Change of land use	*Nature effect*	Negative	Negligible	Low	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Duration	Short term				
	The intensity	Low				
Land and surface occupation of the marine substrate	*Nature effect*	Negative	Negligible	Low	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Duration	Short term				
	The intensity	Low				
Operation stage						
Occupation of land and the surface of the marine substrate	*Nature effect*	Negative	Negligible	Low	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Duration	Short term				
	The intensity	Low				
Decommissioning stage						
Release of the land as a result of the decommissioning of the project components	*Nature effect*	Positive	Negligible	Low	Positive	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Duration	Short term				
	The intensity	Low				
GENERAL ASSESSMENT of the impact on the land use			**Insignificant impact**			

Based on the conclusions from the table above, the potential impact of the project, both individually and cumulatively between stages, is assessed as **insignificant.**

6.2.1.5 Measures to prevent/avoid/reduce impact

Given that from the assessment of the impact on land use, the expected impact is insignificant in all stages of the project, no mitigation measures are required.

However, to prevent any impact, the best applicable construction techniques will be implemented.

At the same time, in order to keep the impact at an insignificant level in all stages of the project, it is recommended:

- The occupation of additional land areas, compared to those provided by the technical project, will be avoided;
- The construction/decommissioning works will take place only in the areas demarcated for the works;
- The transport of materials will be carried out only on the developed/existing access roads.

6.2.2 Soil and subsoil

The activities carried out within the project that could affect the soil and the subsoil are closely related to the work areas and the footprint of the constructions related to NGMS and CCR, as well as to the geological conditions of the areas related to the works associated with the execution of the microtunnel, and the digging of the trench laying the pipeline on land.

Effects on soil and subsoil during the construction, operation and decommissioning stages of the project are presented in table 6.75.

Table 6.33 Effects with potential impact on the soil during the construction, operation and decommissioning stage

Effects with potential impact	Construction stage	Operation stage	Decommissioning stage
Uncovering the topsoil layer	x	-	-
Physical changes in soil and subsoil stratification	x	-	-
Soil compaction and degradation of its structure	x	-	-
Introduction of non-native plant species with invasive potential, in the stage of the restoration works of the surfaces temporarily occupied by the works	x	-	x
Land occupancy with constructions and installations		x	

The evaluation criteria for assessing sensitivity and magnitude are as follows:

<u>Evaluation criteria</u>

Magnitude criteria

Magnitude	Description
Negligible	The impact does not generate quantifiable (visible or measurable) effects in the natural state of the soil or subsoil.
Classified	Localizable and detectable temporary or short-term impacts on soil and subsoil that cause changes beyond natural variability without altering soil and subsoil functionality or quality. The soil returns to its pre-impact state after the activity causing the impact ceases.
Medium	Temporary or short-term impact on the soil and subsoil that may extend beyond the local scale and produce changes in the quality or functionality of the soil and subsoil. However,

Magnitude	Description
	the long-term integrity of the soil and subsoil or any dependent receptor is not affected. If the extent of the impact is large, then the magnitude can also be large.
High	Impact on the soil and subsoil that can cause irreversible changes and beyond the permissible limits, on a local or larger scale. The changes may alter the long-term character of the soil and other dependent receptors. An impact that persists after the cessation of the activity producing it has a high magnitude.

Sensitivity criteria

Sensitivity	Description
Low	Soil and subsoil is important but resistant to change (in the context of the proposed activities) and will quickly naturally return to its pre-impact state once the impact generating activity stops.
Medium	Soil and subsoil is important for the functioning of ecosystems. It may be less resistant to change but can be returned to its original state through specific actions, or it can recover naturally over time
High	Soil and subsoil is critical for ecosystems, it is not resistant to change and cannot be returned to its original state.

<u>Soil and subsoil sensitivity</u>

Considering the current state information, the soil and subsoil physical component was assessed as having **low sensitivity** due to the fact that:

- the project location area does not overlap and/or adjoin a protected natural area designated for the preservation of habitats of conservation interest, nor have any plant species of conservation interest been identified.
- the lands affected by the works have been removed from the agricultural circuit, and do not have an important role for the functioning of ecosystems and do not host species of high conservation value.
- the lands were classified in creditworthiness class III, i.e. soils with medium fertility, widespread in the Dobrogea region.
- the location of the project on land, is not included in a class of geological or paleontological importance, or suitable for exploitation of mineral resources.

These components of the environment are resistant to change (in the context of the proposed activities) and will quickly, naturally return to their pre-impact state once the impact generating activity stops.

6.2.2.1 Assessment of impacts during the construction phase on the soil and subsoil

In the paragraphs below, the effects on the soil are described and quantified, the sensitivity and magnitude of the soil and subsoil determined, and the impact assessed.

6.2.2.1.1 Plant soil uncovering works.

The topsoil will be removed to a thickness of 30 cm for the development of the temporary access road, the development of site organizations, the development of the railway level crossing, the construction of NGMS and CCR as well as from the trench corridor for laying the gas production pipeline and cable with optical fiber.

The topsoil will be temporarily stored on the allocated area of 1,100 m^2 and will be used to restore the affected land, upon completion of construction.

The vegetation layer will be removed from an estimated area of 71,000 m^2 which represents 31% of the total land area owned by OMV Petrom. The development works will be carried out successively and the estimated period of execution is 4 months.

The uncovering of the vegetable soil produces effects on the relationships texture - determining and ecological factors, as the nutrients accessible and mobilizable from the soil structure are dependent on the specific superficial area, being noticeable changes at the level of biochemical processes.

The execution of the works described above are of a nature to produce a physical impact on the ground, but precisely these works in the constructive stage of the project are of a nature to protect the soil, avoiding exposure to aggressive phenomena (compaction, the risk of pollution with petroleum products) characteristic of areas affected by construction works.

The impact generated by these works consists of changes in the pedogenetic process by interrupting the life cycle of the vegetation, microfauna and mesofauna in the soil layer.

However, the impact is minor, due to the current destination of the land, felt locally at the level of the work areas, in the short term and reversible due to the separate storage and therefore ensuring the capacity of the soil for physical and biological rehabilitation. The impact matrix is presented in table 6.34 below.

6.2.2.1.2 Physical changes in soil and subsoil stratification

Changes in soil and subsoil stratification occur as a result of digging and excavation works.

In order to set up the temporary access road, the construction sites, the railway level crossing as well as for the construction of NGMS and CCR, the soil will be excavated to a thickness of 50 cm.

A trench with a depth of 2 m will be excavated for laying the gas production pipeline and fiber optic cable.

In the case of the microtunnel launch pad, after drilling the secant piles, the soil will be excavated to a depth of 19 m. The estimated volume of excavated soil is 3,270 m^3 .

The excavated soil will be temporarily stored on the allocated surface of 8,420 m^2 being used for the development of the surfaces by depositing and compacting a layer of 15-20 cm, for plugging the launch pit and for the development of the land upon completion of the construction works.

The soil excavated from the excavation of the trench will be temporarily stored on the edge of the trench and after laying the pipe will be used to plug the trench.

The cuttings from the microtunneling will be separated from the drilling fluid in the recycling unit and it will be temporarily stored on site before being transported to an authorized facility for processing. The estimated total amount of soil to be excavated through the tunneling process is approximately 4,030 m^3.

The execution of the works described above are of a nature to produce changes at the level of soil stratification, by mixing and/or stirring the soil, leading to a physical, chemical and/or biological degradation (as a result of changes in the pedogenetic process), which have a pronounced impact on the destruction of the structure and production capacity of soils.

Given the low sensitivity of the receptor and the medium magnitude of the analyzed effect, the significance of the impact is minor, felt in the short term, local, reversible. The impact matrix is shown in table 6.34 below.

6.2.2.1.3 Soil compaction and degradation of its structure

Compaction of the soil and degradation of its structure may occur as a result of the works on the development of the temporary access road, the development of site organizations, the development of the railway level crossing as well as the construction of NGMS and CCR.

The area estimated to be affected by the works, which may lead to soil compaction and degradation of its structure, is 54,000 m^2, which represents 24% of the area owned by OMV Petrom.

Soil compaction (settlement, packing) of the soil is the process as a result of which its apparent density increases above normal values, leading to the impairment of the water regime in the soil, as well as to the modification of the physico-chemical properties, such as texture, state relaxation, cohesion and internal friction, also causing changes in thermal aeration in soil stratification.

These changes in the structure of the soil will be inherent as a result of the construction works, maintaining in the long term, in the areas permanently occupied by constructions, respectively an area of 28,132 square meters.

Given that the surfaces temporarily occupied by the works will be ecologically restored, the soil structure will be improved with organic matter, reducing its predisposition to compaction and/or erosion.

With a low receptor sensitivity and a medium magnitude of the analyzed effect, the assessed impact is minor, according to the impact assessment matrix presented in table 6.34, below.

6.2.2.1.4 Introduction of non-native plant species with invasive potential, in the stage of restoration works of the surfaces temporarily occupied by the works

After the completion of the construction works, restoration works will be carried out, by depositing a layer of topsoil on the established areas. The topsoil comes from the temporary storage on the site. After the deposition of the vegetation layer, tree and shrub planting works will be carried out, along the perimeter, in the NGMS and CCR area, and on the S3 and S4 lands, crossed underground by the gas production pipeline, grass will be sown.

The area estimated to be landscaped with trees, shrubs and green space is approximately 195,000 m^2 which represents 87% of the area owned by OMV Petrom.

Although the onshore location of the project is characterized by agricultural ecosystems, the structure of which is strongly anthropized as a result of specific works, given the temporary, controlled storage of the topsoil layer, the risk of the introduction of non-native plant species on the site is reduced with invasive potential.

It is possible, however, that plant species without conservation value with invasive potential, whose seeds remained in the exposed soil, are favored, as a result of the fact that the project location no longer benefited from specific agricultural works, which diminish their growth and spread, and on the edge of access roads and the railway line area, these plant species are common.

The impact is negligible but given the fact that the land project location area is not located in the vicinity of a protected natural area designated for the conservation of habitats of community interest, but is located in a heavily anthropized area, characterized by agro systems, from which these plants (weeds) are specific.

A summary of the impacts is presented in Section 6.2.2.4, table 6.34.

6.2.2.2 Evaluation of the impact on the soil and subsoil during the operation stage

6.2.2.2.1 Occupation of the soil and subsoil with constructions and installations

The only impact on the soil is represented by the permanent occupation due to the footprint of constructions and installations, which is 28,132 square meters, representing 33% of the entire area of the project site.

Given the low sensitivity class and the minor negative magnitude, according to the impact assessment matrix, a minor negative impact result.

6.2.2.3 Assessment of the impact on the soil and subsoil during the decommissioning stage

The decommissioning stage involves a series of works that may have an impact on the soil, as a result of the dismantling of foundations, concrete platforms, dismantling of installations, soil compaction in work areas with heavy machinery, excavations and excavations for the decommissioning of sections of the underground pipeline.

The effects with potential impact on the soil and subsoil are similar to those of the construction stage, namely: topsoil exposure, physical changes in stratification, compaction and degradation of soil texture.

We estimate that the impact on the soil and subsoil during the decommissioning phase will be similar to that during the construction phase (Section 6.2.2.1).
A summary of the impacts is presented in Section 6.2.2.4, table 6.34.

6.2.2.4 Summary of impacts on the soil in all stages of the project

The table below presents the impact assessment by magnitude and receiver sensitivity without applying any mitigation measures, considering the impact significance matrix presented in Section 6.1.4.3.

Table 6.34 Evaluation of the impact on the environmental factor: soil and subsoil

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
Construction stage						
Excavation of topsoil	*Nature effect*	Negative	Medium	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Duration	Short term				
	The intensity	Medium				
Physical changes in soil and subsoil stratification	*Nature effect*	Negative	Medium	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	Duration	Short term				
	The intensity	Medium				
Soil compaction and degradation of its structure	*Nature effect*	Negative	Medium	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	Duration	Short term				
	The intensity	Medium				
Introduction of non-native plant species with invasive potential	*Nature effect*	Negative	Negligible	Low	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	Duration	Short term				
	The intensity	Low				
Operation stage						
Occupation of the surface	*Nature effect*	Negative	Low	Low	Minor	No
	Effect type	Direct				

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
soil and the subsoil with constructions and underground installations	*Reversibility of the effect*	Reversible				
	Extension	local				
	Term	Long term				
	Intensity	Medium	Low	Low	Minor	No
Decommissioning stage						
Excavation of topsoil	*Nature effect*	Negative	Medium	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	Duration	Short term				
	The intensity	Medium				
Physical changes in soil and subsoil stratification	*Nature effect*	Negative	Medium	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	Duration	Short term				
	The intensity	Medium				
Soil compaction and degradation of its structure	*Nature effect*	Negative	Medium	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	Duration	Short term				
	The intensity	Medium				
Introduction of non-native plant species with invasive potential	*Nature effect*	Negative	Negligible	Low	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	Duration	Short term				
	The intensity	Low				
GENERAL ASSESSMENT of the impact on the soil and subsoil			**Minor impact**			

6.2.2.5 Measures to prevent/avoid/reduce the impact on the soil/subsoil environmental factor

Given that from the assessment of the impact on land use, the expected impact is minor in all stages of the project, no impact mitigation measures are necessary.

However, to prevent any impact, the best applicable construction techniques will be implemented:

- Waste management, corresponding to the type and category of which it belongs;
- Avoiding the direct placement of assembly/construction materials and waste resulting from the works on the ground;
- An Environmental Management Plan will be drawn up for the Neptun Deep Project, which will integrate management measures for soil and subsoil protection in all stages of the project, as well as preparation and response actions in case of accidental soil pollution;
- Compliance with the accidental pollution prevention and control plan;
- The provision of absorbent materials for the intervention in case of accidental pollution with hydrocarbons;
- Staff training on how to act and respond in the event of accidental pollution.

A series of measures are necessary regarding the uncovering and storage of topsoil in order to maintain its quality:

- The stripping of the vegetable soil will be up to 30 cm deep, only on the necessary work areas;
- The removal of vegetation from the ground, before the execution of the excavation works, will be avoided, in order to minimize erosion, and the specific bio-chemical processes;
- Any plant debris in the immediate vicinity of the work areas will be mixed with the topsoil to increase its organic matter content and thus increase its productive capacity, limit erosion and compaction and improve water storage capacity;
- When the topsoil stock is to be maintained for more than 30 days, it shall be protected against erosion and compaction by seeding with fast-growing seeds (e.g.mustard or grass);
- The topsoil storage location will be in an area where the topsoil has not been removed;
- It will be avoided that the vegetation layer mixes with the subsoil. The soil resulting from excavations and excavations will be stored separately from the topsoil, either in different locations or by separation with physical barriers (example: geotextile plates);
- The topsoil deposit will be slightly compacted, to limit the penetration of precipitation and promote entrainment/slippage from the deposit. Also, special measures will be taken to ensure ventilation by installing polyethylene pipes with perforations (filter type) on the face of the berms, alternating at about 1-1.5 m, an end of about 0.5 m, which will be left to allow biological processes to continue within the topsoil.
- The soil deposit shall be kept stable and properly drained.
- It is not recommended to handle the soil in unfavorable weather conditions (wind, rain).

In order to reuse the topsoil for the restoration works of the areas affected by temporary works, the following will be followed:

- Work areas affected by temporary works will be cleaned: equipment, materials and/or remains of construction materials - ballast, gravel, crushed stone - will be removed.
- In the decommissioning stage, in order to carry out the ecological restoration works, the condition of the land obtained after cleaning must be equivalent or better than the condition before the construction.
- All waste will be disposed of in the designated storage areas.

- Before carrying out the restoration works, a deep plowing will be applied in order to dismantle the basement. Deep plowing will be carried out at a depth of 40-60cm.
- The works will be executed starting from the farthest place to the proximal point, to avoid the creation of new roads, and or compaction of the laid soil layer.
- The soil surface shall not be handled in wet conditions or when the soil or topsoil is frozen.

6.2.3 Water

The construction, operation and subsequent decommissioning of the Neptun Deep offshore facilities presents a series of effects on seawater, which can induce a potential impact on its quality, and thus could directly affect water bodies (BLK_RO_RG_CT_APE COSTIERE; BLK_RO_RG_MT01) and marine organisms.

Effects with potential impact on water quality identified during the construction, operation and decommissioning stages of the project are presented in table 6.35, below.

Table 6.35 Effects with potential impact on water quality and the underwater environment during the construction, operation and decommissioning stage of the Neptun Deep project

Effect with potential impact	Construction stage	Operation stage	Decommissioning stage
Effects on hydrogeological conditions	-	-	-
Effects on hydrographic conditions	x		
Temporary increase in turbidity	x	-	x
Temporary increase of nutrients and possibly some pollutants present in sediments due to sediment resuspension	x	-	-
Affecting water quality through controlled discharge of effluents	x	x	x
The presence of the gas production pipeline and underwater components		x	

The evaluation criteria for assessing sensitivity and magnitude are as follows:

Evaluation criterias

Magnitude criteria

Magnitude	Description
Negligible	The impact does not generate quantifiable (visible or measurable) effects in the natural state of the environment.
Low	Localizable and detectable temporary or short-term impacts on water that cause changes beyond natural variability without altering water functionality or quality. Water quality returns to its pre-impact state after the activity causing the impact ceases.
Medium	Temporary or short-term impact on water that may extend beyond the local scale and produce changes in water quality or functionality. However, the long-term integrity of the water quality or any dependent receptor is not affected. If the extent of the impact is large, then the magnitude can also be large.

Magnitude	Description
High	Impact on water that may cause irreversible changes and beyond permissible limits, on a local or larger scale. Changes may alter the long-term character of water and other dependent receptors. An impact that persists after the cessation of the activity producing it has a high magnitude.

Sensitivity criteria

Sensitivity	Description
Low	Water is an important environmental factor, but resistant to change (in the context of the proposed activities) and will quickly naturally return to its pre-impact state once the impacting activity ceases.
Medium	Water is an important environmental factor for the functioning of ecosystems. It can be less resistant to changes but can be returned to its original state through specific actions, or it can recover naturally over time.
High	Water is critical to ecosystems, it is not resistant to change and cannot be returned to its original state.

Sensitivity of water bodies and underwater environment

Based on the information presented in Chapter 4 regarding the current state of the Black Sea, the Water environmental factor was assessed as having **medium sensitivity**, from the perspective of the size of the receptor we are referring to, as well as due to the fact that it has an important role for the functioning of ecosystems and hosts species of conservation value.

As such, it is important and may be less resistant TO changes, and in Background the activity can be restored naturally over time, once time what the activity generation of the impact it stops.

6.2.3.1 Forecasting the impacts on the water environmental factor during the construction stage

6.2.3.1.1 Effects on hydrogeological conditions

The geotechnical studies carried out in the onshore site of the project indicated that the water table is present at -30 m from the ground level.

No land works will have effects on groundwater as they are surface works, no waste water or chemicals are discharged into the ground, no boreholes will be dug to supply water to onshore facilities, so there is no risk of an indirect impact on the ground water.

When digging the microtunnel to cross the shore, a maximum depth of 25 m will be reached , being above the ground water level.

Therefore, the works performed during the construction stage are not of a magnitude that would affect or cause changes in the hydrogeological conditions.

During the operation stage, the activities carried out at the NGMS are not likely to produce effects on the hydrogeological conditions.

As in the construction phase, the activities included in the decommissioning phase are not of a nature to generate effects on the hydrogeological conditions.

Thus , taking into account the activities of the project in all its stages, as well as the current state of the analyzed environmental factor, it can be appreciated that the significance of the impact of the Neptun Deep Project on the hydrogeological conditions is "no impact".

6.2.3.1.2 Effects on hydrographic conditions

Excavation work for the microtunnel outlet, dredging of the transit trench for the gas production pipeline, positioning of the pipeline and covering it with a protective layer of rock, planned discharge of water-based drilling fluid are likely to produce a physical disturbance at the level of the sedimentary layer, changing the morphology of the seabed.

Potential impacts on hydrography are related to changes in seabed characteristics that may alter the direction and/or magnitude of bottom currents or the vertical mixing of water.

Sedimentation is one of the factors that can have an irreversible impact on bathymetry and therefore can have a long-term impact on hydrography.

Changes in the morphology of the seabed are likely to lead to negligible changes in the bathymetry of the seabed (depth in the water column), which do not significantly negatively influence the way of life of marine organisms. Details have been presented in detail in Section 6.2.3.1.1, above.

As such, the impact on hydrographic conditions associated with sedimentation during the construction phase is assessed as temporary, local and of low intensity, thus the magnitude of the impact is considered negligible.

Based on Medium receiver sensitivity and negligible impact magnitude, the overall impact on hydrographic conditions is assessed to be insignificant.

6.2.3.1.3 Increase in turbidity in the water column

For the planned works in the coastal area, it is estimated that a volume of 40,950 m^3 of sedimentary substrate will be excavated in order to create the exit of the microtunnel and the laying of the gas production pipeline in the transit trench. The works of filling the trench with excavated material and crushed stone will take place along a corridor with a length of approximately 3,375 m.

All of these works have the potential to cause resuspension and dispersion of seafloor sediments into the overlying water column.

The modeling results presented in Section 6.2.3.1.2, considering different scenarios, indicate total suspended matter > 0.1 mg/l, with the highest concentration of 4 to 6 mg/l in the immediate vicinity of the dredging area in both simulated scenarios (scenarios 1C and 2C), sediment suspension being felt over a distance of 1 to 2 km north - south of the trench axis, for a Duration of 6 hours/day.

Other activities, including rock placement, anchor handling, pipe laying and the use of dynamic positioning vessels can also cause sediment resuspension, but to a lesser extent than seabed intervention work.

An increase in turbidity in the depth horizon of the water column will be felt as a result of the drilling of wells and the controlled discharge of detritus with water-based drilling fluid to the seabed.

It is estimated that a volume of 72,678 cubic meters of water-based drilling fluid and 8,784 cubic meters of WBM cuttings generated when drilling the first 2 sections of the wells with water-based drilling fluid will be discharged directly on the sea floor.

In deep sections, the halocline will limit the mixing of dense bottom water with less saline surface water. This will limit the vertical suspension of sediments at the discharge site.

Although water quality will be affected by the increase in suspended sediments, re-sedimentation will occur within a short period of time so that water quality will return to pre-impact conditions.

In summary, the water quality impacts associated with the release of sediments into the water column during construction are assessed to be temporary, local, and of low intensity. Therefore, the magnitude of the impact is considered low.

Based on the Medium sensitivity and low impact magnitude, the overall impact on water quality from the release of sediments into the water column is assessed to be minor.

6.2.3.1.4 Temporary increase of nutrients and possibly some pollutants present in sediments due to sediment suspension

The construction activities presented above will lead to the release of pollutants into the water column through the resuspension of sediments.

As presented in Section 6.2.3.1.2, as a result of dredging and excavation works, sediment disturbance will lead to a resuspension of pollutants from the sedimentary substrate and a redistribution to the seabed as they settle in the areas surrounding the interventions . Thus, water quality could be affected by higher values of pollutant concentrations in work areas. Most contaminants will settle back to the bottom of the sea, adhering to the sediment particles, and will thus be removed from the water in a short time. Therefore, water quality will return to pre-impact conditions for most contaminants found in sediments.

It should be noted that the release of these pollutants into the water column does not constitute a net increase of contaminants in the marine environment, but rather a redistribution of substances already presents in the sediments.

Water quality impacts associated with the release of sediment pollutants into the water column during construction are assessed to be temporary, local, and of low intensity. Therefore, the magnitude of the impact is considered low.

Based on the Medium sensitivity and low impact magnitude, the overall impact on water quality from the release of pollutants from sediments into the water column is assessed to be minor.

6.2.3.1.5 Affecting water quality through the controlled discharge of effluents during the construction stage

Effluents discharged into the sea during the construction period come from different sources as follows:

- Controlled discharge of pipeline test fluid;
- Water-based drilling fluid from drilling wells;
- Routine evacuations from the drilling rig and support vessels.

These discharges have the potential to affect water quality by introducing solid particles (especially in the case of water-based drilling fluid), causing an increase in turbidity and suspended solids, as well as introducing chemicals and organic matter contained in downloaded streams.

Among the discharge categories listed above, the greatest potential for affecting water quality during the construction phase is the controlled discharge of pipeline testing effluent (hydrotesting water).

6.2.3.2.5.1 Controlled discharge of pipeline test fluid

After the installation of production pipelines and supply/intake pipelines is completed, they are subjected to hydrotesting. The hydrotesting fluid is a mixture of seawater and a common chemical (Hydrosure HD5002) used in the marine pipeline construction industry.

The purpose of this test is to check the lack or leaks of the pipes. This is achieved by filling the pipes with sea water up to the testing pressure and then monitoring if the pressure value is maintained for a predetermined period of time, during which the joints between the system components are inspected for potential leaks.

After testing, the fluid is discharged into the sea at a depth of more than 950 m using the manifold from the Domino 2 drilling Centre. The discharge of the test fluid is performed only once, the discharge point is located deep in the anoxic layer and is expected to exhibit a direct effect on deep water quality indicators in the caisson discharge area.

In order to quantify and document the potential risk to the marine environment generated by the substances in the test water, an effluent dispersion modeling was carried out with the DREAM model, developed by SINTEF, Norway [14].

Effluent dispersion modeling from pipeline testing

Modeling was performed using DREAM (Dose-related risk and effects assessment model) software to confirm that hydrotest fluids that are discharged into the anoxic horizon of the sea remain below the sub-oxic layer. The software version used is 14.0 from 07.07.2022 (Fates.exe (model engine) and MEMW.exe (user interface). The graphics module (MEMW.xls) is from 30 May 2011.

The modeling input data are presented in the table below.

Table 6.36 Volume of fluid used in testing

	Freshwater (m^3)	Sea water (m^3)	TEG (m^3)	Hydrosure HD5002 (m^3)	Total (m^3)
Pelican pipeline	99	N/A	4	1	104
Domino pipeline	26	4,730	36	2	4,794
Gas production pipeline	905	66,576	30	33	67,543
Total	**1,030**	**71,306**	**69**	**36**	**72,441**

Metocean data for the Black Sea were collected from the Copernicus Marine Service.

The data fluid test used in the modeling are as follows:

Water temperature at 950m (° C)	8.95
Salinity of sea water at 50m (ppt)	18.96
Fluid salinity (freshwater and seawater mixture) (ppt)	18.66
TEG concentration (volume fraction)	9.66E-04
Hydrosure concentration (volume fraction)	4.97E-04
TEG PNEC* (ppm)	0.5
Hydrosure marine water PNEC (mg/l)**	1

* from the DREAM database
** From the Safety Data Sheet

Six scenarios were simulated for three discharge rates and different discharge Durations with two discharge directions, which are representative of a Hydrotest fluid discharge at Neptun Deep. All other input parameters are the same for all scenarios, all simulations were run for discharge time.

[14] SINTEF is an independent research organization founded in 1950, which carries out research and development projects. Source: www.sintef.no.

Both horizontal and vertical spills lead to blockage of the discharge in the water column. However, due to seabed and sediment disturbance, horizontal discharge is not recommended for operational reasons.

High discharge velocities result in rapid diffusion in seawater and slowing down of the jet phase. After the jet phase, the discharge is transported entirely by residual turbulence and diffusion (Figure 6.34 to Figure 6.36)

Dosage concentrations of discharged chemicals used in modelling are considering only the concentrations without technological consumption or biodegradation processes prior to discharge. These concentrations are diluted to concentrations below the PNEC (estimated no-effect concentration) at a certain distance and after a certain time after the start of the flow.

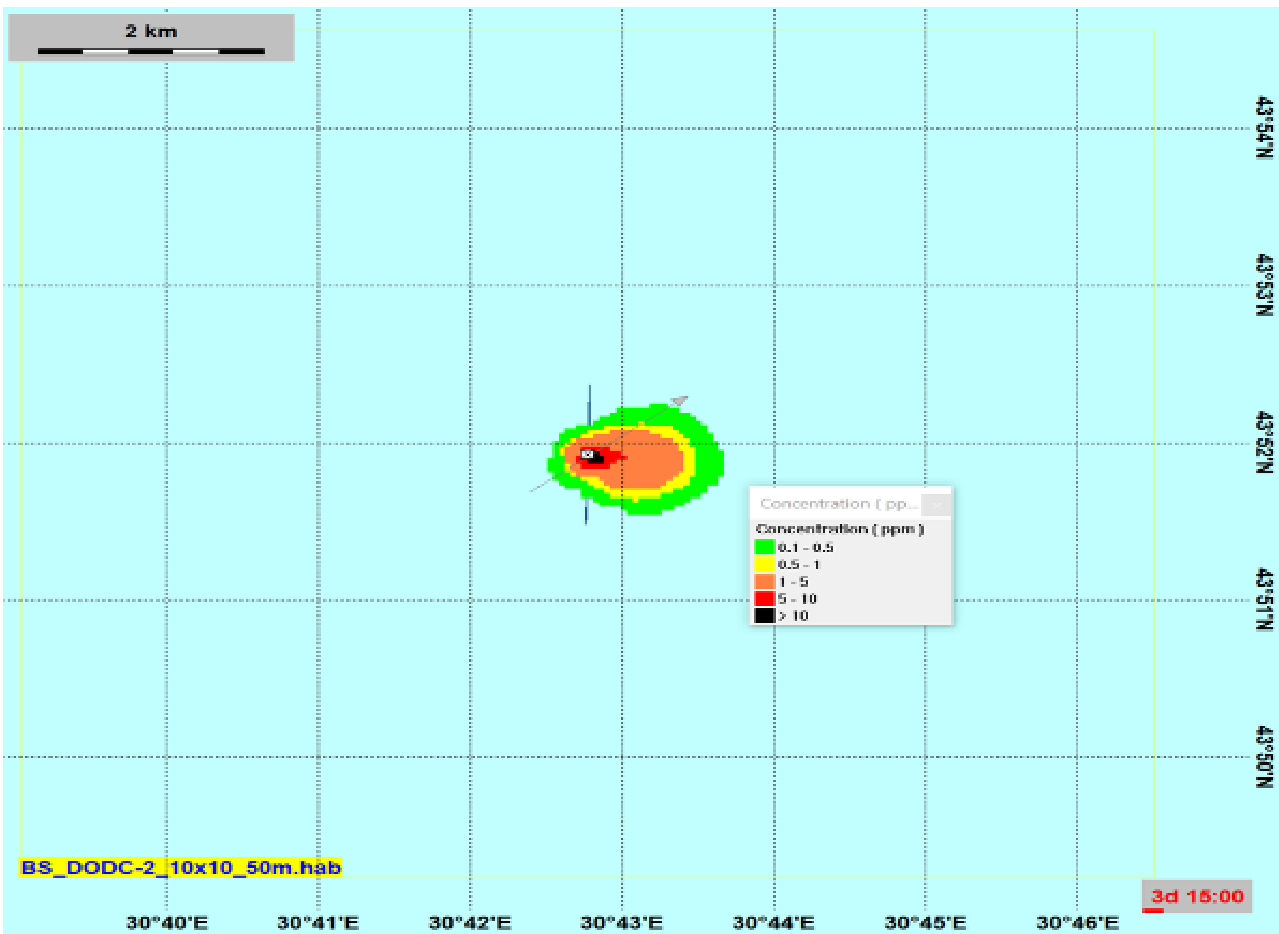


Figure 6.34 Top view in depth - maximum concentrations in the water column at the end of the discharge (87h)

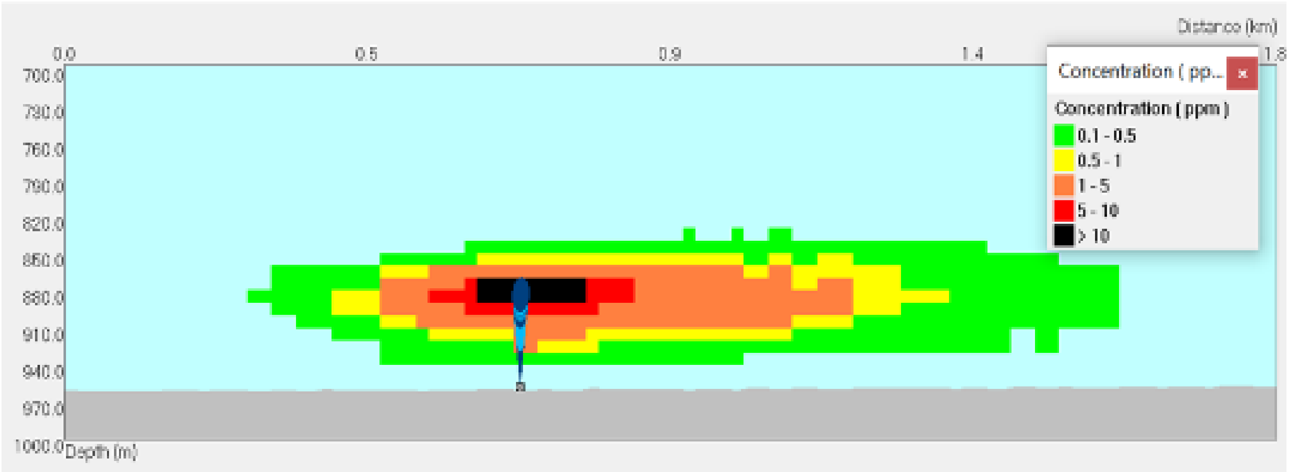


Figure 6.35 View of the fluid plume (jet phase) at the end of the discharge (87h).

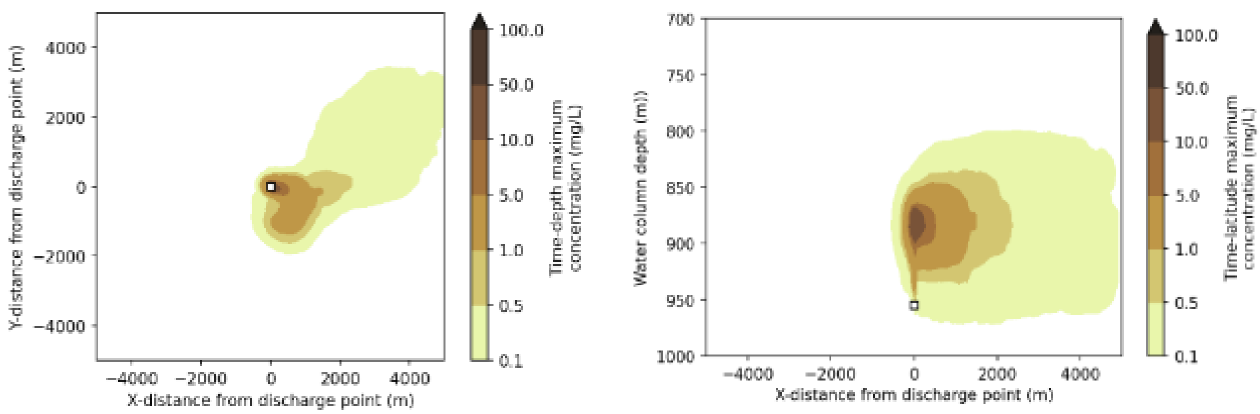


Figure 6.36 General maximum concentrations in the water column (87h)

Modeling in all three discharge scenarios indicates that the extent of the impact will however be local, felt in the discharge area, maintained over a water column (with variations) between 950m and 800m depth, with an attenuation rate to match that moves away from the source, intervening natural dilution.

Conclusions on Water Quality Impacts of Controlled Discharge of Effluent from Pipeline Testing

The potential environmental impacts that may result from the controlled discharge of hydrotesting effluent are closely related to the chemicals used in the mixture that led to a local, temporary change in water quality indicators.

Hydrotesting will be performed immediately after construction and connection of the production pipeline to ensure that there are no leaks and that the pipeline is clean and capable of carrying natural gas at operating pressure.

Hydrostatic test water from the Black Sea will be treated with a common chemical (Hydrosure HD5002) used in the marine pipeline construction industry. This additive is specially designed for such operations and is based on didecyldimethylammonium chloride (20-25%) and ammonium bisulphite (10-20%), with the role of preventing corrosion and algae formation inside the pipeline during the test.

The concentration of the Hydrosure chemical in the hydrostatic test effluent is 200 - 500 ppm (depending on the Duration of the hydrotest). According to the safety data sheet of the product, the chemicals contained are bidegradable, and easily biodegradable. As such, the additive contained in a diluted form in the hydrotest water will be further diluted to extremely low concentrations, which are expected to be harmless to the aquatic environment in the area.

Upon completion of hydrotesting during the commissioning phase, hydrotest water will be discharged into the sea from the Domino Drilling Centre at 950 m seawater depth, with an estimated volume of 72,441 m^3 of hydrostatic test water being discharged.

Given the depth of discharge, as well as the fact that the plume of effluent remains in the anoxic layer of the sea, where there are no favorable conditions for life, along with the biodegradability of the products, the impact is local, temporary, reversible and of low intensity.

The significance of the impact is minor considering the average sensitivity of the receiver and the low magnitude of the impact.

6.2.3.2.5.2 Controlled discharge of water-based drilling fluid directly from the borehole to the seabed

Water-based drilling fluid (WBM) will flow on the seabed during the drilling of the first two well sections, as it is being run without a riser. Where possible, these upper sections will be drilled using an RMR system to recover WBM. A subsea pump and return line will transfer the WBM back to the drilling rig.

On the rig, the WBM will be separated from the detritus and the mud will be recirculated to the rig tanks and downhole. The detritus separated from the drilling fluid is discharged back to the seabed.

Prior to drilling the last upper section at each drill Centre, the RMR system will be removed to allow for the installation of the column and blowout preventer (BOP). In this case, the last upper section of the well will be conventionally drilled, meaning that both WBM and detritus will be allowed to flow to the seabed.

The advantage of using the RMR system is that it significantly reduces the total volume of WBM discharged into the sea. If the RMR subsea lift pump fails or needs to be recovered, the drilling process will continue conventionally with the discharge of WBM and detritus to the seabed.

It should be noted that once the top sections are dilled and the riser can be installed, drilling subsequently switches to a closed system (isolated from the marine environment) using NAF drilling fluid. The NAF returns to the drilling rig where it will be fed into a centrifuge system to separate the detritus, and then fed back into the drilling system to continue operations. Detritus separated from the NAF will be collected and transported ashore for treatment and disposal at an authorized waste facility.

A volume of 72,678 cubic meters of WBM and 8,784 cubic meters of WBM cuttings generated when drilling the first 2 well sections with water-based drilling fluid is estimated to be discharged directly on the sea floor.

Variable salinity, which results in a density difference between the surface and deep layers of the Black Sea, completely inhibits vertical circulation below a certain depth, and the mixing between the dense deep-water layer and less saline surface water is limited.

Which means that a temporary change in water quality is expected in the lower horizon, in the area where the well is located. The detritus and the suspensions from the chemical substances in the composition of the WBM (bentonite, barite) will be deposited on the substrate of the seabed, without affecting the water column located above the operational area.

Given the depth of the water in the drilling area, the temporary, local and short-term change in water quality in the lower horizon will not have a significant impact on benthic organisms.

Studies on the environmental impact of WBM discharge into the North Sea indicate that detritus mixed with WBM can seriously affect biomarkers in filter-feeding bivalves and cause increased sediment oxygen consumption and mortality in benthic fauna. Levels of effects occur over a distance of 0.5–1 km. The stress is mainly physical.[15]

However, in the area where the wells are located, no sensitive benthic habitats were identified, given the water depth, i.e. between 120-130 m in the Pelican South perimeter and between 700-1100 m in the Neptun Deep perimeter, which is why no specific habitats for species can be found of bivalves, than at most a few individuals of Oligochaetes and Nematodes (Chapter 4 - table 4.86).

Thus, the water-based drilling fluid has a minimal effect due to its non-toxic nature as well as the capacity of rapid dispersion and biodegradation, the risk of impact of operational spills on populations and the ecosystem is currently considered low, in the specialized literature.

In summary, given that the drilling of the wells will be performed in stages, with large time intervals between drillings, the impact on water quality associated with the controlled discharge of water-based drilling fluids and detritus during the drilling of the first 2 sections of the wells is evaluated to be temporary, local and of low intensity. Therefore, the magnitude of the impact is considered low.

[15]Torgeir Bakke, Jarle Klungsøyr, Steinar Sanni, Environmental impacts of produced water and drilling waste discharges from the Norwegian offshore petroleum industry, Marine Environmental Research, Volume 92, 2013, Pages 154-169, ISSN 0141-1136, https://doi. org/10.1016/j.marenvres.2013.09.012. (https://www.sciencedirect.com/science/article/pii/S0141113613001621) – accessed 5.10.2023

Based on the medium sensitivity and low impact magnitude, the overall impact on water quality as a result of the water-based drilling fluid discharge is assessed to be minor.

6.2.3.2.5.3 Routine discharges from the drilling platform and support vessels

Routine discharges into the sea of liquids and other matter must comply with the discharge restrictions imposed by the MARPOL 73/78 Convention on standard effluent quality parameters, in the case of wastewater, and hydrocarbon content, in the case of drainage water.

Both the drainage water and the wastewater will be treated before discharge in such a way as to meet international standards in order to reduce the level of hydrocarbons in the discharged water to a maximum of 15 ppm.

If the hydrocarbon content of the drainage water exceeds the level of 15 ppm, the contaminated water will be stored and transported to the shore, from where it will be taken over by an authorized company, in order to be treated in onshore facilities to reduce the amount/concentration of pollutants on which contains its waste water, so that the discharge conditions imposed by the regulations in force are respected.

On board the drilling unit and support vessels there are wastewater separators, waste water treatment facilities, waste water storage tanks, which meet MARPOL requirements.

With regard to planned discharges, the following limits are imposed under MARPOL requirements:

- drainage waters, sump waters: there are no quantitative limitations, it is sufficient only to treat them in an oil/water separator, which is designed to reduce the hydrocarbon content of the waste water to a maximum of 15 ppm;
- domestic water: without quantitative limitations, their primary treatment is required according to MARPOL requirements. To be allowed to discharge into the sea, the quality of the effluent must be as follows: solid suspensions < 50 mg/l, faecal coliforms < 250/100 ml, CBO5 < 50 mg/l, residual chlorine < 5 mg/l;
- food waste will be shredded to min. 25mm through the shredder installed on board before being discharged into the sea.

Discharges of greywater, blackwater (sewage) and food waste are expected to have a negligible impact on seawater quality, as these discharges are checked against international treatment and discharge at sea requirements that apply to all ships and are considered to present a negligible risk to the marine environment.

Therefore, given the negligible magnitude and average sensitivity of the receiver, the significance of the expected impact of routine discharges from the MODU and support vessels during the construction phase is assessed to be insignificant.

6.2.3 .2 Forecasting the impacts on the water environmental factor during the operating period

6.2.3.2.1 Affecting water quality by controlled discharge of effluents during the operating period

During the operating period, the sources of impact on the marine environment come from the Neptun Alpha Production Platform and the support vessel that serves the platform for periodic (quarterly) maintenance works.

Sources of offshore liquid effluents during normal operation include the following:

- Routine effluent (480 te) from 40 personnel working during four operations and maintenance (O&M) campaigns, 20 of whom are support ship crew members, assuming a wastewater generation rate of 200 L per person per day for 60 days.
- The produced water (5,292,500 m^3) will be discharged in a controlled manner into the sea in the hypoxic zone during operation, in the first 10 years of operation an average volume of 50 m^3 per day is estimated, which will gradually increase for the next 10 years, reaching an average volume of 1400 m^3 per at the end of the project.
- Domestic water (200 m^3) from the open drain tank with separator and hydrocarbon analyzer. It is estimated that a quantity of 50 m^3 of household water will not be compliant for discharge into the sea (hydrocarbon content >15ppm), and it will have to be pumped to the support vessel for disposal onshore.
- Waste water from gas turbine generator (GTG) washing (18 m^3) generated twice a year. This wastewater is pumped and directed to the support vessel for onshore disposal.
- Discharge of subsea hydraulic fluid (water based hydraulic fluid) directly into the sea, generating 1 m^3 per year based on each partial start-up and shutdown (PSD)/emergency shutdown (ESD) of a well head (XT) and assuming 20 shutdowns and restarts unique wells in the first 2 years, 12 shut-ins and the restart of a single well over 18 years.
- It is assumed that the cooling water, including sodium hypochlorite, is discharged into the sea with the water produced in the hypoxic zone, it is estimated that a volume of 420 m^3 /h is generated.
- Subsea leakage from subsea directional control valves (DCV) per operating period (6.3 m^3 /year) discharged directly into the sea, estimating an assumed leakage of 24 valves @3ml/hour equivalent to 72ml/hour per submarine control module (SCM) (the project has 10SCM).
- Open drain water (rainwater) is discharged into the sea (130 m^3) through the produced water caisson 4 times a year.
- The TEG water from the Domino subsea pig station (1 m^3 /year) is discharged directly into the sea based on the release of some treated water when replacing the cartridge, assuming that the purge occurs every two years (expected to be less than that).
- Methanol for restart - Normal restart (954 m^3 /year) is discharged into the sea mixed with produced water. A volume of 159 m^3 per PSD restart with 6 PSDs per year is estimated.
- Methanol for shutting down and restarting a single well (161 m^3 /year) is discharged into the sea mixed with produced water. An assumption is made that there are 20 unique well shutdowns and restarts in the first 2 years, with 12 unique well shutdowns and restarts over 16 years.

- Methanol for restart - planned shutdown (TAR) (318 m^3 /event) is discharged into the sea mixed with produced water. Five panned shutdowns are assumed during the life of operation, occurring once every 4 years.
- Methanol for start, restart - emergency (ESD) (159 m^3 /year) is discharged into the sea mixed with produced water. It is estimated that 1 event per year is done with a short emergency shutdown.

Of all the effluents listed above, produced water mixed with the cooling water is the effluent with a continuous discharge, having the largest volume discharged in the operating stage.

The rest of the effluents (domestic wastewater, rainwater, water from the platform), which are part of the routine discharges from the platform and the support vessel, have an intermittent controlled discharge throughout the operating period, having negligible effects on water quality.

6.2.3.2.2 Controlled discharge of produced water, cooling water, fluids from initial start-up and operational restart of wells

The discharged effluent has an variable content of heavy metals, hydrocarbons, can contain production and treatment chemicals, , which at high concentrations can affect marine life, thus leading to potential negative impacts.

The discharge temperature of the produced water is usually considerably higher than the ambient sea temperature, presenting a potential risk to any local temperature-sensitive species when the effluent is discharged without cooling.

It is therefore important to quantify the significance of these impacts.

A series of studies and analyzes were carried out in the design stage to identify potential environmental risks, and establish management measures and reduction of potential impacts to a reduced level, acceptable for the environment:

- Generation of a spill inventory covering the relevant phases of the Project.
- BAT study for produced water to identify the treatment method and disposal options onshore and offshore, thus leading to the selected technical solution.
- BAT study on the offshore open drainage system to identify the best options available for open drains
- The solution for the collection and discharge of rainwater potentially contaminated with hydrocarbons from the Neptun Alpha production platform.
- The Dose Effects and Risk Assessment Model (DREAM) was used to simulate and quantify the risk from different produced water release scenarios.

Produced water treatment system

The fluids produced by the Neptun Deep project are very lean, with the low hydrocarbon dew point b which means that fluid processing will not result in liquid hydrocarbons. The production stream is primarily a mixture of gas and water, with the primary processing route for the collection of hydrocarbon-free water. There may be small amounts of sand particles from development deposits that will be entrained in the production flow and are expected to be carried in the fluid flow.

Under normal operating conditions, most of the water will be collected in the Primary Separator and directed to the reservoir water degasser. This is a vertical vessel that operates under the reverse pressure of the Low-Pressure Flare (LP Flare) system, which is basically a normal atmospheric pressure system. The purpose of this vessel is to allow any gas absorbed into the water stream to escape before the water stream is discharged into the sea.

The water flow from the TEG dehydration system is continuous and recovered. Streams from the TEG dewatering system are the result of residual water that was in the gas stream and must be removed so that the exported gas stream meets wet gas specifications for export. This water flow is also free of liquid hydrocarbons.

Cooling water

A wet gas cooling system is provided on the upper deck of the production platform to assist the TEG dehydration process by reducing the gas temperature in some operating cases where the temperature prevents the delivery wet gas from reaching its dew point.

This system uses seawater brought to the production platform by means of sump pumps. Each of these pumps has a nominal capacity of 317.3 m^3/h and to ensure that marine micro-organisms do not clog the pumps, the suction of each during operation will be dosed with sodium hypochlorite (SHC) at a routine rate of 2 ppmv.

The dosing rate will be adjusted so that feedback from a downstream free chlorine analyzer can be reassessed so that the final discharge concentration is <0.2 ppm per NTPA001.

The return flow of the pump will be directed to the technological water disposal caisson. It will mix with produced water prior to discharge. **Chemicals**

Based on laboratory chemical analyses, the optimal concentration for the injection of chemical substances into the technological process was determined, in order to reach the maximum admissible limits for those parameters provided for in NTPA 001/2002 of the produced water upon discharge.

For minimal effects on the marine environment, the dosage rates will be optimized by the operator, so that the final concentrations proposed for use will be even lower than those recommended by the testing laboratory.

No priority substances are found in the content of the products used.

The chemical products are soluble in water, and the substances contained have different levels of biodegradability (fast/ easy/ slow biodegradable) according to the information provided in the technical safety data sheets.

Technological water discharge caisson

The technological water resulting from the degasification vessel, the water collected at the open drain system and the water recovered from the flare separators, will be directed to the vertical discharge caisson into the sea. The caisson is equipped with a ventilation valve located on the inlet line. The sea discharge head of the caisson is located at a depth of 90m, with a diameter of 500mm.

Open Drains System

The production platform will have an Open Drain System installed. The purpose of this system is mainly to manage rainfall runoff on the platform surfaces, both in the upper and lower exposed areas. There is the possibility of leakage of oily or chemical liquids during equipment maintenance, so the Open Drain System is provided in order to retain potentially contaminated liquids.

Each branch of the open drain system will have an associated liquid seal vessel. A final coarse filter will intercept the collected liquids in the upper part of the production platform, later directed to the tank of the open drainage system.

The open drain system tank is located in one of the legs of the platform and has a working volume of 200 m^3, an open drain system pumping caisson and a hydraulically driven open drain pump.

Inlet sources are normally assumed to be uncontaminated, so a remote drain capability is provided so that the contents of the open drain tank can be disposed of via the produced water drain culvert. This activity will only be carried out after confirming the fact that the hydrocarbon content in the discharged wastewater respects the limit of 15 ppm. This measurement will be made by an online OIW (oil in water) analyzer installed on the water discharge route. The analyzer location is upstream of the recirculation line back to the open drain tank and provides an escape route via a hose connection to the FSV (Floating Storage Vessel) should the water quality not meet disposal standards.

The open drain system is also used during planned overhaul activities were emptying of vessels and low point drains may be required. Maintenance activities may also involve cleaning using biocides. Any planned activity involving the use of known contaminants will also include the final evacuation of the effluent facilities to the FSV, thereby ensuring that the system returns to a clean operational state.

In order to quantify and document the potential risk to the marine environment generated by the substances in the technological water discharged through the discharge caisson of the production platform, a modeling of the dispersion of the effluent was carried out with the DREAM model, developed by SINTEF[16], Norway.

Environmental risk modeling of controlled discharge of produced water

A series of software modeling was run to establish **the dose effect** and **environmental impact factor (EIF).**

[16]SINTEF is an independent research organization founded in 1950, which carries out research and development projects. Source: www.sintef.no.

The EIF methodology is based on a PEC/PNEC approach where **the predicted environmental concentration** (PEC) for each compound emitted is compared to a **predicted no-effect concentration** (PNEC) for the same compound. When the PEC exceeds the PNEC, adverse effects may occur as a result of exposure to that compound.

PEC (Predicted Environment Concentration) is expressed as a concentration for individual substances or as a dilution for the entire effluent.

The PNEC (Predicted No Effect Concentration) is derived from laboratory test results/available toxicity information and is provided for each compound present in the discharge.

In modeling the PNEC prediction, the DREAM model, developed by SINTEF, Norway, was used, with a series of scenarios being run (cold season versus warm season; technological water with low salinity versus technological water with high salinity).

The result of the modeling provided by SINTEF, through OMV Petrom SA and the assessment of the effects of the effluent on the aquatic environment are presented in the following paragraphs.

The DREAM model, developed by SINTEF, Norway, uses the Lagrangian model, which generates numerical particles at the point of discharge, which are transported with currents and eddies from the sea. Different properties such as compound masses, densities and settling velocities are associated in each case in a particular way to represent the characteristics of a discharged compound. Particles can also represent different states or phases, such as bubbles, droplets, dissolved matter, or solid matter. Particles are calculated as a function of concentration by dividing the model area into a "cell" grid representation and considering the particles and properties of each compound in each grid cell. Thus, DREAM generates a near-field model (“effluent plume”) that calculates possible turbulence or jets at the effluent discharge outlet. This model takes into account temperature differences before the discharged effluent is mixed with water from the natural environment.

Environmental risk is calculated from the degree of dispersion and characteristics of the compound (e.g. biodegradation) and hence the predicted environmental concentrations (PECs) and toxicity (predicted no effect concentrations, PNECs) in a reference water volume where PEC exceeds PNEC.

Thus, an EIF unit (EIF = 1) is defined as a volume of water with horizontal dimensions of 100m x 100m and 10m in depth (100,000 m^3) in which the total risk, including the contributions of all chemical components in a release with a ratio PEC/PNEC > 1. From an environmental point of view, this implies that the term "no effect" refers to a volume of water of at least 100 000 m^3. Any effect occurring in a volume smaller than this is accepted in the "no effects" term.

Thus, a cut-off criterion for the probability of risk or effect of 5% is used. Thus, EIF values < 10 are considered as having a low risk to the environment - acceptable, while EIF > 100 typically require further action, such as changing the chemical composition or technical disposal solutions to achieve EIF values <10.

To confirm that dispersion modeling using the DREAM program is a robust methodology applicable in the Black Sea environment, it was validated by researchers from INCDM Grigore Antipa. The INCDM concluded [17]that while the DREAM model used a different approach to that followed by NTPA001, the DREAM model is a robust tool for rapid environmental risk assessment of produced water discharge and can be used to select injection dosage rates chemicals having a minimal impact on the environment.

A number of sequences were run in the DREAM model until all technical and dosage aspects were harmonized with minimal risk to the marine environment.

The final set of simulations [18]run by SINTEF in the DREAM model considered the package of chemicals supplied by ChampionX (chemical vendor), selected based on laboratory tests to be the most environmentally friendly compared to other products supplied by other companies, with a caisson discharge with a diameter of 0.5m, located at a depth of 90m.

The scenarios run considered the recommended dosage concentrations and the maximum number of effluents, both separately for each chemical component of the products, but also the mix of products, as well as the hydrological and hydrodynamic characteristics of the Black Sea in warm season and cold season.

At the same time, scenarios with a concentration of 0.2 ppm sodium hypochlorite and methanol in intermittent discharges (first start-up of the production wells and restarts during the operating period) were also included in the modeling.

Thus, in the table below (table no. 6.37) the concentrations (minimum dosages) and maximum quantities of effluents reaching the production platform from the Domino and Pelican drilling centers are indicated:

Table 6.37 Chemical input rates and effluents in DREAM modeling

CASE STUDY#	**10**	**10B**	**10C**	**10D**
SEASON	Warm season (September)		Cold season (April)	
TECHNOLOGICAL WATER SALINITY (PW)	High	Low	High	Low
CHEMICAL SUBSTANCE CONCENTRATIONS (ppm) recommended				
Corrosion inhibitor	50	50	50	50
Component 1	1,2	1,2	1,2	1,2
Component 2	11.24	11.24	11.24	11.24
Component 3	2.2	2.2	2.2	2.2
Component 4	9.76	9.76	9.76	9.76
Component 5	PLONOR[19]	PLONOR	PLONOR	PLONOR

[17] INCDM Gr. Antipa - Report on the assessment of ecotoxicity (DREAM Model), May 31, 2023
[18] Neptun Deep Final Produced water DREAM modeling results & PNEC Sensitivities, SINTEF May 31, 2023;

[19]PLONOR – indicates that the chemical is on the OSPAR PLONOR List and presents low or no risk to the environment.

CASE STUDY#	10	10B	10C	10D
SEASON	Warm season (September)		Cold season (April)	
TECHNOLOGICAL WATER SALINITY (PW)	High	Low	High	Low
CHEMICAL SUBSTANCE CONCENTRATIONS (ppm) recommended				
Inhibitory scales	15	15	15	15
Component 1	PLONOR	PLONOR	PLONOR	PLONOR
Component 2	4.5	4.5	4.5	4.5
Component 3	PLONOR	PLONOR	PLONOR	PLONOR
Component 4	PLONOR	PLONOR	PLONOR	PLONOR
Antifoaming	10	10	10	10
Component 1	4	4	4	4
Component 2	0	0	0	0
TEG	332	332	332	332
EFFLUENTS m^3 / hour				
Domino PW m^3/hour (with the use of corrosion inhibitor)	43.06	43.06	43.06	43.06
Pelican PW m^3/hour (using all other substances)	64.45	64.45	64.45	64.45
TEG	0.57	0.57	0.57	0.57
Cooling water	317.3	317.3	317.3	317.3

***NOTE** : The full name of the chemical compounds provided in the table will be made available to the authorities by OMV Petrom SA - the signatory of the confidentiality agreement with the manufacturer, with the specification "Strictly confidential".*

It was appreciated that the mixture of produced water (PW), cooling water and water from the TEG stream leads to a "dilution" of the chemicals in these streams (table no. 6.38).

Table 6.38 Concentration rates of substances at discharge, per case study

MIX				
Total volume evacuated	382.32	382.32	382.32	382.32
Corrosion inhibitor (special case):	91.76	91.76	91.76	91.76
Total volume evacuated	360.93	360.93	360.93	360.93
PW diluted with cooling water and TEG water	5.93	5.93	5.93	5.93
TEG diluted with PW and cooling water	670.74	670.74	670.74	670.74
Special case: corrosion inhibitor:				
PW diluted with cooling water and TEG water	8.38	8.38	8.38	8.38
CHEMICAL SUBSTANCE CONCENTRATIONS (ppm) RESULTING IN THE EFFLUENT DISCHARGED				
Corrosion inhibitor	5.97	5.97	5.97	5.97
Component 1	3.0542	3.0542	3.0542	3.0542
Component 2	0.1432	0.1432	0.1432	0.1432
Component 3	1.3410	1.3410	1.3410	1.3410
Component 4	0.2625	0.2625	0.2625	0.2625
Component 5	PLONOR	PLONOR	PLONOR	PLONOR
Inhibitory scales	2.5286	2.5286	2.5286	2.5286
Component 1	PLONOR	PLONOR	PLONOR	PLONOR
Component 2	0.5057	0.5057	0.5057	0.5057
Component 3	PLONOR	PLONOR	PLONOR	PLONOR

Component 4	PLONOR	PLONOR	PLONOR	PLONOR
Foaming	1.6858	1.6858	1.6858	1.6858
Component 1	1.0115	1.0115	1.0115	1.0115
Component 2	0.6743	0.6743	0.6743	0.6743
TEG	0.4950	0.4950	0.4950	0.4950
CASE STUDY #	**10**	**10B**	**10C**	**10D**
Resulting salinity				
High salinity PW	28	28	28	28
Low salinity PW	6,787	6,787	6,787	6,787
Salinity in cooling water (sea water - 50m) ppm	18.45	18.45	18.45	18.45
Salinity in PW, cooling water &TEG, and high salinity PW	20.06	-	20,20	-
Salinity in PW, cooling water &TEG, high salinity PW	-	16.48	-	16.63
EFFLUENT TEMPERATURE				
Total volume temperature (PW+ TEG+ cooling water)	22.32	22.32	22.32	22.32
EIF maximum result (Medium time)	**2 (0.31)**	**1 (0.16)**	**0**	**0**

***NOTE** : The full name of the chemical compounds provided in the table will be made available to the authorities by OMV Petrom SA - the signatory of the confidentiality agreement with the manufacturer, with the specification "Strictly confidential" -in order to keep the commercial secret of manufacturer's recipe.*

The results of modeling the scenarios are highlighted graphically in Figures 6.37 - 6.40 below.

 # Case study 10A – Warm season, high effluent salinity (September)

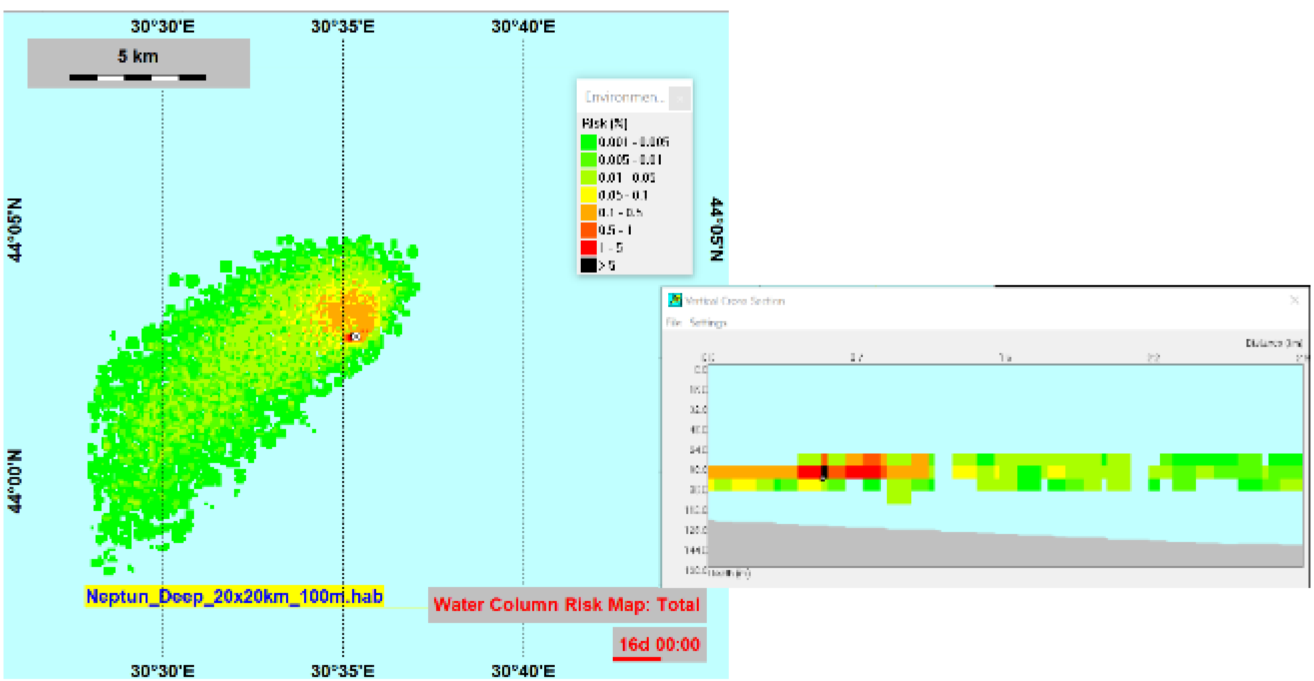


Figure 6.37 The concentration on the water column and the result of the environmental risk, at the time of EIF =2 (0.31) (Source SINTEF)

Case study 10B- warm season, low effluent salinity (September)

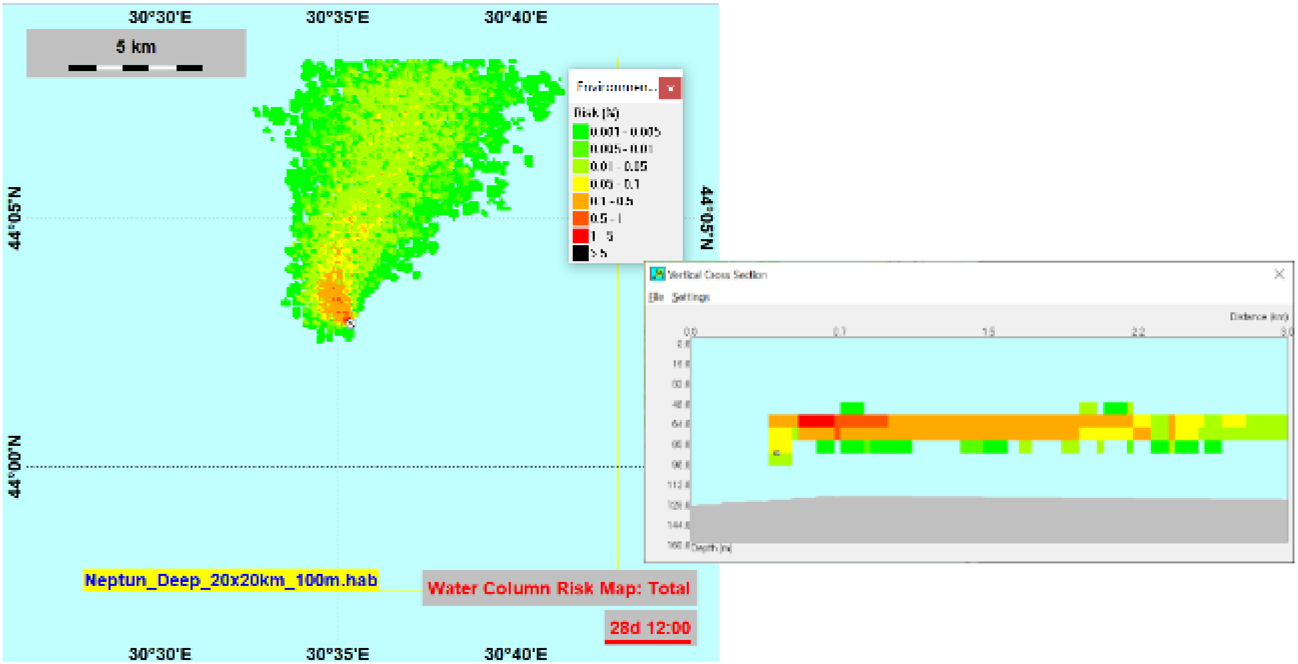


Figure 6.38 Concentrations in the water column and the environmental risk result at the time EIF =1 (0.16) (source: SINTEF)

Case study 10C – cold season, high effluent salinity (April)

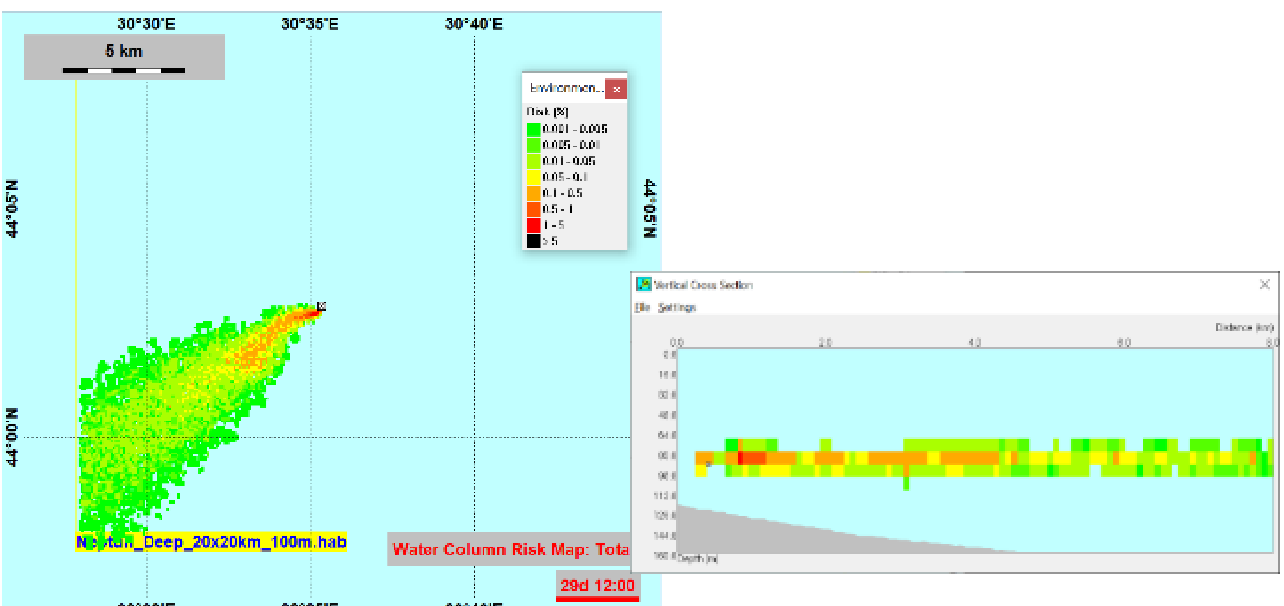


Figure 6.39 Water column concentrations and environmental risk result at the end of the simulation (EIF=0) (source: SINTEF)

#Case study 10D – cold season, low effluent salinity (April)

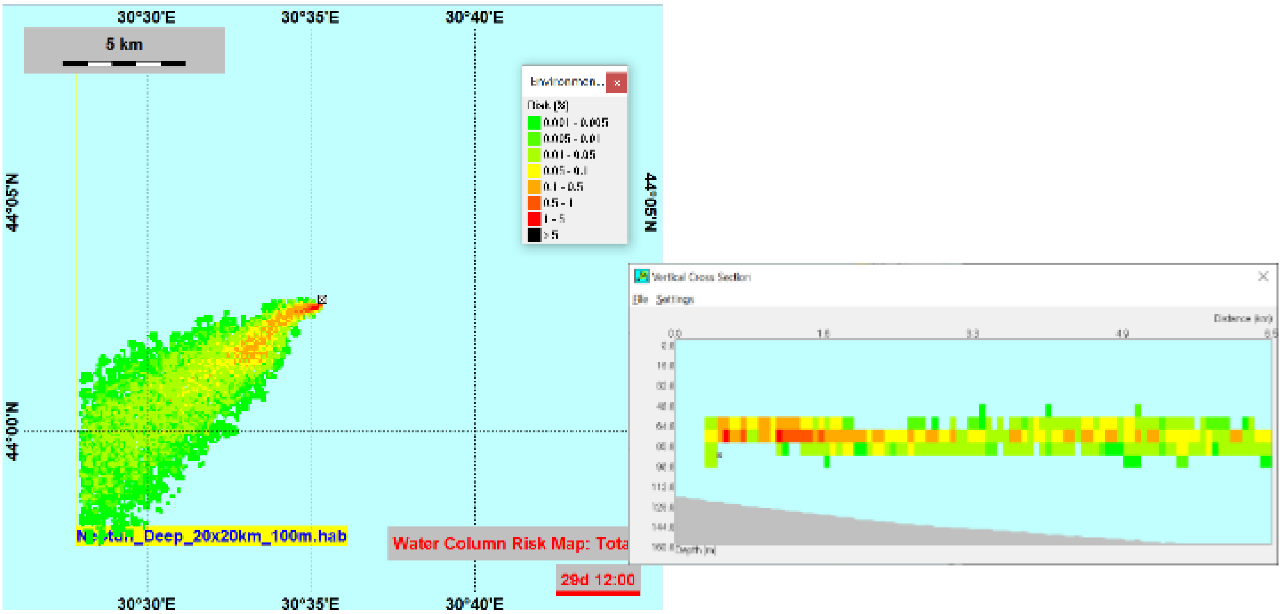


Figure 6.40 Concentrations in the water column and the resulting environmental risk at the end of the simulation (EIF=0)(source: SINTEF)

The modeling result indicates that, in scenario 10B (warm season, reduced effluent salinity) the effluent plume moves with the currents in the opposite direction to the marine protected area, which is a negligible concern for the project.

In the case of scenario 10A (warm season, high salinity of the effluent) the effluent plume exceeds the conventional surface limits of the protected natural area Canionul Viteaz, but the effluent concentrations are very low ranging between 0.1 and 0.042 ppb, which contributes to a risk negligible between 0.001 - 0.005%.

In the case of scenarios 10C and 10D (for cold season simulations, low and high effluent salinity) both have EIF=0 results, for both scenarios the effluent transport is similar.

DREAM modeling discharge of produced water containing sodium hypochlorite and methanol (intermittent discharges)

Another set of scenarios include a concentration of 0.2 ppm sodium hypochlorite, and methanol in intermittent discharges (first start-up of the production wells and restarts during the operating period) [20].

The scenarios concern 2 sets for each season (cold and hot) low salinity and high salinity in the effluent (produced water) with sodium hypochlorite and methanol content. As these categories of discharges are intermittent, the EIF period does not apply to these cases.

[20] SINTEF – Neptun Deep, Well Restart DREAM modelling results & PNEC sensitivities (with SHC &MeOH), September, 2023

The salinity level of the produced water proved to have low influence on the modeling result, with an inconclusive effect. Instead, the presence of the concentration of sodium hypochlorite, even if it is in the concentration provided for discharge by NTPA001, has a dominant contribution in modeling the risk to the environment.

The input data in the modeling of intermittent discharges are presented in the table below. Both profiles represent the same production chemical dosages and 0.2 ppm SHC in the cooling water. This results in mixing of produced water, cooling water, and water from the EG stream with methanol and a "dilution" of the chemicals in those streams.

Table 6.39 Well start-up scenarios, intermittent methanol discharge (high rate)

CASE STUDY#	12	12B	12C	12D
SEASON	Warm season (September)		Cold season (April)	
TECHNOLOGICAL WATER SALINITY (PW)	high	Low	high	Low
CHEMICAL SUBSTANCE CONCENTRATIONS (ppm) recommended				
Corrosion inhibitor	50	50	50	50
Component 1	1,2	1,2	1,2	1,2
Component 2	11.24	11.24	11.24	11.24
Component 3	2.2	2.2	2.2	2.2
Component 4	9.76	9.76	9.76	9.76
Component 5	PLONOR[21]	PLONOR	PLONOR	PLONOR
Scale inhibitor	15	15	15	15
Component 1	PLONOR	PLONOR	PLONOR	PLONOR
Component 2	4.5	4.5	4.5	4.5
Component 3	PLONOR	PLONOR	PLONOR	PLONOR
Component 4	PLONOR	PLONOR	PLONOR	PLONOR
Antifoaming	10	10	10	10
Component 1	4	4	4	4
Component 2	0	0	0	0
Methanol	0	0	0	0
Sodium hypochlorite	0.2	0.2	0.2	0.2
TEG	332	332	332	332
				EFFLUENTS m^3 / hour
Domino PW m^3/hour (with the use of corrosion inhibitor)	43.06	43.06	43.06	43.06
Pelican PW m^3/hour (using all other substances)	64.45	64.45	64.45	64.45
TEG	0.57	0.57	0.57	0.57
Cooling water	317.3	317.3	317.3	317.3
153m^3 methanol over 65 hours	-	-	-	-
241m^3 methanol over 65 hours	-	-	-	

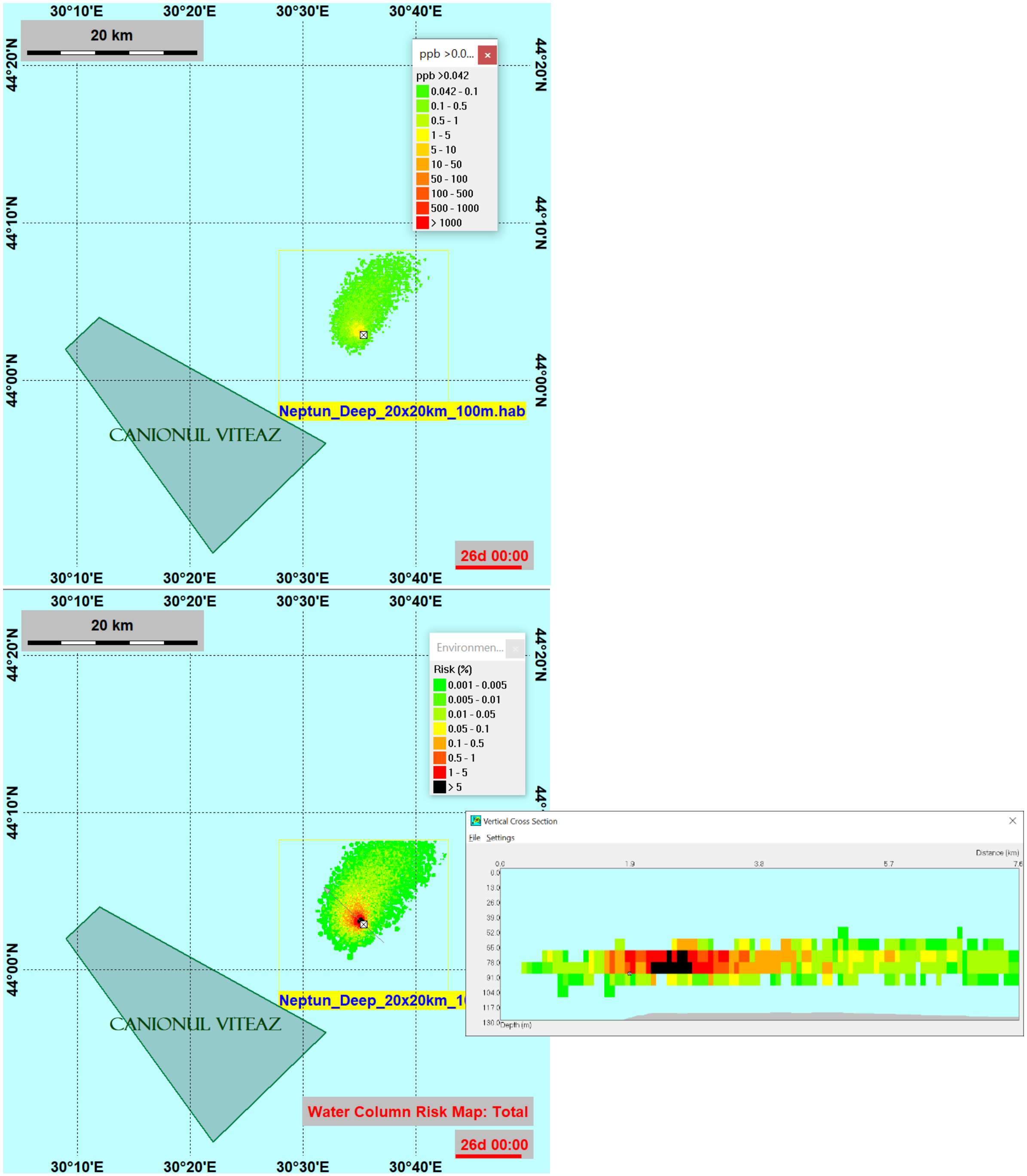
The input data in the DREAM modeling for the mix of concentrations for the discharge with methanol at a rate of 241 m^3, over 65 hours, are presented in the table below.

[21]PLONOR – indicates that the chemical is on the OSPAR PLONOR List and presents low or no risk to the environment.

Table 6.40 Mix of concentrations for periods of methanol discharge with a rate of 241m³ , more than 65 hours

MIX				
Total volume evacuated	382.32	382.32	382.32	382.32
Corrosion inhibitor (special case):	91.76	91.76	91.76	91.76
Total volume evacuated	360.93	360.93	360.93	360.93
PW diluted with cooling water and TEG water	5.93	5.93	5.93	5.93
TEG diluted with PW and cooling water	670.74	670.74	670.74	670.74
Special case: corrosion inhibitor:				
PW diluted with cooling water and TEG water	8.38	8.38	8.38	8.38
CHEMICAL SUBSTANCE CONCENTRATIONS (ppm) RESULTING IN THE DISCHARGED EFFLUENT				
Corrosion inhibitor	5.97	5.97	5.97	5.97
Component 1	3.0542	3.0542	3.0542	3.0542
Component 2	0.1432	0.1432	0.1432	0.1432
Component 3	1.3410	1.3410	1.3410	1.3410
Component 4	0.2625	0.2625	0.2625	0.2625
Component 5	PLONOR	PLONOR	PLONOR	PLONOR
Scale inhibitor	2.5286	2.5286	2.5286	2.5286
Component 1	PLONOR	PLONOR	PLONOR	PLONOR
Component 2	0.5057	0.5057	0.5057	0.5057
Component 3	PLONOR	PLONOR	PLONOR	PLONOR
Component 4	PLONOR	PLONOR	PLONOR	PLONOR
Antifoaming	1.6858	1.6858	1.6858	1.6858
Component 1	1.0115	1.0115	1.0115	1.0115
Component 2	0.6743	0.6743	0.6743	0.6743
Methanol	-	-	-	-
Sodium hypochlorite	0.1660	0.1660	0.1660	0.1660
TEG	0.4950	0.4950	0.4950	0.4950
CASE STUDY #	**12**	**12B**	**12C**	**12D**
Resulting salinity				
High salinity PW	28		28	8
Low salinity PW		6,787		6,787
Salinity in cooling water (sea water - 50m) ppm	18,705	18,773	18,841	18,909
Salinity in PW, cooling water &TEG, and high salinity PW	20,27	-	20.38	-
Salinity in PW, cooling water &TEG, high salinity PW	-	16.75	-	16.87
EFFLUENT TEMPERATURE				
Total volume temperature (PW+ TEG+ cooling water)	22.32	22.32	22.32	22.32

The maximum concentrations in the water column and the resulting environmental risk at the time when the EIF is maximum are shown in the figure below.



exported GIS file : 12a_20x20-high salinity_ PEC

Figure 6.41 Maximum concentrations in the water column and the environmental risk result at the time of a maximum EIF (scenario 12A – warm season, high produced water salinity)

The conclusions of the DREAM modeling report for the intermittent discharge of produced water containing methanol and sodium hypochlorite are presented below:

The modeling results indicate a low EIF in all scenarios, with a maximum EIF =21, for a maximum discharge rate. The scenarios confirm the favorable properties of the ChampionX product package selected for use in the operational stage, with a view to production.

Once sodium hypochlorite is added, the EIF increases significantly, and sodium hypochlorite is dominant in the environmental risk modeling result. The sodium hypochlorite concentration used in modelling reflects the concentration expected at the discharge point and is in compliance with the maximum allowable limits established by NTPA001.

HOCNEF toxicity references and PNECs derived from LC50, values with a safety factor of 1000 were considered when interpreting the results.

Intermittent methanol discharges at the rates studied do not influence environmental risk and EIF. Methanol is considered PLONOR and includes an environmental risk assessment when it is not discharged intermittently or in very large volumes.

In conclusion, the chemical components from the corrosion inhibitor induce an environmental risk for a small volume of water (0.0003 m^3) around the discharge source when the discharge occurs in the warm period. This conclusion is based on a conservative PNEC value with LC50 values and a safety factor of 1000. The highest dosages studied resulted in an EIF around 20.

This meant that no environmental risk >5% is encountered more than 100m from the discharge source for all cases studied, based on a simulation of a modeled area consisting of 100x100x10m=1EIF cells.

The full DREAM modeling report can be found in **Appendix M.**

Conclusions regarding the impact of the controlled discharge of produced water effluent on the marine environment

Produced water is a complex mixture of dissolved and particulate organic and inorganic chemicals. The physical and chemical properties of produced water vary greatly depending on the geological age, depth and geochemistry of the hydrocarbon-bearing formation, as well as the chemical composition of the oil and/or gas phases in the reservoir and the chemicals added to production.

Controlled discharge of produced water into the lower seawater or ocean horizon is a practice commonly used in the oil and gas industry worldwide.

Most countries benefiting from significant offshore natural gas fields (USA, Canada, Nordic countries, etc.), have regulated the discharge of produced water into the sea by establishing maximum permissible limits for hydrocarbon content, an aspect that has shown the most concerns in terms of contaminant content and effects of produced water on the marine environment. Moreover, the general consensus at the annual international conferences and seminars on produced water/water from the oil & gas industry (Produced Water Conference) is that any effect of produced water on individual offshore production sites is most likely minor [1].

The literature abounds on field studies and newer and older research on the effects of the discharge into the marine environment of effluent – water produced from oil and gas drilling and exploitation.

The effect of the discharge of produced water in the lower horizon, characterized by the hypoxic zone (dissolved oxygen <2.0 mg/l) of the water, was the subject of research carried out on an extensive area of 17,000 km^2 in Louisiana, over a period of 3 years, between 2005-2007 (Rabalais, 2005, Veil et al. 2005, Bierman et al, 2007). At the time of the study, approximately 287 oil and gas production platforms were operating in this area, many of which discharged treated produced water. A comprehensive monitoring program was conducted in this area to determine if the discharged production water (~81,000 m^3/day) contributed significant amounts of nutrients to Louisiana's coastal waters. Water produced by 50 gas platforms discharging 1280,000 m^3/day into the hypoxic zone was analyzed from the perspective of nutrient concentration. Water produced from most gas platforms recorded higher nutrient concentrations, increased dissolved oxygen values, and less ammonia. The ratio of estimated annual nutrient loading from all platforms in the hypoxic zone to annual nutrient loading from the Mississippi River ranged from 0.00003 for nitrate to 0.07 for ammonia. Researchers concluded that discharged produced water contributed very low to organic loading (Rababalis, 2005, Bierman et al., 2007).[22]

The effects of water discharges produced in the marine environment are felt on living organisms due to absorption through the skin or gills of water-soluble compounds and/or through oral ingestion or digestion of particulate matter. However, it is worth noting that dissolved or particulate matter of produced water substances are found both in the water column and in the sediment, being available throughout the ecosystem (Jonny Bayer, 2020).

Chronic toxic effects have been monitored both in the drilling and production stages through regular studies on benthic communities in the North Sea, knowing that this is a very productive area in natural gas, and the acute toxic effects of water produced in the column of water and sediment, in the immediate phase after discharge, being a very important aspect to evaluate from the perspective of environmental risk.

The study showed that the total flow of produced water in the Norwegian sector of the North Sea is expected to increase due to oil production. Water produced from three oil fields in this sector showed large differences in chemical composition and toxicity to four test organisms in the laboratory (*Skeletonema costatum, Mytilus edulis, White Abra, Crassostrea gigas*). The EC50 values for these organisms ranged from 0.2 to about 30% of the water produced in the test environment. Biodegradation of the produced water changed the chemical composition and generally reduced the toxicity. Dispersion model data combined with toxicity estimates indicated that acute toxicity should only be expected in close proximity to discharge points, while at a distance (namely> 2 km) toxic effects are considered negligible.[1]

The scientific community unanimously agrees that water produced before disposal in the marine environment must already meet the quality standards required by the legislation of the respective country. Several handling technologies can be applied to reduce and remove contaminants from

[22] Jerry M Neff – Produced water: Overview of composition, fates and effects, 2011

produced water, namely gravity separation, flotation, adsorption, membrane separation, and biological treatment. The combined use of several technologies is necessary to achieve optimal results. Therefore, produced water that has been processed can be recovered and safely disposed of in the environment.[2]

Given the fact that the Neptun Deep project envisages the exploitation of natural gas, it is not expected that liquid hydrocarbons will be present in the reservoir water, and as for the produced water discharged in a controlled manner from Neptun Alpha, it will pass through a system for the treatment and separation of gaseous hydrocarbons, before discharge through a caisson, into the sea, at a depth of 90m. Analyzers are placed on the technological circuit of the treatment plant regarding the concentration of different chemical compounds in the produced water, implicitly the hydrocarbon content, to verify the maintenance of the maximum permissible limit of 15ppm in the discharged effluent, as well as the maximum permissible limit for the monitored parameters.

Regarding the chemical products used in production, in order to determine the maximum concentration, so that the discharged effluent complies with the maximum admissible values, according to NTPA001, physico-chemical analyzes were carried out on synthetic samples by an accredited laboratory according to SR EN ISO 17025: 2018, and based on the results obtained, the laboratory determined by calculation the maximum permissible concentration recommended to be used for each chemical product, so as not to exceed the maximum permissible discharge limits, for those parameters provided for in NTPA001:2018 .[23]

For those substances that are not mentioned in NTPA001:2018, and which, therefore, have not regulated a maximum admissible limit, in order to evaluate the level of toxicity of the concentration of the substances when discharged into the outfall, ecotoxicity tests were carried out in the laboratory by INCDM "Grigore Antipa".

The purpose of the tests was to evaluate, under laboratory conditions, the ecotoxicity of the chemical products contained in the produced water on potentially affected marine organisms.
The ecotoxicity tests were performed on 3 native species from the Black Sea, respectively: *Skeletonema costatum* , *Acartia tonsa* , *Chelon auratus.* The test species and conditions were selected to best reflect the trophic levels of the Black Sea communities (primary producer – first order consumer – second order consumer) and the likely conditions of the effluent discharge area.
The test results for each sample, on the organisms selected from the 3 marine species, were considered acceptable, the criteria and conditions provided in the method standards being fulfilled. A sample with reference toxic substance (3,5-dichlorophenol) was tested in parallel, to confirm the fulfillment of the validity criteria of the tests.
Ecotoxicity tests for *Acartia tonsa and Chelon auratus* showed that the products or their mixture had no acute toxicity at the concentrations proposed for discharge. Toxicity tests for *Skeletonema costatum* showed a low effect for the antifoam AFMR20400A and the scale inhibitor SCAL13370A

[23] TECH Centre&Lab report, April 28, 2023, OMV

(15% and 18% growth inhibition, respectively) and a high effect for the corrosion inhibitor CORR12452A and their mixture (79% growth inhibition %, respectively 92%).

The long-term toxic effects (chronic toxic) have been assessed by INCDM "Grigore Antipa" taking into account the chronic toxicity information available in the database of the European Chemicals Agency (ECHA) [24].

The data available in ECHA database can help in the absence of chronic tests in the aquatic environment by providing existing information on the properties and effects of chemicals. ECHA collects and analyzes data on the physicochemical characteristics, toxicity, persistence, and bioaccumulation of chemicals, as well as information on their uses and exposure.

In order to establish the long-term effects of the produced water, according to the Water Management Notice issued for the Neptun Deep project, until the completion of the construction of the project, laboratory studies, carried out by a laboratory specialized in marine ecotoxicity, are to be completed.

In order to estimate the risk of exposure of aquatic organisms, the use of the DREAM model provided relevant information regarding the affected area as well as the natural dilution effect of the effluent in the water mass as it disperses from the source.

Thus, the area affected by the effluent (produced water) (PEC>PNEC), according to the DREAM simulations, extends over a radius of approx. 1.5 km around the fixed source (discharge caisson), maintaining a water column between the depth of 40m and 100m. Regarding the intermittent discharges of produced water containing methanol and sodium hypochlorite, the effect is located immediately near the source, up to a distance of 100m.

In the effluent discharge area, higher values of the water quality parameters are expected, but as far as the effluent is dispersed in the water mass, the dilution phenomenon will naturally occur.

It can be appreciated that the extension of the impact will be local, however, felt in the discharge area, maintained on a water column (with variations) between the depth of 40 m and over 100 m, having an attenuation rate as it moves away from the source, natural dilution taking place.

Discharge of effluent containing chemicals in concentrations calculated according to laboratory chemical tests is still expected to have a direct effect on water chemistry in the caisson discharge area but is not able to change the chemical status of the water body BLK_RO_RG_MT01_APE MARINE.

Given the fact that the production platform is designed to operate for a maximum of 20 years, the Duration of the effect is long-term, felt only during the operation period of the project, with an Medium probability of occurrence, but once the mining activity ceases, the return to the initial conditions being possible, which indicates the reversible nature of the impact.

[24] INCDM "GA", May 2023 -Ecotoxicity tests for the Neptun Deep Project environmental agreement

Since the impact on the water can be foreseen, but it is within the detection limit and does not lead to permanent changes in the structure and function of the receiver, it can be appreciated that the intensity of the effect is moderate.

Based on Medium receptor sensitivity and moderate magnitude, the significance of the impact of produced water discharge to the marine environment is moderate.

6.2.3.2.2 Presence of gas production pipeline and underwater components

The impact on water, as a result of metal ions from sacrificial anodes, is a local increase in the concentration of metals in water.

Cathodic protection is a technique used to prevent corrosion of underwater pipelines by using sacrificial anodes, which are usually made of an aluminum alloy. During this process, the anodes gradually erode in the water, releasing aluminum, zinc, and cadmium ions into the environment.

The release of metal ions (aluminum, zinc, cadmium) into the water throughout the life of the pipeline will undergo a slow process of sedimentation in the substratum of the seabed, which will retain these compounds.

The amount of aluminum, zinc and cadmium released from the anodes of the cathodic protection system of the pipeline is negligible compared to the sedimentation sources of the metals, namely naval traffic, shipyards, and ports, along with alluvial transport by sea currents.

As such, the release of these chemical compounds into seawater will not result in an overall increase in the concentration of these metals in seawater, so they do not pose an increased risk to sediment quality or benthic fauna.

6.2.3.3 Forecasting the impacts on the water environmental factor in the decommissioning stage

6.2.3.3.1 Temporary increase in turbidity

Decommissioning works of underwater structures will be carried out based on a decommissioning plan.

The impact on water, as a result of the structural change at the level of the sedimentary substrate, presents a potential increase in turbidity in the water column.

All underwater structures located on the surface of the seabed are designed so that they can be recovered upon decommissioning in the event that "abandonment in situ" will not be permitted. Jacket piles will not be retrieved but may be cut at or below the seabed.

During the decommissioning works, a physical disturbance of the sediments is anticipated as a result of the suspension and re-sedimentation process, which may lead to a local increase in turbidity.

The decommissioning period of the underwater components is estimated at 18 months.

6.2.3.3.2 Routine Discharges from Vessels Used in Decommissioning

The impact of routine discharges from vessels used in decommissioning is like the impact during the construction phase.

6.2.3.4 Summary of impacts on the water environmental factor during the construction, operation and decommissioning stage of the Neptun Deep project

The table below shows the impact assessment by magnitude and receiver sensitivity without the application of impact mitigation measures.

The impact significance matrix is presented in Section 6.1.4.3.

Table 6.41 Evaluation of the impact on the water environmental factor in all stages of the project

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
Construction stage						
Effects on hydrogeology	*Nature effect*	No effect	No effect	Medium	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	No effect				
Effects on hydrographic conditions	*Nature effect*	Negative	Negligible	Medium	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Regional				
	Term	Short term				
	The intensity	Medium				
Increasing turbidity in the water column	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Regional				
	Term	Short term				
	The intensity	Low				
Temporary increase of nutrients and possibly some pollutants present in sediments due to sediment suspension	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Regional				
	Term	Short term				
	The intensity	Low				
Impact of water quality through	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
controlled discharge of effluents during the construction phase	*Reversibility of the effect*	Reversible				
	Extension	Regional				
	Term	Short term				
	The intensity	Low				
Routine discharges from vessels used in decommissioning	*Nature effect*	Negative	Negligible	Medium	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Regional				
	Term	short term				
	Intensity	Low				
Operation stage						
Affecting water quality through the controlled discharge of effluents during the operating period	*Nature effect*	Negative	Medium	Medium	Moderate	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Regional				
	Term	Long term				
	The intensity	Medium				
The presence of the natural gas transport pipeline	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Regional				
	Term	Long term				
	Intensity	Low				
Decommissioning stage						
Temporary increase in turbidity	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Regional				
	Term	short term				
	The intensity	Low				
Routine discharges from vessels used in decommissioning	*Nature effect*	Negative	Negligible	Medium	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Regional				
	Term	short term				
	Intensity	Low				
GENERAL EVALUATION OF THE WATER FACTOR			**Moderate impact**			

6.2.3.5 Measures to prevent/avoid/reduce the impact on the water environmental factor

Although, during the construction and decommissioning period, the forecasted impact on water quality is of minor significance, the fact that during the operation period a moderate impact on water is assessed as a result of the discharge of effluents (produced water) in the deep area, from the location of the platform production, given the high sensitivity of the environmental factor, the following mitigation measures need to be implemented:

- In order to prevent the occurrence of any impact, the best applicable techniques will be implemented for the construction, installation and operation of the offshore components of the project;
- An Environmental Management Plan will be drawn up for the Neptun Deep Project, which will integrate management measures for the protection of water quality in all stages of the project, as well as preparation and response actions in case of unplanned discharges of products and chemicals, or pollution accidents with hydrocarbons;
- Compliance with the accidental pollution prevention and control plan;
- Ensuring that all vessels used in all stages of the project comply with the requirements of MARPOL 73/78 and hold the necessary certifications;
- Auditing of ships in the pre-mobilization stage in order to verify/inspect compliance with the requirements of IMO standards (waste, anti-fouling, emissions, wastewater treatment systems on board);
- Carrying out works in the offshore area according to the established schedule, without exceeding the areas allocated to the project;
- Elaboration, implementation and strict compliance with the naval traffic program for support vessels;
- Development of the Ballast Water Management Plan, according to IMO standards, to prevent the introduction of non-indigenous, invasive species into the Black Sea;
- The ships and the drilling platform will discharge ballast water before entering the Black Sea, in case they will be mobilized from another marine area;
- Elaboration of the Management Plan regarding the hydrotesting of underwater installations and pipelines;
- Ensuring the selection of the package of chemicals with the lowest risk of dangerousness/toxicity for the aquatic environment;
- Ensuring the selection of chemicals with the least hazardous properties and in accordance with NTPA001 and complying with the measures approved by the competent authority for environmental and water protection.
- The dosage and quantities of chemical substances must be in accordance with manufacturer recommendations, respecting the storage, use and disposal measures provided in the safety data sheets.
- Carrying out the eco-toxicity study by performing chronic toxicity tests as requested in the water management permit.

6.2.4 Marine sedimentary substrate

The effects with potential impact on the marine sedimentary substrate during the construction, operation and decommissioning stages of the project are presented in table 6.42.

Table 6.42 Effects with potential impact on sediments during the construction, operation and decommissioning stage

Effect with potential impact	Construction stage	Operation stage	Decommissioning stage
Physical disturbance at the level of the sedimentary layer	x	-	x
Changing the quality of the sediments as a result of the suspension and resedimentation process	x		x
Change in sediment quality as a result of the discharge of water-based drilling fluid at the level of the sedimentary substrate	x		
Physical presentation of underwater installations	-	x	-
Local emissions of metal ions from sacrificial anodes that provide cathodic protection of the pipeline	-	x	-
Increasing the concentration of sediment quality parameters by sedimentation of chemical compounds from the planned discharged effluent		x	

The evaluation criteria for assessing sensitivity and magnitude are as follows:

<u>Evaluation criterias</u>

Magnitude criteria

Magnitude	Description
Negligible	The impact does not generate quantifiable (visible or measurable) effects in the natural state of the environment
Low	Temporary or short-term impacts on the sedimentary substrate that cause changes beyond natural variability without altering the functionality or quality of the sedimentary substrate. The sedimentary substrate returns to its pre-impact state after the cessation of the activity causing the impact.
Medium	Temporary or short-term impact on the sedimentary substrate that may extend beyond the local scale and produce changes in sediment quality or functionality. However, the long-term integrity of the sedimentary substrate or any dependent receptor is not affected. If the extent of the impact is large, then the magnitude can also be large.
High	Impact on the sedimentary substrate that can cause irreversible changes and beyond the permitted limits, on a local or larger scale. The changes may alter the long-term character of the sedimentary substrate and other dependent receptors. An impact that persists after the cessation of the activity producing it has a high magnitude.

Sensitivity criteria

Sensitivity	Description
Low	The sedimentary substrate is important but resistant to change (in the context of the proposed activities) and will quickly naturally return to its pre-impact state once the impact generating activity stops.
Medium	The sedimentary substrate is important for the functioning of ecosystems. It may be less resistant to change but can be returned to its original state through specific actions, or it can recover naturally over time.
High	The sedimentary substrate is critical for ecosystems, it is not resistant to changes and cannot be returned to its original state.

The sensitivity of the marine sedimentary substrate

Based on the information presented in Chapter 4, regarding the current state, the physical component, the sedimentary substrate, was evaluated as having **medium sensitivity**, on the one hand, from the perspective of the size of the receptor to which we refer, as well as the fact that it has an important role for the functioning of ecosystems and ensures the habitat for species of benthic and demersal marine fauna with conservation value.

As such, it is important and can be less resistant TO change in the Background activity, but it can recover naturally over time, once time what the activity generation of the impact it stop.

6.2.4.1 Forecasting impacts during the construction stage

In the paragraphs below, the effects on sediments are described and quantified, the sensitivity and magnitude of the sedimentary substrate determined, and the impact assessed.

6.2.4.1.1 Physical disturbance at the level of the sedimentary layer

A series of works in the marine area are likely to lead to a physical disturbance at the level of the sedimentary layer, with consequences in changing the morphology of the seabed as well as the quality of the sediments.

Excavation work is planned in the coastal area, approximately 600 m from the shoreline for the microtunnel outlet and 3.375 km of trench for laying the production pipeline. It is estimated that a volume of 40,950 m^3 of sedimentary substrate will be excavated for the exit shaft of the microtunnel.

After the completion of the microtunnel and the installation of the gas production pipeline and fiber optic cable, the shaft and 1.6 km of the trench will be filled with crushed stone and the remaining 1.775 km of the trench will be filled with the excavated sedimentary substrate.

In this working area, on a calcareous substrate, the sedimentary layer consists of sand, clay, gravel and accumulations of organic material. Also, rocky formations with irregular morphology were identified in the area. The estimated period of execution of the works is approximately 3 months.

The installation of the gas production pipeline, the optical fiber cable, the underwater components, the anchoring of the vessels used in the project in the shallow areas as well as the installation of the jacket of the Neptun Alpha platform will lead to the disturbance of the sedimentary substrate but it is expected that it will be less than in the case of dredging works.

At the same time, the drilling of the first 2 sections of the wells will lead to the suspension of sediments in the water column and the discharge on the seabed of the water-based drilling fluid and the generated detritus will lead to the modification of the morphology of the seabed. It should be noted that the discharge of water-based drilling fluid and detritus on the seabed is a normal practice, in the case of marine drilling given the fact that the drilling of the 2 sections is drilled without a riser, so that the two components cannot be recovered.

The construction activities outlined above, but mainly the excavation of the trench and the laying of the pipeline protection layer, will result in physical disturbances on the seabed, which may change the morphology of the seabed sediments.

Changes in the morphology of the seabed are likely to lead to negligible changes in the bathymetry of the seabed (depth in the water column), which do not significantly negatively influence the way of life of marine organisms.

A conservative impact assessment is that physical disturbances on the seabed can cause long-term changes that return to the initial state over time through specific actions, therefore the sensitivity to physical disturbances is assessed to be medium.

Based on the Medium sensitivity and magnitude of the negligible impact, the overall impact on sediment quality from physical seabed disturbance is assessed to be insignificant.

6.2.4.1.2 Modification of sediment quality as a result of the suspension and re-sedimentation process (TSS)

The works specified in Section 6.2.3.1.1 are likely to temporarily suspend the sediments and lead to an increase in the concentration of total suspended matter, and thereby have an influence on the modification of the sediment quality indicators.

Sediment plume dispersion modeling was carried out.

Sediment plume dispersion modeling

In this modeling, the MIKE 3 MT Model is used to simulate the sediment plume resulting during the dredging and plugging operations of the transition trench. The MIKE 3 MT model is a three-dimensional sediment transport model that models the transport, deposition, and resuspension of fine sediments (and sediment mixtures) under wave and current action.

The wave characteristics in the studied area are calculated using the MIKE 21 SW FM model, which is a wave generation module. For this model, the bathymetry of the area, the wave conditions of the offshore area and the wind strength of the area are required as inputs.

The level and direction of the currents in the studied area were determined with the help of the hydrodynamic module of the MIKE 3 Flow Model FM model. It consists of several modules, including a hydrodynamic module.

In the modeling, 6 scenarios were chosen, 4 of which last for 4 days each and 2 longer scenarios with a Duration of 60 days each. Wave direction, wind direction and speed are from actual measurements at different time periods and seasons (table 6.43).

Table 6.43 List of scenarios used in modeling the sediment plume.

Scenario ID	Start of measurement	End of measurement	The direction of the waves	Wind direction	Medium wind speed (m/s)	Maximum wind speed (m/s)	Duration of trench dredging/plugging	Remarks
1S	30/05/2004 07:00	03/06/2004 07:00	NE + ENE	NW to NE	8	10	3 x 10hr with a 14 hour break	Current direction facing south in the trench area
2S	21/11/2006 20:00	25/11/2006 20:00	SE + SSE	SE to SV	8	10	3 x 10hr with a 14 hour break	Current direction oriented to the north in the trench area
3S	22/03/2004 19:00	26/03/2004 19:00	SE + SSE	SE to SV	8	9	3 x 10hr with a 14 hour break	Current direction oriented to the north in the trench area
4S	28/01/2010 16:00	28/01/2010 16:00	E + ESE	Mainly SSW to SE	6	8	3 x 10hr with a 14 hour break	Current direction oriented to the north in the trench area
1C	07/01/2008 00:00	30/08/2008 00:00	Variable	Variable	5	10	Dredging 28 x 10hr Ditch plugging 15 x 10hr with a 14 hour break for both activities	Current direction oriented north and south
2C	20/04/2005 00:00	19/06/2005 00:00	Variable	Variable	6	10	Dredging 28 x 10hr Ditch plugging 15 x 10hr with a 14 hour break for both activities	Current direction oriented north and south

[1] Medium wind speed is the medium wind speed during dredging
[2] max wind speed represents the maximum wind speed during dredging.
The dragline can operate on waves of a maximum of 1.2 m.

The 4 short event series (1S-4S) are used to examine the sensitivity of the sediment plume (caused by dredging and deposition at locations along the trench) to typical environmental conditions.

The 2 long series (1C-2C) are used to examine the displacement of the sediment plume due to the complete dredging and storage operations. This approach was adopted to understand the extension of the sediment plume under various environmental conditions.

The simulation was performed on 4 sections of the trench with the 6 scenarios presented above.

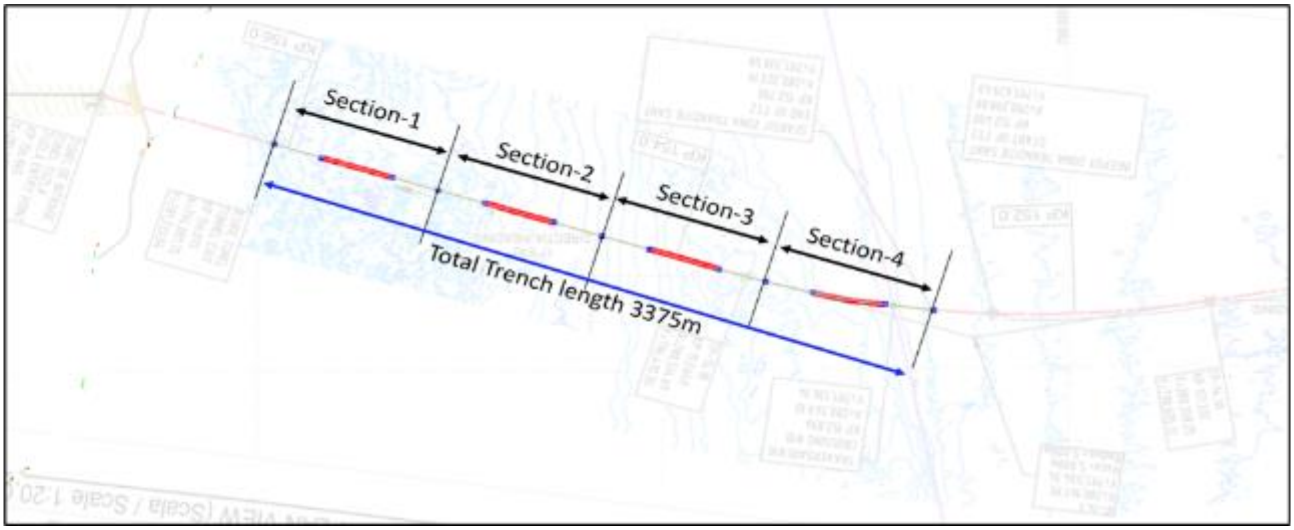


Figure 6.42 Trench sections used in modeling

As currents and/or wave conditions decrease in intensity, suspended sediment will gradually settle out of the water column onto the seafloor. Coarse material will settle quickly, while finer material will settle further from the trench corridor.

For a conservative assessment, the 2 scenarios regarding the complete dredging and storage works (1C, 2C) were taken into account, the results of which are presented below.

Modeling results of complete dredging work scenarios

The simulations for the full dredging works using 2 example environmental conditions (scenario 1C and 2C), as described in Table 6.36, aimed to model the dispersion of the sediment plume to examine the effect of the proposed dredging works on the surrounding marine environment.

The modeling indicates the following parameters:

- Total suspended solids concentrations (TSS), mg/l
- Change in sediment layer level after 28 days of dredging operations.

Total suspended matter (TSS) modeling results can determine the percentage of time TSS is predicted to exceed 1 mg/l during the 28-day dredging operation. The results are shown in Figure 6.43 to Figure 6.47.

In these figures the proposed ditch line is shown as a black line and the Natura 2000 sites are marked with rectangles with sloping green lines.

As current speed and/or wave conditions decrease in intensity, suspended sediment will gradually settle from the water column to the seafloor. Coarse material will settle quickly, while finer material will be dispersed further from the trench before finally settling.

The results of the change in the level of the sedimentary layer after 28 days of dredging operations are presented in Figure 6.47. It is noted that the calculated change in the level of the sedimentary layer is only due to the effect of the dredging operations.

Modeling results for dredging operations, scenarios 1C and 2C, indicate the following:

- The sediment plume generated during dredging operations depends on the direction of the currents. The sediment plume is generated immediately after the start of dredging and is transported in the direction of the dominant current. Thus, the sediment plume is carried to the south when the direction of the current is oriented to the south and vice versa when the direction of the current is oriented to the north.
- The sediment plume extends approximately up to 10 km north and south of the dredging area. The highest concentration of TSS, between 4 mg/l to 6 mg/l will be in the immediate vicinity of the dredging area in both simulated scenarios (scenarios 1C and 2C). However, TSS concentrations are slightly higher in the bottom layer compared to the surface layer.
- The area where TSS exceeds 1 mg/l (for more than 6 hours) during the 28-day dredging period is within 1 to 2 km north and south of the trench line. The frequency of exceedance in this area is 1 to 5 percent of the time (approximately 7 to 34 hours) in both simulated scenarios. The relatively small percentage of time that the TSSC concentration exceeds 1 mg/l is due to the Duration of dredging operations (10 hours/day) as well as the 18% fine sediment in the water column.
- Model results show that suspended sediments will settle within 2 to 3 km of the trench line. Most of the sediments will settle in the immediate vicinity of the dredging area (figure 6.43)

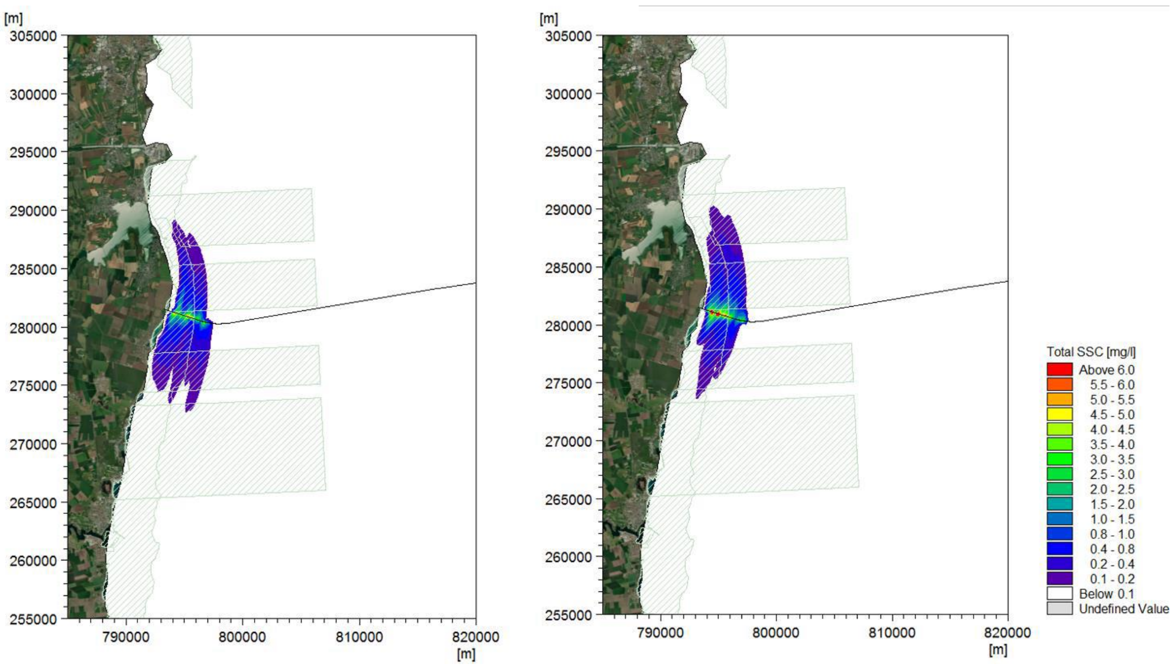
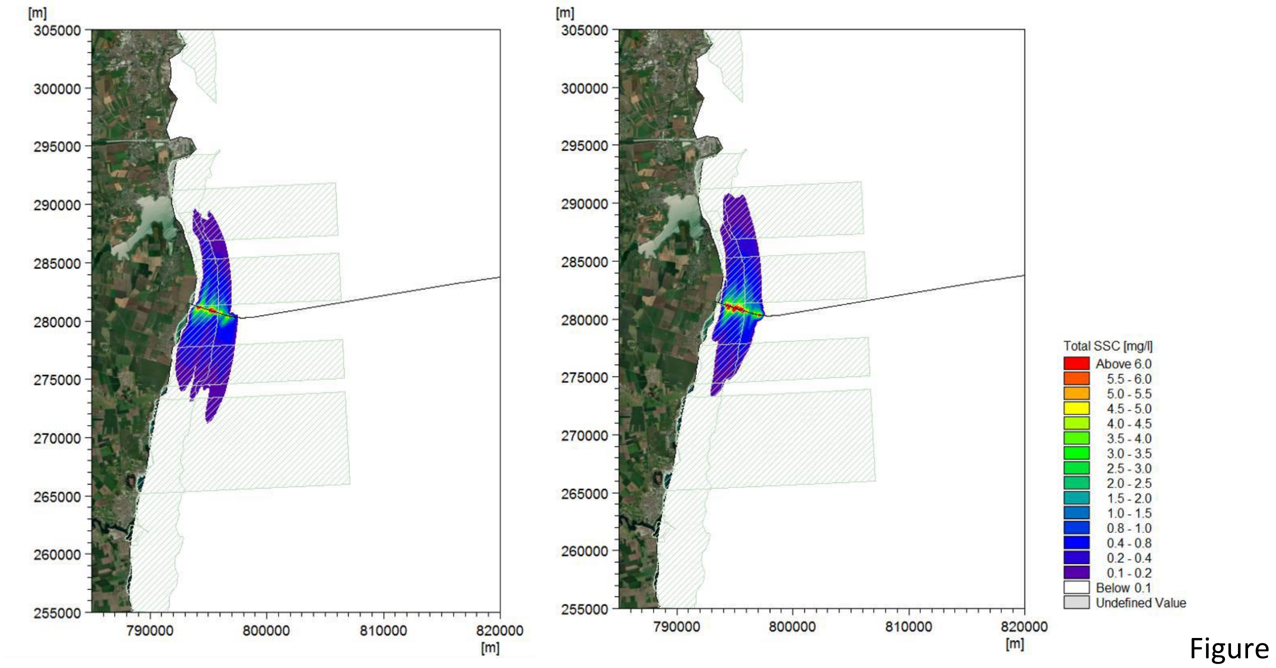


Figure 6.43 Estimated maximum concentration of total suspended matter in the surface layer during scenario 1C (left) and scenario 2C (right) during the 28-day excavation period



Figure

Figure 6.44 Estimated maximum concentration of total suspended matter, in the bottom layer , during scenario 1C (left) and scenario 2C (right), during the 28-day excavation work

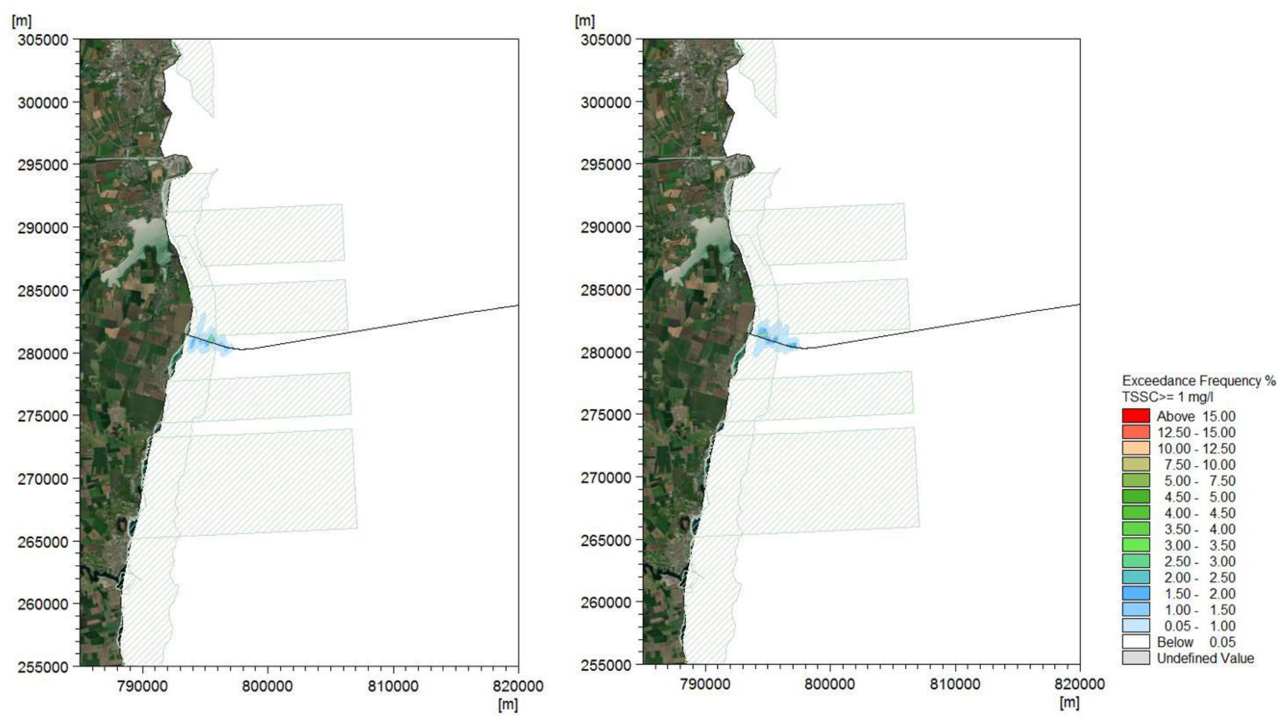


Figure 6.45 Percentage of time TSS exceeds 1 mg/l in the surface layer during scenario 1C (left) and scenario 2C, (right) during the 28-day excavation period

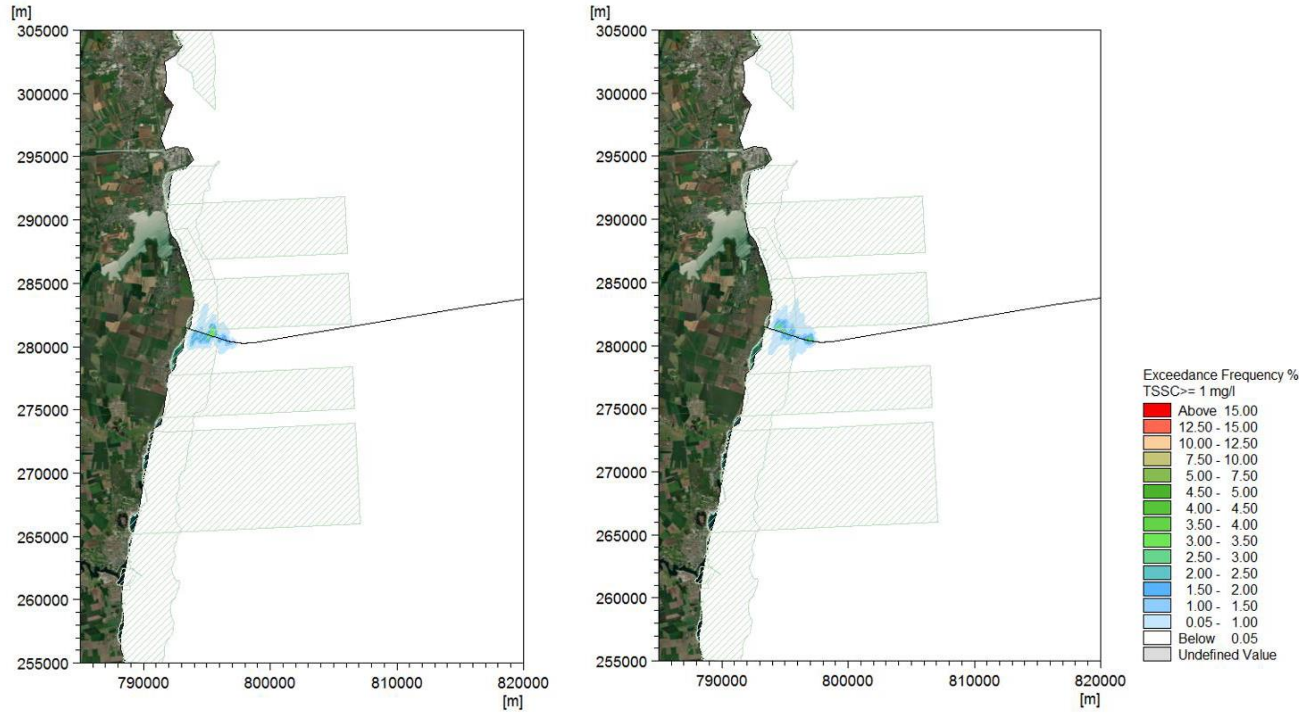


Figure 6.46 Percentage of time TSS exceeds 1 mg/l in bottom layer during scenario 1C (left) and scenario 2C, (right) during 28-day excavation

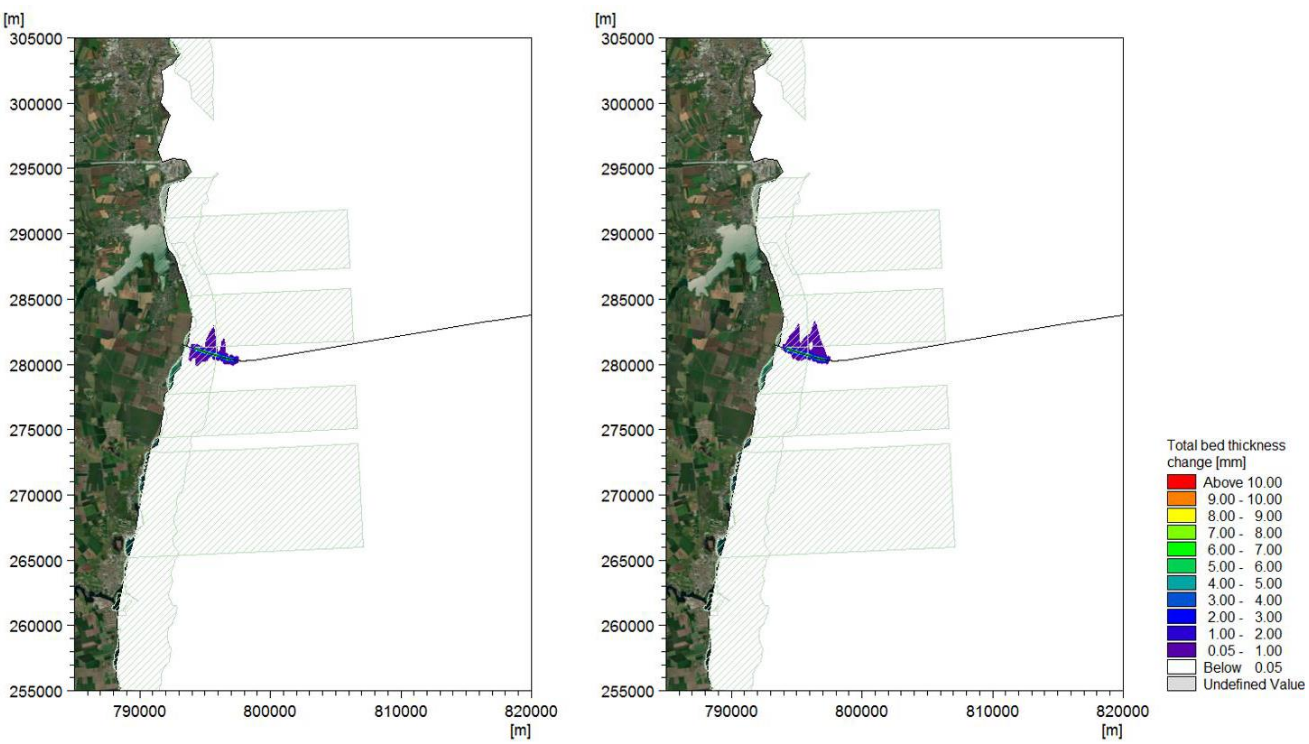


Figure 6.47 Change in sediment substrate thickness due to deposition of suspended sediments from the water column during scenario 1C(left) and scenario 2C(right)

Scenario modeling results for the works of plugging the transition trench with excavated material (1775 m)

In the scenario, it was considered that the material consists of fine sand 33%, sand 76%, and there were no other substances in suspension in the water column, the execution time of the work was 15 days (10 hours/day), the capacity is 300 m ^{3} /h (50 kg/s).

Model results for trench plugging operations indicate the following:

- The sediment plume (margin of 0.1 mg/l) during the 15 days extends between 1km to 2km from the trench line in both scenarios simulated for full trench plugging operations.
- The area where TSS exceeds 1 mg/l (for more than 1% or 3.5 hours) during the 15-day work period is within 0.5 km north and south of the trench line. This is true for both simulated scenarios (scenario 1C and 2C).
- Suspended sediments during trench plugging operations are deposited within 1 km of the trench line. Most of the deposition occurs in the ditch because the coarse sand fractions are deposited quickly due to a high sedimentation rate.

The effect of sedimentation along the trench line, under all modeling conditions, is limited to within 1km to 2 km of the trench line.

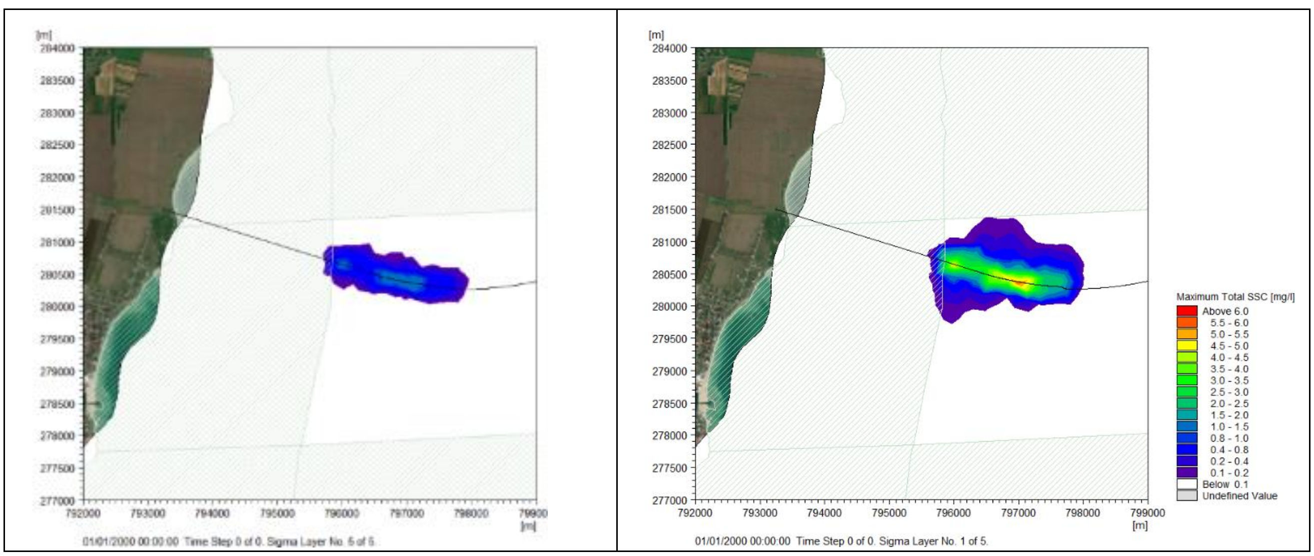


Figure 6.48 Estimated maximum concentration of total suspended matter, scenario 1C, in the surface layer (left) and bottom layer (right), during the 15-day works

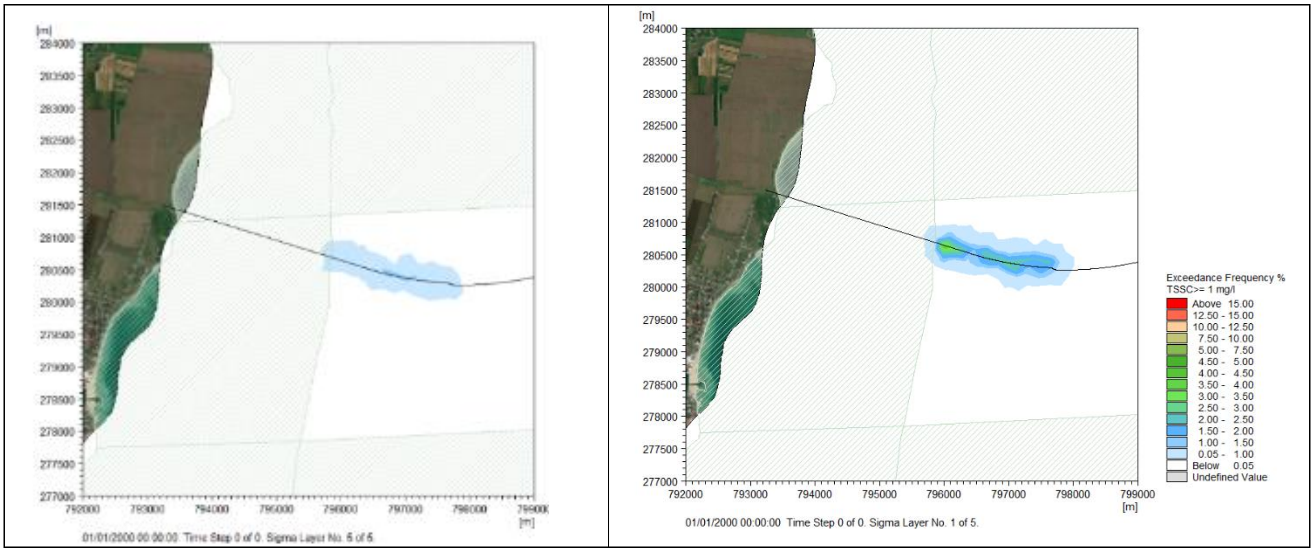


Figure 6.49 Percentage of time TSSC exceeds 1 mg/l, during scenario 1C, in the surface layer (left) and bottom layer (right) during the 15-day works

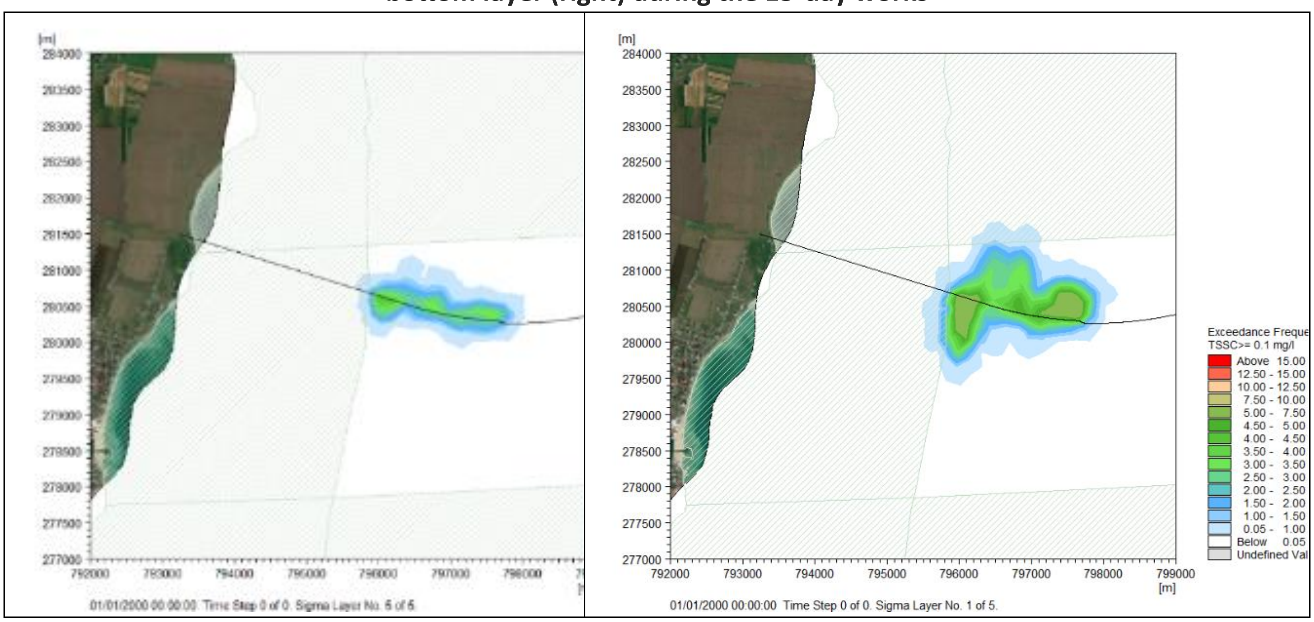


Figure 6.50 Percentage of time TSSC exceeds 0.1 mg/l, during scenario 1C, in the surface layer (left) and bottom layer (right) during the 15-day works

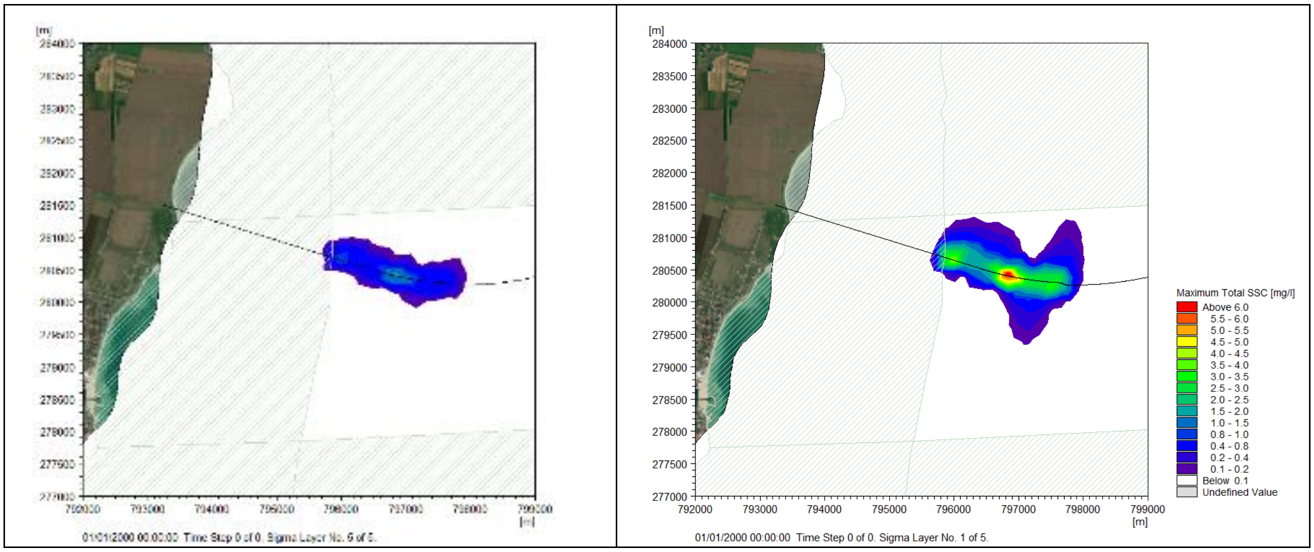


Figure 6.51 Estimated maximum concentration of total suspended matter, scenario 2C, in the surface layer (left) and bottom layer (right), during the 15-day works

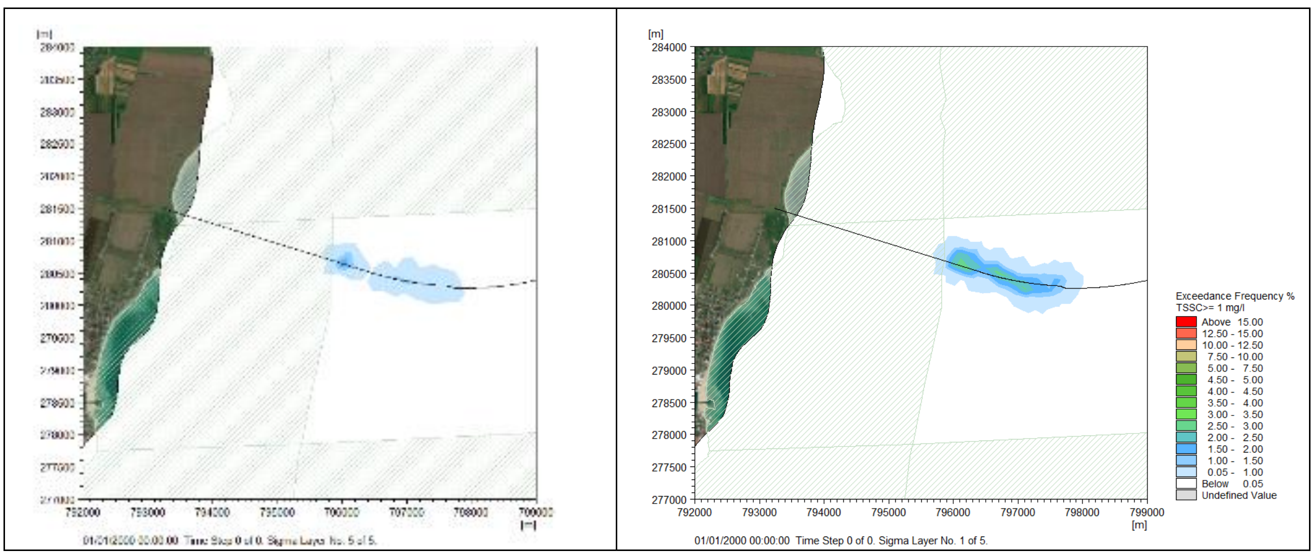


Figure 6.52 Percentage of time TSSC exceeds 1 mg/l, during scenario 2C, in the surface layer (left) and bottom layer (right) during the 15-day works

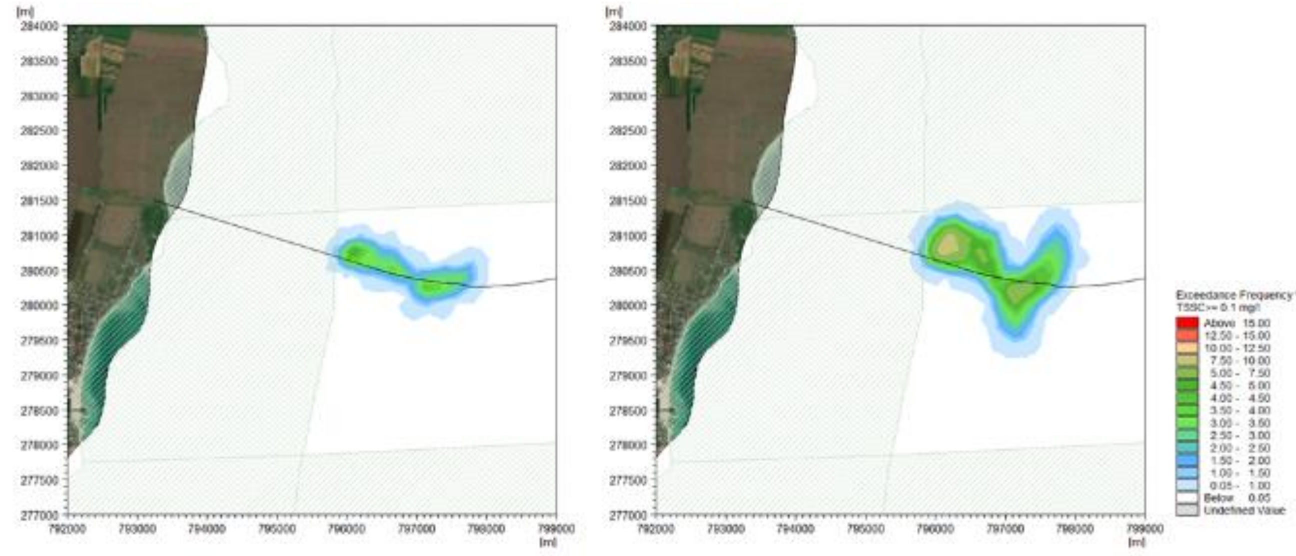


Figure 6.53 Percentage of time TSSC exceeds 0.1 mg/l, during scenario 2C, in the surface layer (left) and bottom layer (right) during the 15-day work period

Detailed modeling of sediment plume dispersion is presented in appendix M.

Conclusions on the impact of sediment disturbance and suspended solids (TSS) sedimentation

As it resulted from the modeling of the scenarios presented in Section 6.2.3.1.1.1, the works are of a nature to temporarily suspend and lead to a redistribution of the sedimentary material.

Considering different scenarios, the result indicates that suspended sediments will be deposited on the trench line in the immediate vicinity of the dredging area for approximately 2 to 3 km during dredging (excavation) and approximately 1 km on the trench line during construction of trench filling of about 1 mm.

As a result of the dredging works, sediment layers will be exposed inside the trench, and the redox potential and biogeochemical processes at the water/seabed interface will be temporarily affected. However, sediment of a fundamentally different quality than the current surface sediment is not expected to be exposed. In addition, physical factors such as grain size, density, total organic carbon (TOC) concentration, will not be altered by physical disturbance of the sediment, as similar properties are expected to be present in all affected layers.

As a result of these works, contaminants will be resuspended with sediment and redistributed to the seabed as it settles in areas surrounding seabed interventions. However, this will not lead to any overall change in sediment quality. It is important to note that the release of contaminants into the water column does not constitute a net increase of contaminants in the marine environment, but rather a redistribution of substances already present in the sediments. With time, the surface sediment layer is expected to return to pre-intervention conditions.

Placing rock to protect the pipeline will result in the placement of a new hard substrate on the seabed but will not change the quality of the existing sediment.

Additional sediment disturbance can be caused by the anchoring or use of dynamic positioning system vessels in shallow areas. These impacts, however, are highly localized and on a much smaller scale than those caused by the seabed interventions discussed above.

The modification of the sediment structure as a result of the suspension and resedimentation process can cause medium-term changes, which return to the initial state over time, naturally, therefore, the sensitivity is assessed to be Medium.

Based on the Medium sensitivity and the magnitude of the negligible impact, the overall impact on sediment quality is assessed to be insignificant.

6.2.4.1.3 Change in sediment quality as a result of the discharge of water-based drilling fluid at the level of the sedimentary substrate

The drilling of the wells, mainly the introduction of the drill column, involves a direct but local disturbance of the sediments as a result of their suspension and resedimentation process.

The drilling of the first 2 sections of the wells will lead, to the suspension of sediments in the water column, and to the discharge of detritus mixed with the water-based drilling fluid on the seabed. It is estimated that a volume of 8,784 cubic meters of water-based drilling fluid detritus will be discharged directly on the sea floor from each well, which will be deposited in the immediate vicinity of the well location.

It should be noted that the discharge of water-based drilling fluid and cuttings on the seabed is a normal practice, while drilling of the 2 top sections (when the riser cannot be installed), so the two components cannot be recovered.

Therefore, the digging of the first two sections of the wells, using the water-based drilling fluid and the evacuation of the resulting detritus on the seabed, will lead to a local disturbance of the physico-chemical characteristics of the sediments.

The impact on sediment quality resulting from detritus discharges is mainly due to the effects of chemicals contained in the water-based drilling fluid.

Sediment quality characteristics that may change include sediment structure, particle distribution, particle flux, and chemical composition. Impacts associated with routine drilling discharges will be limited to the area surrounding the discharge source at the well and MODU locations, which is at water depths between 120m -130m (Pelican South) and 700 - 1100m (Domino) and > 160km from shore.

The water-based drilling mud discharged at the exit of the borehole is composed of 90% seawater and 10% solid mass, whose chemical composition includes substances with no harmful effect on the environment (bentonite, barite), and crushed rock (detritus) resulting from drilling.

However, in the shallower area, i.e. in the South Pelican perimeter, where the water depth reaches at most 130m, by discharging WBM at the level of the well, changing the characteristics of the sedimentary substrate can lead to effects on benthic organisms.

A study undertaken by INCDM Grigore Antipa, in 2021 for the purpose of investigating marine habitats in the offshore location area of the Neptun Deep project, indicates that in the area of the Pelican South drilling Centre diversity is very low. In general, benthic communities sampled at stations with water depths greater than 120m were composed only of individuals from the order Oligochaeta and Nematoda (Chapter 4 – table 4.86).

Regarding the effects on the sediment characteristics and implicitly on the benthic fauna, a post-drilling study with discharge of WBM, carried out in the Northwest Shelf, [25]undertaken by the company Woodside, demonstrated that after 3 years, the effect on the environment was diminished. Concentration levels of barium, lead and chromium were slightly higher at stations located 200m from the wellhead, and analysis of dominant taxa groups demonstrated that different communities persisted at station 1, located only 10m from the wellhead. It was concluded that the differences are due to variation in sediment composition (increased silicon dioxide (SiO_2) and sand particle size) rather than any chemical effect (Hanley, 1993).

The conclusion is also confirmed by other studies, which showed that the impact of WBM on benthic communities is at most temporary, the tests showing relevant indications regarding a rapid recovery of the benthic fauna (up to 3 years).[26]

Thus, water-based drilling fluid has a minimal effect due to its non-toxic nature as well as its ability to disperse and biodegrade rapidly (Terrens et al, 1998).

Due to the dilution capacity of the sea, the influence of deep currents and the alluvial input brought by them, as well as the location of the well sites and the water depth in these locations, we appreciate that, against the background of this dynamic, the potential impact on the sediments will be felt directly and locally in close proximity to the probe, manifested in the short term, with a low intensity, reversible.

Based on the Medium sensitivity and low impact magnitude, the overall impact on sediment quality is assessed to be minor.

[25] Western Australian continental shelf region, which includes an extensive oil and gas region off the coast of northwestern Australia in the Pilbara region.

[26] SAYLE, S., SEYMOUR, M., and E. HICKEY. "Assessment of Environmental Impacts from Drilling Muds and Cuttings Disposal, Offshore Brunei." Paper presented at the SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Kuala Lumpur, Malaysia, March 2002. doi: https://doi.org/10.2118/73930-MS

6.2.4.2 Forecasting the impacts in the operation stage

6.2.4.2.1 The physical presence of the pipeline and underwater installations on the sedimentary substrate

The quality of local sediments can be affected by changes in the bottom water dynamics caused by the presence of pipelines (production, adduction and supply, underwater systems), the layer of rocks placed to protect the pipeline. These changes can affect the rate of resuspension in the immediate vicinity of the pipelines, as well as the rate of local sedimentation.

Considering that the seabed sediment is an important receptor, the sensitivity is assessed to be medium.

As discussed in Section 6.2.3.1 the spatial scale, intensity, and associated sedimentation are highly localized and insignificant compared to the vast area of sedimentary substrate surrounding underwater facilities.

In summary, the impact on sediment quality associated with the physical presence of pipelines and structures on the seabed during operation is considered to be local, long-term and of low intensity. Therefore, the magnitude of the impact is considered negligible.

Based on the Medium sensitivity and magnitude of negligible impact, the overall impact on sediment quality from the physical presence of pipelines and structures on the seabed is assessed to be insignificant.

6.2.4 .2.2 Local emissions of metal ions from sacrificial anodes providing cathodic protection of the pipeline

Cathodic protection is a technique used to prevent corrosion of underwater pipelines by using sacrificial anodes, which are usually made of an aluminum alloy. During this process, the anodes gradually erode in the water, releasing aluminum, zinc, and cadmium ions.

The release of metal ions (aluminum, zinc, cadmium) into the water throughout the life of the pipeline will undergo a slow process of sedimentation in the substratum of the seabed, which will retain these compounds.

The spatial extent of sedimentation around the production pipeline, where metals released into the seawater will accumulate and add to the natural aluminum, zinc and cadmium content, depends on the local pattern of currents and erosion/sedimentation.

The amount of aluminum, zinc and cadmium released from the anodes of the cathodic protection system of the pipeline is negligible compared to the sedimentation sources of the metals, namely naval traffic, shipyards and ports, along with alluvial transport by sea currents.

As such, the release of these chemical compounds into seawater will not result in an overall increase in the concentration of these metals in seawater, so they do not pose a risk to change sediment quality or benthic fauna, the magnitude being negligible.

Based on the Medium sensitivity and magnitude of the negligible impact, the overall impact on sediment quality from metal ion release is assessed to be insignificant.

6.2.4.2.3 Increasing the concentration of sediment quality parameters by sedimentation of chemical compounds from the planned discharged effluent

The potential impact on sediments results indirectly from the possibility of accumulation on the sedimentary substrate of the remains of the chemical substances contained in the effluents.

The substances contained in the chemical products in the composition of the effluents have different levels of biodegradability according to the information provided in the technical safety sheets.

It is well known that when water-soluble substances are present in water, they can be transported and transferred to sediments by various mechanisms, such as adsorption or precipitation.

These mechanisms are important in terms of the life cycle of substances and their interactions with the aquatic environment. Through these processes, water-soluble substances can be transformed and retained in marine sediments.

Biodegradation is the process in which microorganisms break down substances into simpler and less toxic compounds. This process can take place in surface water and in the sediment layer, and microorganisms play an essential role in the transformation of these substances.

Sedimentation refers to the process by which particles or suspended substances in water are deposited on the seabed, forming sediments. Chemicals can be carried by water currents and settled on the seabed in certain areas or favorable conditions. This sedimentation can involve biodegradable and non-biodegradable substances.

It is important to understand that these mechanisms may vary depending on the specific characteristics of water-soluble substances and the marine environment. Also, factors such as temperature, pH, water oxygen level and sediment composition can influence the biodegradation and sedimentation of substances.

Since the presence of the effluent in the water will be for a limited period (maximum 20 years), manifested locally, in the caisson unloading area from the Neptun Alpha Product Platform, at a depth of 90m, the manifestation of this potential indirect impact on the sediments will follow the same process, ceasing with the completion of natural gas exploitation operations from the Neptun Deep field.

The potential indirect impact on sediments may be reversible for those substances that are no longer found in the water column. If the concentration of substances in the water decreases, or if they are completely removed, the sediments can undergo recovery processes over time.

The reversibility of the impact is possible, but depends on several factors, including the degree of persistence and toxicity of the substances, the Duration of exposure and the specific characteristics of the sediments and the aquatic ecosystem.

The probability of the occurrence of the impact is low, in the context where from the DREAM simulations, the effluent remains constant above the depth of 95m, but it is possible that the effluent reaches depths greater than 100m.

The sensitivity of the receiver is Medium, on the one hand from the perspective of the size of the receiver we are referring to, as well as given its resistance to changes, in the context of the activity and the natural return once the activity generating the impact stops.

Consequently, the impact on the sedimentary layer can be indirectly negative, with a significance of minor impact, manifested locally and in general in the long term and reversible.

It is important to assess and monitor impacts on sediments in the broader context of aquatic environmental quality, taking into account the complex interactions between substances, sediments, aquatic organisms and biogeochemical processes.

6.2.4.3 Forecasting impacts in the decommissioning stage

6.2.4.3.1 Physical disturbance of the sedimentary substrate

Decommissioning works of underwater structures will be carried out on the basis of a decommissioning plan and as a result of obtaining the environmental agreement for decommissioning.

For decommissioning all installations and pipelines will be emptied, flushed, using a combination of equipment located on the platform and subsea equipment, pumping on the platform will be done by temporary pumping equipment installed as part of the safe activities.

All underwater structures located on the surface of the seabed are designed so that they can be recovered upon decommissioning if "abandonment in situ" will not be permitted. Jacket piles will not be recovered but can be cut at or below the seabed.

During the decommissioning works, a physical disturbance of the sediments is anticipated as a result of the suspension and resedimentation process, which may lead to a slight modification of the sedimentary profile and, implicitly, of the bathymetry in the area dedicated to the works.

Similarly, as in the construction stage, changes in the morphology of the seabed during decommissioning will lead to negligible changes in the bathymetry of the seabed (depth in the water column), which do not significantly negatively influence sensitive receptors (benthic organisms).

Physical disturbances to the seabed during the decommissioning stage may cause long-term changes that return to the original state over time naturally, therefore the sensitivity to physical disturbances is rated as medium.

Based on the Medium sensitivity and the magnitude of the negligible impact, the overall impact on sediment quality from physical seabed disturbance is assessed to be negligible.

6.2.4.3.2 Change in sediment quality as a result of the suspension and re-sedimentation process

Decommissioning of offshore facilities is expected to increase turbidity in the deep-water column.

These impacts, however, are very localized and on a much smaller scale than those caused by interventions on the seabed during the construction phase, discussed in Section 6.2.3.1.

After quieting, the surface sediment layer is expected to return to pre-intervention conditions.

Based on the Medium sensitivity and magnitude of the negligible impact, the overall impact on sediment quality from physical seabed disturbance is assessed to be insignificant.

6.2.4.4 Summary of impacts on sediments in all stages of the project

The table below shows the impact assessment by magnitude and receiver sensitivity without the application of impact mitigation measures.

The impact significance matrix is presented in Section 6.1.4.3.

Table 6.44 Evaluation of the impact on the environmental factor sedimentary substrate in all stages of the project

Effect	Magnitude components		Magnitude	Sensitivity	Meaning Impact	Potential cross-border impact
Construction stage						
Physical disturbance at the level of the sedimentary layer	*Nature effect*	Negative	Negligible	Medium	Insignificant	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	Intensity	Low				
Changing the quality of the sediments as a result of the suspension and resedimentation process	*Nature effect*	Negative	Negligible	Medium	Insignificant	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	Intensity	Low				
Change in sediment quality as a result of the discharge of water-based drilling fluid at	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				

Effect	Magnitude components		Magnitude	Sensitivity	Meaning Impact	Potential cross-border impact
the level of the sedimentary substrate	*Extension*	Local				
	Term	Short term				
	Intensity	Low				
Operation stage						
Physical presence of underwater facilities	*Nature effect*	Negative	Negligible	Medium	Insignificant	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Long term				
	The intensity	Low				
Local emissions of metal ions from sacrificial anodes that provide cathodic protection of the pipeline	*Nature effect*	Negative	Negligible	Medium	Insignificant	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Long term				
	The intensity	Low				
Increasing the concentration of sediment quality parameters by sedimentation of chemical compounds from the planned discharged effluent	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Indirect				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Long term				
	The intensity	Low				
Decommissioning stage						
Physical disturbance at the level of the sedimentary layer	*Nature effect*	Negative	Negligible	Medium	Insignificant	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
Changing the quality of the	*Nature effect*	Negative	Negligible	Medium	Insignificant	No
	Effect type	Direct				

Effect	Magnitude components		Magnitude	Sensitivity	Meaning Impact	Potential cross-border impact
sediments as a result of the suspension and resedimentation process	*Reversibility of the effect*	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
GENERAL ASSESSMENT OF The Sediment Substrate Factor			**Minor impact**			

The impact assessment for the environmental factor sediments led to a significance of the minor impact in the construction stage and the operation stage of the project, and a negligible impact in the decommissioning stage, so that the significance of the impact of the project on this environmental factor is minor/insignificant (table 6.44).

6.2.4 .5 Measures to prevent/avoid/reduce the impact on the sediment factor

Given that from the assessment of the impact on the sedimentary layer, the expected impact of the project during the construction and operation period is minor, no mitigation measures are necessary, but it is recommended to implement a set of measures aimed to keep the impact at an insignificant level.

- To prevent the occurrence of any impact, the best applicable techniques will be implemented for the construction, installation and operation of the underwater components of the project;
- An Environmental Management Plan will be drawn up for the Neptun Deep Project, which will integrate management measures for the protection of the sedimentary layer in all stages of the project, as well as preparation and response actions in case of unplanned discharges of products and chemical substances, or pollution accidents with hydrocarbons;
- Compliance with the accidental pollution prevention and control plan;
- Implementation and compliance with the Waste Management Plan, corresponding to the type and category of which it is a part.
- Installation of a suspended solid matter retention curtain to mitigate the dispersion of suspended sediments for the construction work in shallow water where such curtains can be effective (measure in line with the protection of marine habitats of conservation interest within ROSAC 0273 Zona marina de la Capul Tuzla)
- The well rig insurance has a drilling fluid recirculation control system to maximize fluid recycling.
- Ensuring that the drilling platform has an adequate containment, drainage and monitoring system to prevent any discharge of unauthorized effluents (containing more than 15ppm hydrocarbons, effluents with high contaminant content, untreated wastewater, etc.);
- Ensuring that the drilling platform meets all the safety conditions stipulated by the standards and best practices in the offshore oil and gas industry;
- Ensuring that the rig has adequate safety systems such as blowout preventers, alarms and automatic emergency shutdown systems that comply with regulatory requirements;

- Observance of the dose of chemical products in the test water, the water produced to avoid the change of the chemical parameters of the sediments as a result of the sedimentation of the remains of substances with low biodegradability.

6.2.5 Marine Strategy descriptors evaluation related to Neptun Deep project

The Marine Environment Strategy Framework Directive (2008/56/EC) (MSFD) was transposed into national legislation by the Government's Emergency Ordinance 71/2010 on establishing the strategy for the marine environment and adopted by Law 6/2011 for the approval of the Emergency Ordinance of Government no. 71/2010 regarding the establishment of the strategy for the marine environment and modified by Law 205/2013 for the amendment of GEO 71/2010 regarding the establishment of the strategy for the marine environment.

In the context of the obligations provided by the Marine Environment Strategy Framework Directive that must be fulfilled by Romania, as an EU member state, efforts are aimed at improving and maintaining the good condition of the Black Sea marine ecosystem.

The progress made towards the achievement of the objectives for achieving good environmental status (Good Environmental Status - GES) and the environmental objectives are evaluated through programs aimed at collecting data and information and are subsequently reported. The last national report on the ecological state of the Black Sea marine ecosystem in order to fulfill the reporting obligations provided for in art. 17 of the Marine Environment Strategy Framework Directive (2007/56/EC) was carried out in 2018.

In the table below, the potential impact of the project on the DCSMM descriptors is presented and consequently how the project would affect the achievement of the objectives or the long-term objective for GHG for each descriptor established in the MSFD.

Table 6.45 Evaluation of descriptors from the Marine Strategy in relation to the Neptun Deep project

DESCRIPTOR		Criteria[27]	The impact of the Neptun DEEP project
D1	**Biodiversity** *Marine Mammals*	D1C1 – Primary: The mortality rate per species from bycatch is below levels that threaten the species so that long-term viability is ensured.	The activity carried out will not affect the size of the population because the project does not involve activities that can cause bycatch The impact on the environmental objectives for descriptor 1, biodiversity, will not prevent or delay the achievement of good environmental status for this descriptor as defined by its objectives.
		D1C2 – Primary: The population abundance of the species is not adversely affected by anthropogenic pressures so that long-term viability is ensured	Potential effects caused by disruption of species activity may occur but without affecting population size.
		D1C3 - Secondary The population demographic characteristics of the species indicate a healthy population which is not adversely affected by anthropogenic pressures.	The activity carried out will not affect the demographic characteristics of the population
		D1C4 The distribution area of the species and, as the case may be, the structure is consistent with the prevailing physiographic, geographic and climatic conditions.	The activity carried out will not affect the distribution area of the species
		D1C5 Species habitat has the extent and condition necessary to support the various stages of the species' life cycle.	The activity carried out will not affect the habitat for the species

[27]DECISION (EU) 2017/848 establishing methodological criteria and standards regarding the good ecological status of marine waters and the specifications and standardized methods for monitoring and evaluation, as well as repealing Decision 2010/477/EU

DESCRIPTOR		Criteria[27]	The impact of the Neptun DEEP project
	Biodiversity *Fish*	D1C1 – Primary: The mortality rate per species from bycatch is below levels that threaten the species so that long-term viability is ensured.	No accidental catches will be made during the implementation of the project and its operation.
		D1C2 – Primary: The population abundance of the by-caught species is not adversely affected by anthropogenic pressures so that long-term viability is ensured	The activity carried out will not affect the abundances characteristic of cod and shark populations at the regional level.
		D1C3 - Primary The population demographic characteristics of the species indicate a healthy population that is not adversely affected by anthropogenic pressures.	The activity carried out will not affect the demographic characteristics of the population
		D1C4 The distribution area of the species and, where applicable, the structure is consistent with the prevailing physiographic, geographical and climatic conditions.	The activity carried out will not affect the distribution area of the species
		D1C5 Species habitat has the extent and condition necessary to support the various stages of the species' life cycle.	The activity carried out will not affect the habitat for the species
	Biodiversity *Pelagic habitats*	D1C6 – Primary: The condition of the habitat type, including its biotic and abiotic structure and functions, is not adversely affected by anthropogenic pressures.	The project will not affect pelagic habitats. During the operating period, the biomass values in the water body BLK_RO_RG_MT01_Marine waters, in general, will not be influenced by the effluent discharged at the depth of 90m. It is estimated that any changes in the biomass will only be detectable if the sampling point for zooplankton will be located at a distance of less than 3500 m from the production platform, on the main direction of

DESCRIPTOR		Criteria[27]	The impact of the Neptun DEEP project
			orientation of the effluent plume - SW (the result from the DREAM simulation).
D2	**Non-indigenous species**	D2C1 – Primary: The number of non-indigenous species newly introduced by human activities into nature, over assessment periods (6 years), measured from the reference year, as reported for the initial assessment under Article 8(1) of Directive 2008/56/ CE, is kept to a minimum and, if possible, reduced to zero.	The activity carried out will not introduce non-native species. Complying with MARPOL rules regarding ballas water discharge eliminates this risk.
D2	**Non-indigenous species**	D2C2 – Secondary: Abundance and spatial distribution of established non-indigenous species, especially invasive species, that contribute significantly to adverse effects on specific groups of species or general habitat types	There is no cause-and-effect relationship The activity will not affect the abundance or spatial distribution of non-native species.
		D2C3 – Secondary: The proportion to which each species group and the extent to which each large habitat type assessed is being adversely altered by non-native species, particularly invasive non-native species	There is no cause-and-effect relationship.
D3	**Populations of all commercially exploited fish and crustaceans**	D3C1 – Primary: The fishing mortality rate of commercially exploited species is at or below levels that can produce maximum sustainable yield (MSY)	Commercial fishing is mainly carried out up to the 50 m isobath. The project is not of a nature to endanger and/or induce an increase in the mortality rate of species exploited for commercial purposes
		D3C2– Primary: Reproductive stock biomass of commercially exploited species populations is above biomass levels that can generate maximum sustainable yield	Potential effects caused by disruption of species activity may occur but without affecting population size.
		D3C3 – Primary:	Potential effects caused by disruption of species activity may occur but without affecting population size

DESCRIPTOR		Criteria[27]	The impact of the Neptun DEEP project
		The age and size distribution of specimens from the populations of commercially exploited species indicates the good health of the population.	
D4	**Marine Food Web**	D4C1 – Primary: The diversity (species composition and their relative abundance) of trophic associations is not adversely affected as a result of anthropogenic pressures.	In the operating stage, the extent of the impact is local, limited to the zone of influence of the effluent discharge, 7000 m in the SW direction, and is not able to affect certain links permanently and irreversibly in the trophic network (phytoplankton, zooplankton and ichthyofauna).
		D4C2- Primary The balance of total abundance among trophic associations is not adversely affected by anthropogenic pressures	Activity is not able to affect certain links permanently and irreversibly in the trophic network (phytoplankton, zooplankton and ichthyofauna).
		D4C3 – Secondary: The size distribution of specimens within trophic associations is not adversely affected by anthropogenic pressures	Activity is not able to affect certain links permanently and irreversibly in the trophic network (phytoplankton, zooplankton and ichthyofauna).
		D4C4 – Secondary (to be used to support criterion D4C2 if necessary): Productivity of the trophic association is not adversely affected by anthropogenic pressures	Activity is not able to affect certain links permanently and irreversibly in the trophic network (phytoplankton, zooplankton and ichthyofauna).
D5	**Eutrophication** *Nutrients in the water column: Dissolved inorganic nitrogen (DAN), total nitrogen (AT), dissolved inorganic phosphorus (FAD), total phosphorus (FT)*	D5C1 – Primary: Nutrient concentrations are not at levels indicating adverse effects of eutrophication.	There is no cause-and-effect relationship.
D5	**Eutrophication** *Chlorophyll a in the water column*	D5C2 – Primary: Chlorophyll concentrations are not at levels indicating negative effects of nutrient enrichment.	There is no cause-and-effect relationship.
D5	**Eutrophication**	D5C3 – Secondary:	There is no cause-and-effect relationship.

DESCRIPTOR		Criteria[27]	The impact of the Neptun DEEP project
	Harmful algal blooms (eg, cyanobacteria) in the water column	The number, spatial extent, and Duration of harmful algal bloom events are not at levels indicative of adverse effects of nutrient enrichment	
D5	**Eutrophication** *The photic limit (transparency) of the water column*	D5C4 – Secondary: The photic limit (transparency) of the water column is not reduced, due to the increase in the number of suspended algae, to a level that indicates	There is no cause-and-effect relationship.
D5	**Eutrophication** *Dissolved oxygen at the bottom of the water column*	D5C5 – Primary (may be replaced by D5C8): Dissolved oxygen concentration is not reduced, due to nutrient enrichment, to levels indicating negative effects on benthic habitats (including biocenoses and related mobile species) or other eutrophication effects.	There is no cause-and-effect relationship.
D5	**Eutrophication** *Opportunistic macroalgae from benthic habitats*	D5C6 – Secondary: Abundance of opportunistic macroalgae is not at levels indicating negative effects of nutrient enrichment.	There is no cause-and-effect relationship.
D5	**Eutrophication** *Macrophyte communities (algae and perennial sea grasses such as fucaceae, zoster and sea grass) in benthic habitats*	D5C7 – Secondary: The species composition and relative abundance or depth distribution of macrophyte communities reach values indicating that there is no adverse effect as a result of nutrient enrichment, including by reducing water transparency,	There is no cause-and-effect relationship.
D5	**Eutrophication** *Macrofauna communities in benthic habitats*	D5C8 – Secondary (unless used instead of criterion D5C5): The species composition and relative abundance of macrofaunal communities reach values indicating that there is no adverse effect due to nutrient and organic enrichment	There is no cause-and-effect relationship.
6	**The integrity of the seabed**	D6C1 – Primary: Spatial extent and distribution of physical loss (permanent change) of the natural seabed,	During the operation period, the project will occupy an area of 0.813607 km^2 in the marine area

DESCRIPTOR		Criteria[27]	The impact of the Neptun DEEP project
	Physical loss of the seabed (including tidally bounded areas).	D6C2 – Primary: Spatial extent and distribution of pressures associated with physical disturbances exerted on the seabed	The project is not able to affect this criterion. The seabed occupied by the project is strictly related to the footprint of the infrastructure.
	Seabed integrity *Large benthic habitat types or other habitat types as used in descriptors 1 and 6.*	D6C3 – Primary: The extent in space of each type of habitat negatively affected by physical disturbances through the changes produced at the level of the biotic and abiotic structure and its functions	The project is not able to make morpho-structural and functional changes to the benthic habitats.
D7	**Hydrographic changes** *Hydrographic changes of the seabed and water column (including tidally bounded areas)*	D7C1 – Secondary: Spatial extent and distribution of permanent change in hydrographic conditions (eg, changes related to wave action, currents, salinity, temperature) of the seabed and water column, particularly associated with physical loss (1) of the seabed natural.	The project is not in a position to make changes to hydrographic conditions.
	Hydrographic changes *Hydrographic changes of the seabed and water column (including tidally bounded areas)*	D7C2 – Secondary: Spatial extent of each benthic habitat type adversely affected (physical and hydrographic features and associated biological communities) due to permanent alteration of hydrographic conditions	The project is not able to make morpho-structural and functional changes to the benthic habitats.
D8	**Contaminant concentration**	D8C1 – Primary: Inside coastal and territorial waters, contaminant concentrations do not exceed established limit values contaminate[28] 1. Heavy metals in water, sediments, biota 2. Synthetic pollutants in water, sediments, biota 3. Polynuclear aromatic hydrocarbons in water, sediments, biota	Potential effects caused by an unplanned event such as accidental pollution may occur. From the impact evaluation on marine water, the results shows that the project does not lead to a significant impact capable of changing the current ecological state. The effluents will be discharged in compliance with the approved maximum allowable limits.

[28] ANEMONE Deliverable 1.3, 2021. "Black Sea monitoring and assessment guideline", Todorova V. [Ed], Ed. CD PRESS, 190 pp., http://www.blacksea-commission.org/Downloads/ANEMONE/Deliverable%201.3.pdf

DESCRIPTOR		Criteria[27]	The impact of the Neptun DEEP project
D9	**Contaminant concentrations in fish** *Pb, Cd, Hg, PAH Polycyclic aromatic hydrocarbons (PAHs), sum of dioxins (WHOPCDD/F-TEQ) and sum of dioxins and dioxin-like PCBs (WHOPCDD/F-PCBTEQ), PCBs 28, 52, 101, 138,153, 180, Benzo-apyrene, Radionuclides*	D9C1 – Primary: Level of contaminants in edible tissues (muscle, liver, roe, meat or other soft parts, as appropriate) of seafood (including fish, crustaceans, mollusks, echinoderms, algae and other marine plants) caught or harvested in the environment natural (exclusive of fish with fins) do not exceed the limits: heavy metals, polychlorinated biphenyls, organochlorine pesticides, polycyclic aromatic hydrocarbons	From the impact evaluation on marine water, the results shows that the project does not lead to a significant impact capable of changing the current ecological state. The effluents will be discharged in compliance with the approved maximum allowable limits. Potential effects caused by an unplanned event such as accidental pollution may occur.
D10	**Waste** *Waste (except micro-waste), classified in the following categories (1): Man-made polymer materials, rubber, cloth/textiles, paper/cardboard, processed/worked wood, metal, glass/ceramics, chemicals, unspecified and food waste.*	D10C1 – Primary: The composition, quantity and spatial distribution of litter on coastlines, in the surface layer of the water column and on the seabed are at levels that do not affect the coastal and marine environment.	The waste generated in all stages of the project is transported to the shore for recovery/disposal by authorized economic operators. In usual practice, in well drilling activities, the cuttings generated when drilling the first 2 sections with water-based drilling fluid, will be discharged directly to the sea floor.
D10	**Waste** *Micro-waste (particles < 5 mm), classified as "artificial polymer materials" and "other*	D10C2 – Primary: The composition, quantity and spatial distribution of micro-debris on coastlines, in the surface layer of the water column and in the seabed, sediment are at levels that do not affect the coastal environment and high	It's not necessary

DESCRIPTOR		Criteria[27]	The impact of the Neptun DEEP project
D10	**Waste** *Waste and micro-waste in the categories "artificial polymer materials" and "other", assessed on any species in the following groups: birds, mammals, reptiles, fish or invertebrates*	D10C3 – Secondary: The amount of waste and micro-waste ingested by marine animals is at a level that does not adversely affect the health of the species concerned.	It's not necessary
D10	*Species of birds, mammals, reptiles, fish or invertebrates that are at risk from the waste*	D10C4 – Secondary: The number of specimens of each species that are adversely affected by the waste, for example by entrapment, other types of injury or mortality or health effects	It's not necessary
D11	**Energy and noise** *Impulsive anthropogenic noise in water.*	D11C1 – Primary: The spatial distribution, temporal dimension and sources of anthropogenic impulsive noise do not exceed levels that adversely affect marine animal populations	The descriptor is not affected. During the installation of the Neptun Alpha Platform Jacket, the noise generated is impulsive. Potential effects from underwater noise exposure to marine mammals and fish may occur, but they are of very short Duration and reversible.
	Energy and noise *Continuous low-frequency anthropogenic sound in water.*	D11C2 – Primary: Spatial distribution, temporal dimension and continuous low-frequency anthropogenic sound do not exceed levels that adversely affect marine animal populations	During the works carried out in the marine area, the noise generated is continuous. Potential effects from underwater noise exposure to marine mammals and fish may occur, but they are of low intensity and consequently it is estimated that it will not affect the marine animals.

Status descriptors

Descriptors associated with biodiversity (D1), marine food webs (D4) and seabed integrity (D6) are interdependent.

The objective of the three descriptors is to maintain biodiversity at the species, population and habitat levels and to ensure that ecosystem structures and functions are supported.

The discharge of the reservoir water into the sea during the operation stage is done at a depth of 90m, and the DREAM simulation shows that the effluent with the highest concentration of chemical substances does not affect the upper layer (euphotic zone) of the water column which constitutes the living environment for phytoplankton. The extent of the impact is local, limited to the zone of influence of the effluent discharge, 7000 m in the SW direction, and is not able to affect certain links permanently and irreversibly in the trophic network (phytoplankton, zooplankton and ichthyofauna).

Also, given the fact that the discharge area is located at great distances from coastal waters, the breeding and growth habitats of *Squalus acanthias juveniles will not be affected.*

The presence of adults in the platform area is sporadic and most likely they will not be exposed to concentrations of substances (including Cl_2) that could be lethal. In the case of *Merlangius merlangus* individuals (in different stages of development) belonging to this species can be present in the water column between 30 and 90 m where adverse effects can be recorded.

The activity carried out will not affect the population size as dolphins are sporadically observed (in passage) in the area of the platform.

The potential impacts on the environmental targets for descriptors 1,4 and 6 are assessed not to affect the achievement of good environmental status for these descriptors as defined by its objectives.

Descriptor 2 – Introduction of non-indigenous species

The introduction of non-indigenous species is considered a pressure descriptor associated with human activities.

The objective for descriptor D2 is to reduce the introduction of non-native species.

The Neptun Deep project has the potential to introduce non-native species through the traffic of vessels used in construction, operation, and decommissioning, as well as through colonization along the gas production pipeline and underground infrastructure. Introduction of non-native species has the potential to threaten native species through competition for food and space. The impact will be local and there will be no impact in a cross-border context.

By implementing the project, a new substrate (gas production pipeline) will be introduced that will create a new type of habitat. The impact will be local in the pipeline area.

Therefore, it can be concluded that the Neptun Deep project will not affect the achievement of the targets or the long-term objective of good ecological status for Descriptor D2.

Descriptor 3 – Populations of all fishes and crustaceans exploited for commercial purposes

The implementation of the project may lead to potential effects caused by the disruption of the activity of the species but without affecting the size of the population through the underwater noise generated as well as, in the event of an unplanned event of accidental hydrocarbon pollution.

The objective for commercially exploited fish is to maintain spawning biomass at a biologically safe limit.

Commercial fishing is mainly carried out up to the 50 m isobath, so there will be an impact on the activity during the construction phase in the excavation area of the trench and the tunnel outlet as well as during the installation of the gas production pipeline and fiber optic cable, due to the establishment of the safety zone around the work areas. This impact will be negative, direct, local, and short-term.

Impacts during construction and operation (individually or cumulatively) will not result in significant impacts on fishing levels, fertility and/or stocks, age, and size distribution.

Thus, it can be concluded that the Neptun Deep project will not affect the achievement of commercial fish and shellfish targets, nor will it affect the achievement of the long-term objective of good ecological status for the D3 descriptor.

Descriptor 5 – Eutrophication

Europeanization is a pressure descriptor and can have the effect of increasing harmful algal blooms as well as changing marine ecosystem parameters.

The objective for eutrophication is to maintain the concentration of nitrogen, phosphorus, total chlorophyll within the limits of defined chemical quality, respectively the 75th percentile of all concentrations measured in the range to be evaluated not to be higher than the threshold value.

Nutrient concentration may increase during the construction stage as a result of disturbance of the sedimentary substrate through excavation works, installation of pipelines and/or handling of anchors, drilling of wells, installation of underwater components. However, the transfer of nutrients from sediments into the water column is estimated to have a minor impact on turbidity and, based on this, it is assumed that there will also be a minor impact on the oxygen content of the waters (see section 6.2.6.1.7). The hydrotest fluid is discharged to a depth of 950 m which is anoxic zone and it is estimated that there will be impact on the water. No algal blooms, including those of toxic algae, are expected and negligible impacts on pelagic and benthic communities are expected.

During the operation stage, the discharge of produced water will be carried out at a depth of 90 m, from studies in the platform area, dissolved oxygen content is high in the surface mixed layer and decreases rapidly to about 90 m depth, with limited dissolved oxygen concentration beyond this point, confirming the suboxic state of the water column beyond about 100 m water depth. In addition, benthic communities have low abundance in the analyzed area.

There will be no impact on descriptor 5, eutrophication, and it is stated that the project will not affect the achievement of good environmental status for this descriptor as defined by its objectives.

Descriptor 7 – Hydrographic changes

Both during the construction stage and during the operation period of the Neptun Deep Project, the works and activities carried out are not likely to change the hydrographic conditions.

Therefore, it can be concluded that the Neptun Deep project will not affect the achievement of the targets or long-term objective of good ecological status for Descriptor D7.

Descriptor 8 – Contaminant concentrations

Contaminants in water are considered pressure descriptors.

The objective for the concentration of contaminants in the marine environment is to maintain the concentration of contaminants measured in the appropriate matrix (water, sediment, biota) in a way that ensures comparability with assessments made under Directive 2000/60/EC. Contaminants considered are heavy metals, organochlorine pesticides, polycyclic aromatic hydrocarbons and chlorinated biphenyls in sediments.

From the assessment of the impact on the water and the sedimentary substrate there is a potential pressure on the descriptor.
Pipeline testing fluid, which is a mixture of fresh water, seawater and a Hydrosure chemical will be discharged into the water during the construction phase. The discharge will take place in the Domino area at a depth of 950 m and the extent of the impact will be local, felt in the discharge area, maintained on a water column (with variations) between the depth of 950 m and over 800 m, having a rate of attenuation as it moves away from the source, natural dilution taking place.

In the operating phase, the produced water will be discharged into the sea at a depth of 90 m, but the composition of the produced water does not contain the contaminants specified above and thus there is no causal relationship between the analyzed activity and this descriptor.

During the operational phase, the release of metal ions (aluminum, zinc, cadmium) from the anodes of the cathodic protection system into the water throughout the life of the pipeline, will undergo a slow sedimentation process in the seabed substrate, which will retain these compounds.

The spatial extent of sedimentation around the production pipeline, where metals released into the seawater will accumulate and add to the natural aluminum, zinc and cadmium content, depends on the local pattern of currents and erosion/sedimentation.

The amount of aluminum, zinc and cadmium released from the anodes of the cathodic protection system of the pipeline is negligible compared to the sedimentation sources of the metals, namely naval traffic, shipyards, and ports, along with alluvial transport by sea currents.

As such, the release of these chemical compounds into seawater will not result in an overall increase in the concentration of these metals in seawater, so they do not pose an increased risk to sediment quality or benthic fauna.

Unplanned events such as accidental fuel spills can lead to increased contaminant concentrations. The probability of such an event occurring is low. The risk of accidental fuel spillage can be prevented by applying accident prevention measures. Also, by applying intervention plans in case of accidental pollution, the spread of the layer is limited.

Thus, it can be concluded that the Neptun Deep project will not affect the achievement of the contaminant concentration targets, nor will it affect the achievement of the long-term objective of good ecological status for the D8 descriptor.

Descriptor 9 - Contaminant concentrations in fish

The discharge of the water produced during the operation stage has an extension of the local impact, limited to the zone of influence of the effluent discharge, 7000 m in the SW direction and is not able to affect certain links permanently and irreversibly in the trophic network (phytoplankton, zooplankton and ichthyofauna).

Contaminants in fish and other seafood will only appear as a result of a major accidental fuel spill.

The potential risk of affecting contaminants in fish and other seafood for human consumption is assessed to be negligible given the low probability of an accidental fuel spill event.

Potential impacts on the environmental targets for descriptor 9, contaminants in fish and other seafood for human consumption, are assessed not to affect the achievement of good environmental status for this descriptor as defined by its targets.

Descriptor 10 - Waste

The established objective refers to the composition, quantity, and spatial distribution of waste on the shore, in the surface layer of the water column, and on the seabed not reaching levels that harm the coastal and marine environment.

Under normal conditions, waste generated at all stages of the project will be transported to the shore for disposal/recycling by authorized economic operators.

It is common practice when drilling wells, as with water-based fluid drilling, that the generated cuttings from the 2 top sections when the riser cannot be installed, will be discharged directly to the seabed as they cannot be recovered.

There will be no impact on descriptor 10, waste, and it is stated that the project will not affect the achievement of good environmental status for this descriptor as defined by its objectives.

Descriptor 11 - Energy and noise

The established objective is to prevent the increase of underwater noise.

The construction works associated with the Neptun Deep project will generate both impulsive and continuous noise, but they will not be executed at the same time and will be of short Duration. According to the modeling, the impulsive noise level will be able to have a negative impact on marine mammals and fish. Section 6.2.9 assessed the impact on marine mammals and fish and a moderate impact is estimated given that they will move away from the noise source from the first impulses which have a low intensity.

During the operational phase, underwater noise is generated by ship traffic.

Therefore, it can be concluded that the Neptun Deep project will not affect the achievement of the targets or long-term objective of good ecological status for Descriptor D11.

6.2.6 Air quality and climate

The effects on air quality of the construction, operation and decommissioning stages of the project are presented in table 6.46.

Table 6.46 Effects on air quality during construction, operation and decommissioning

Effect	Construction stage	Operation stage	Decommissioning stage
Air pollutant emissions in the terrestrial area	x	x	x
Air pollutant emissions in the marine area	x	x	x
Greenhouse gas	x	x	x

The evaluation criteria for assessing sensitivity and magnitude are as follows:

Evaluation criteria

Magnitude criteria

Magnitude	Description
Negligible	The impact does not generate quantifiable (visible or measurable) effects in the natural state of the environment
Low	Localizable and detectable temporary or short-term impact on air quality that causes changes above natural variability without altering air quality or functionality. Air quality returns to pre-impact conditions after the activity causing the impact ceases.
Medium	Temporary or short-term impact on air quality that may extend beyond the local scale and cause air quality change. However, the long-term integrity of air quality or any dependent receptor is not affected. If the extent of the impact is large, then the magnitude can also be large.
High	Impact on the air quality that can cause irreversible changes and beyond the permissible limits, on a local or larger scale. The changes may alter the long-term character of the airshed and other dependent receptors. An impact that persists after the cessation of the activity producing it has a high magnitude.
Positive	The activity carried out improves the air quality

Sensitivity criteria

Sensitivity	Description
Low	Air quality is important but resistant to change (in the context of the proposed activities) and will quickly naturally return to its pre-impact state once the impact generating activity stops.
Medium	Air quality is important for the functioning of ecosystems. It can be less resistant to changes but can be returned to its original state through specific actions, or it can recover naturally over time.
High	Air quality is critical for ecosystems, it is not resistant to change and cannot be returned to its original state.

Air sensitivity

On the basis of the information regarding the current state, presented in Chapter 4, the physical component AIR has been assessed as having a **low sensitivity**, partly from the perspective of the size of the receptor to which we refer, and also due to the fact that, in the context of the project activities, it will quickly recover naturally to the state before the impact once the impact-generating activity stops.

Climate sensitivity

Based on the information regarding the current state, this environment component has been assessed as having a moderate sensitivity, partly due to the size of the receptor under consideration and the fact that CO_2 emissions remain in the atmosphere and contribute to global warming.

6.2. 6.1 Assessment of the impact during the construction phase on air and climate

6.2.6.1.1 Dust and pollutant emissions generated by land-based works

Dust emissions during the construction phase in the land area are associated with soil excavation, embankment development, car traffic. Dust emissions often vary substantially during different phases of the construction process.

The associated sources of airborne dust emissions from during construction activities are as follows:

- Site development and execution of civil works;
- Dust emissions generated by site traffic;
- Handling of excavated soil, fill material, aggregates and construction materials;
- Construction waste handling (for example, detritus resulting from the execution of the microtunnel);

During the construction stage, pollutant emissions come from car traffic and machinery operation.

In chapter 2, Section 2.5.3.1, the calculation of pollutant flows emitted during the onshore construction stage is presented.
Sources of emissions from mobile sources:

- Combustion gas emissions from the operation of the crane with Diesel fuel which generate the following pollutants: CO_2, CO, NOx, N_2O, CH_4, SO_2 and VOC.
- Emissions of combustion gases from the operation of heavy machinery with Diesel fuel (cranes, excavators, trucks, front loaders, concrete mixers, compactors, nacelles, generators, air compressors).

The work carried out will generate GHG greenhouse gases (eg CO_2, CH_4 and N_2O) which will contribute to climate change.

The quantity of pollutants emitted during the construction phase in the land area is as follows:

Table 6.47 The quantity of pollutants emitted during the construction stage in the land area

Description	Pollutant	Amount of pollutant (tons/construction period)	Emissions	Observations
Equipment used in land construction	NO_X	164.50	Continue	During the construction period. The works are not carried out simultaneously.
	CO	43,48		
	PM	-		
	CH_4	-		
	COV	5,539		
	SO_2	11.08		
	N_2O	-		
	CO_2	8,862		

The CO_2 emissions reported by Romania in 2021 were 78.75 Mt and of GHG in 2022 117.09 [29]Mt.

Emissions associated with construction works in the land area are estimated to be 8,862 tons, which represents 0.11% of the total CO_2 emissions reported by Romania in 2021.

The estimated GHG emissions are 8,862 tCO_{2e}, representing 0.008% of the total GHG emissions reported by Romania in 2022.

Construction works in the land area are estimated to last approximately 19 months.

The effects on air quality associated with construction works in the terrestrial area are minimal, over a short period of time, and reversible once the activity ceases. Given the location of the project, there will be no transboundary impact.

Based on the low sensitivity and low magnitude of impact, the overall impact on air quality from construction works in the land area is assessed to be minor.

[29]EDGAR - Emissions Database for Global Atmospheric ResearchSource: https://edgar.jrc.ec.europa.eu/report_2023

The effects of greenhouse gas emissions will be long-term, irreversible, and will have a transboundary extension.

Based on the characteristics and activities of the project, high sensitivity and low magnitude, an insignificant impact on climate change is expected during the construction phase.

6.2.6.1.2 Emissions of pollutants generated in the marine area

In the construction stage in the marine area, the sources of polluting emissions come from ships, from the drilling platform of the production wells, as well as emissions from the testing before commissioning of the equipment on the production platform.

Sources of air emissions from offshore construction/installation vessels include:

- Emissions from the operation of ships, tugs, machinery, barges, cranes from construction/installation at sea, powered by Diesel fuel, the emitted pollutants being the following: CO_2, CO, NOx, N_2O, CH_4, SO_2 and VOC .
- Emissions from the operation of the MODU and vessels used at drilling Centers for pipeline testing (pipeline filling, hydrotest, emptying and pressure tests), the emitted pollutants being the following: CO_2, CO, NOx, N_2O, CH_4, SO_2 and VOC .
- Emissions from the operation of vessels for gas production pipeline filling and hydro tests.
- Emissions from essential diesel power generator on the production platform for commissioning and start-up.
- Emissions from gas turbine generators since commissioning.

Sources of emissions from the start-up and commissioning of the equipment on the production platform:

- Offshore LP/HP Flare Pilot – The Low Pressure (LP) Flare is only used during this phase when transitioning from Commissioning to Operations. The LP Flare will be lit when the first of the SPS's commences forward gas (expected to be Pelican). A combined LP & High Pressure (HP) Flare tip with 3 pilots is assumed. Pilots will be lit during the GPP N2/ back gassing process. This is assumed to be a 2-day process, noting that the pilots cannot be lit until natural gas is present in the vent gas as N2 will snuff the pilots, generating gas combustion products, including CO2, CO, NOX, CH4, Particulate Matter (PM) and VOCs.
- HP Flare - Initial Cold Start (Pelican well ramp-up) – Based on the Pelican system being brought online first and may take up to 5 days generating gas combustion products, including CO2, CO, NOX, CH4, PM and VOCs.
- Flaring - Start Up Gas - Domino Flowline Purging (Flaring). The Domino flowline is initially filled with N2 with Pelican production flared while N2 system purges (24h – slow well ramp up). This assumes a mixing zone of 50% of total Domino flowline volume with a worst case

100% CH4 in the mixing zone to be flared generating gas combustion products, including CO2, CO, NOX, CH4, PM and VOCs.

- Venting of start-up gas (pre-flare ignition) generating CO2, CH4, and VOCs. An assumption is made that there is no pig train barrier during the back gas operation with relative plug flow assumed, and some mixing will take place. Estimated mass of methane vented prior to ignition of HP Flare is 66 te (assuming 100% methane in the mixing zone). Venting is calculated as an average over the year; however, the peak flow is 96,500 kg/h over a 41-minute Duration.

Sources of air emissions from offshore shipping include:

- Helicopter emissions that generate CO_2, CO, NO_X, CH_4, SO_2 and VOCs. The distance to the offshore production platform and return is considered to be 320 km. It is assumed that during construction there will be 4 helicopter trips per day for 90 days, assuming it covers the winter period.
- Emissions from support vessels used for transport that generate CO_2, CO, NO_X, CH_4, SO_2 and VOCs.

In chapter 2, section 2.5.3.1, the calculation of pollutant flows emitted during the offshore construction stage for each source is presented.

The total amount of pollutants emitted into the air during the construction period at sea is as follows:

Table 6.48 The quantity of pollutants emitted during the offshore construction stage

Pollutant	Quantity (tons)	
	Continuous emissions	Intermittent emissions
NO_X	3.01	3,056
CO	0.77	361.92
PM	0.06	1,395
CH_4	0.08	134.17
VOC	0.02	73.98
SO_2	0.01	76.28
N_2O	-	-
CO_2	2,825	238,173

The CO $_2$ emissions reported by Romania in 2021 were 78.75 Mt and of GHG in 2022 117.09 [30]Mt.

Emissions associated with construction works in the land area are estimated to be 240,998 tons, which represents 0.31% of the total CO_2 emissions reported by Romania in 2021.

The estimated GHG emissions are 134.25 tCO_{2e}, (3,759 tCO_{2e}) and 240,998 tCO_{2e} representing 21% of the total GHG emissions reported by Romania in 2022.

[30]EDGAR - Emissions Database for Global Atmospheric Research Source: https://edgar.jrc.ec.europa.eu/report_2023

The sources of emissions in the drilling phase of the production wells are the following:

- Emissions from diesel powered crane operation generating CO_2, CO, NO_X, N_2O, CH_4, SO_2 and VOCs. The cranes are assumed to operate for 12 hours per day for a total of 800 days during the drilling period and consume 2.5 liters of fuel per hour of operation.
- Gas emissions from the operation of the rig's eight diesel fueled power generators generating CO_2, CO, NO_X, N_2O, CH_4 and VOCs. They are estimated to operate 24 hours/day for 800 days, with an estimated diesel consumption of 50 tons/day.
- Emissions from the operation of temporary diesel fueled equipment that generate CO_2, CO, NO_X, N_2O, CH_4, SO_2 and VOCs. The Riser less Mud Recovery (RMR) system is estimated to consume 500 liters/hour for 80 days. Wireline (WL) and General Pumps (GP) are estimated to consume 458.37 liters/hour for 5 days and 2 days respectively.

The sources of emissions from transport, during the well drilling stage, are the following:

- Helicopter emissions that generate CO_2, CO, NO_X, CH_4, SO_2 and VOCs. It is estimated that 1 trip/day will be made during construction for 800 days. The distance from NGMS and Pelican is 218 km and to Domino is 238 km. Fuel consumption is estimated at 5.5 km/l.
- Emissions from vessels used for transport (support vessels, anchor handling tugs, multipurpose vessels (MSVs)) generate CO_2, CO, NO_X, CH_4, SO_2 and VOCs. An estimated Duration of 800 days for support vessels and anchor handling tugs, multi-purpose vessels (MSV) 60 days. Fuel consumption is estimated at 35 tons/day.

In chapter 2, at point 2.5.3.1, the calculation of pollutant flows emitted during the drilling construction stage of the production wells for each source is presented.

The total amount of pollutants emitted into the air during the period of drilling production wells is as follows:

Table 6.49 The total amount of pollutants emitted into the air during the period of drilling production wells

Pollutant	Quantity (tons)	
	Continuous emissions	Intermittent emissions
NO_X	2.6930	9,477
CO	0.7153	595.82
PM	0.0842	0.0162
CH4	-	-
COV	-	231.14
SO_2	0.850	238.97
N_2O	-	-
CO_2	121,093	428,540

The CO_2 emissions reported by Romania in 2021 were 78.75 Mt and of GHG in 2022 117.09 [31]Mt.

[31]EDGAR - Emissions Database for Global Atmospheric ResearchSource: https://edgar.jrc.ec.europa.eu/report_2023

Emissions associated with wells drilling are estimated to be 549,634 tons, which represents 0.70% of the total CO_2 emissions reported by Romania in 2021.

The estimated GHG emissions are 549,634 tCO_{2e}, representing 0.47% of the total GHG emissions reported by Romania in 2022.

The effects on air quality associated with construction works in the marine area are minimal, short-term, and reversible once the activity ceases. Under normal operating conditions, the impact on air will not have a transboundary extension.

Based on the low sensitivity and low magnitude of the impact, the overall impact on air quality from construction works in the marine area is assessed to be minor.

The effects of greenhouse gas emissions will be long-term, irreversible, and will have a transboundary extension.

Based on the characteristics and works of the project and taking into account the medium sensitivity and medium magnitude, a moderate impact on the climate is expected during the construction phase in the marine area.

6.2.6.2 Impact assessment in the operating stage

6.2.6.2.1 Emissions of pollutants in the terrestrial area

In the operating stage, at NGMS and CCR, continuous emissions come from car traffic and the rest are intermittent. Intermittent directed emissions of pollutants are from natural gases that are released into the atmosphere during maintenance operations and in emergency situations. Emissions can be either planned once every 4 years (emissions vented to depressurize pipelines) or unplanned (namely, emissions from flanges, safety valves and corrosion; improper installation or maintenance of equipment). An emergency is a temporary, unexpected, infrequent situation in which the release of methane is unavoidable and necessary to prevent an immediate and substantial adverse impact on human safety, public health, or the environment.

In point 2.5.3.1, b. the calculation of the pollutant flows emitted during the onshore operation period is presented.

The sources of emissions during the operating period, from transport, are the following:

- Emissions of combustion gases from motor vehicles using petrol or diesel. These generate CO_2, CO, NO_X, N_2O, CH_4, SO_2, VOCs. It is estimated that the project vehicles will travel at 60 km/h, 365 days/year with 50% diesel and 50% gasoline vehicles.

Sources of emissions under normal operating conditions are the following:

- Emissions from the diesel backup power generator;

- Emissions from filter replacement are estimated 2 times/year for 20 minutes to change filters and empty the separator (0.6 t/event).
- Emissions from pigging calibration, an annual calibration is estimated in the first two years and once every 4 years thereafter, according to the risk integrity analysis (together with annual technical maintenance) (0.19 t/event), time of 20 minutes.
- Emissions during planned technical maintenance (8 tons/event), based on the physical volume of the entire onshore facility of 170 m^3 (between inlet and outlet valves), maintenance is estimated once every 4 years, in parallel with the maintenance of at the platform for 40 minutes.
- Fugitive emissions – emissions from safety valves (PSV) due to sealing losses of PSV valves, assuming emission class V. Estimated annual emissions are 0.11 tons, including a 100% margin.
- Fugitive emissions from flange emissions (0.25 tones/year), based on a current estimate of 200 flanges (which could increase), each flange having an acceptable emission rate of <1.4 m^3/year.

Table 6.50 Total annual quantity of pollutants emitted into the air, during the operating period from the onshore activity

Pollutant	Quantity (tons/year)	
	Continuous emissions	Intermittent emissions
NO_X	0.00717	0.00020
CO	0.01014	0.00005
PM	0.00014	0.00001
CH4	0.00000	9.66260
COV	0.00113	0.06442
SO_2	0.00001	0.00006
N_2O	0.00009	0.00000
CO_2	0.07013	9.22652

The CO_2 emissions reported by Romania in 2021 were 78.75 Mt and of GHG in 2022 117.09 [32]Mt.

Emissions associated with operating phase onshore are estimated to be 9.22 tons, which represents 0.00012% of the total CO_2 emissions reported by Romania in 2021.

The estimated GHG emissions are 9.22 tCO_2 (9.22 tCO_{2e}), 9.66 t CH4 (270.5528 tCO_{2e}), 0.00009 t NO2 (0.024 t CO_{2e}), representing a total of emissions 279.80 CO_{2e}, respectively 0,00024% of the total GHG emissions reported by Romania in 2022.

[32]EDGAR - Emissions Database for Global Atmospheric Research Source: https://edgar.jrc.ec.europa.eu/report_2023

The effects on air quality associated with operational works in the terrestrial area are minimal, short-term, and reversible once the activity ceases. Given the project's location, there will not be a transboundary impact.

Based on the low sensitivity and low impact magnitude, the overall impact on air quality from the construction works in the terrestrial area is assessed to be minor.

The effects of greenhouse gas emissions will be long-term, irreversible, and the emission quantity is low, with a transboundary extension.

Based on the characteristics and works of the project, and considering the high sensitivity and medium magnitude, a moderate impact on the climate is expected during the operational phase.

6.2.6.2.1.1 Modeling the dispersion of pollutants in the air generated during the operation stage in the land area

To determine potential effects on nearby residents as well as pollutant dispersion during venting operations at the NGMS, airborne pollutant dispersion modeling was performed[33] using the commercially available BREEZE AERMOD v11 Pro Plus software provided by Trinity Consultants. Pollutants released during evacuation include particulate matter, nitrogen, carbon dioxide, methane, ethane, propane, butane, pentane, hexane given the residential areas of the project area. Currently, there are no environmental exposure limits for these substances in Romania. There are only occupational health thresholds for methane, carbon dioxide, nitrous oxide and/or other greenhouse gas emissions. Modeling details can be found in Appendix M.

In the operating stage of the NGMS there are no continuous emissions and therefore the modeling has taken into account maintenance work and/or emergency situations when pollutants are released.

Pollutant emissions can influence the population thus sensitive receptors, identified are shown in the image below:

[33]Source: IO Consulting – Neptun Deep Project - Onshore Vent Air Dispersion Study

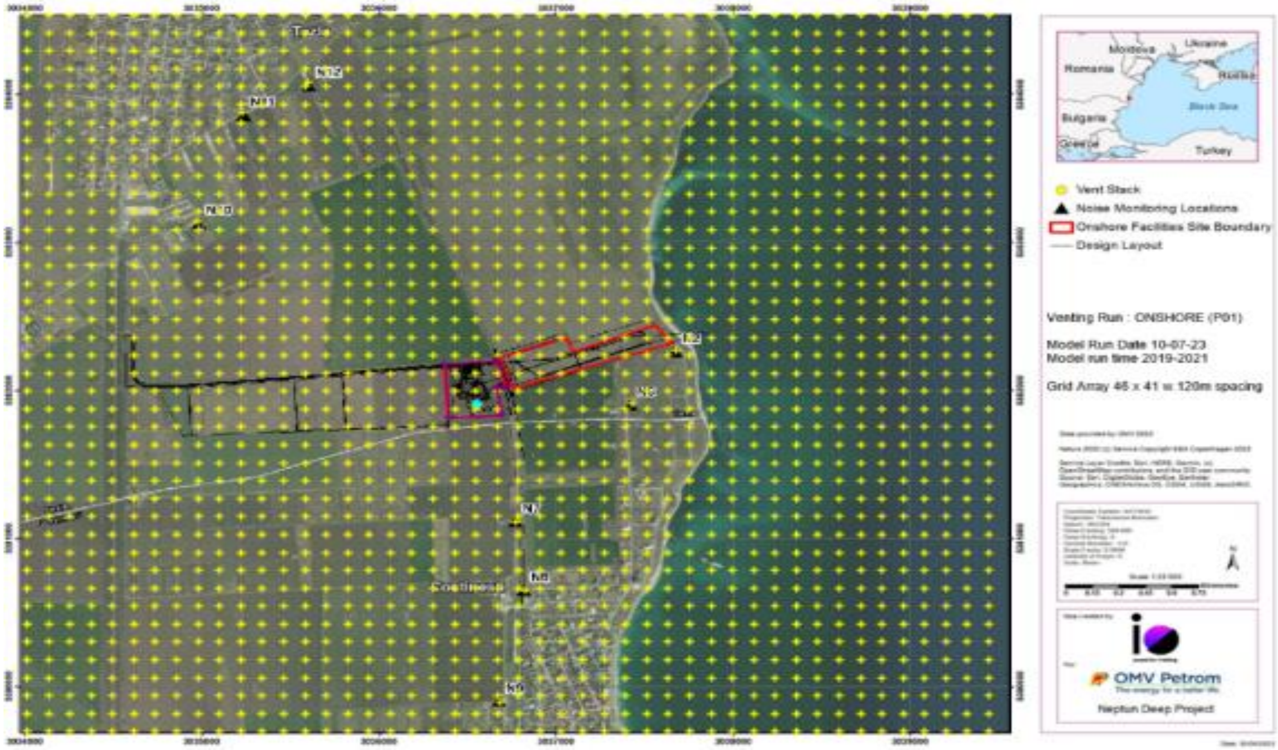


Figure 6.54 Sensitive receptors in the area of the project site

The pollutants emitted during the NGMS operation stage and the estimated amount to be emitted, used in modeling, can be found in the table below:

Table 6.51 Pollutants emitted during the NGMS operation stage and the estimated amount to be emitted

Polluting type	Amount (g/s)
N_2	8.68
CO_2	7.28
CH_4	3303.47
C_2H_6	4.35
C_3H_8	1.82
C_4H_{10}	1.20
C_5H_{12}	1.49
C_6H_{14}	3.56

Modeling results

Table 6.52 Concentration of pollutants emitted at each receptor

Pollutant	Receiver	Pollutant concentration after 1 hour of emission (µg/m ³)
N_2	The highest concentration measured in one hour	193.34
CO_2	The highest concentration measured in one hour	162.16
CH_4	The highest concentration measured in one hour	73,581.67
	N2	12,164.57
	N6	17,722.79
	N7	19,990.99
	N8	11,595.94
	N9	6,655.88
	N10	6,749.55
	N11	5,630.93
	N12	5,628.88
C_2H_6	The highest concentration measured in one hour	96.89
	N2	16,018
	N6	23,337
	N7	25,007
	N8	15,270
	N9	8,764
	N10	8,888
	N11	7,415
	N12	7,412
C_3H_8	The highest concentration measured in one hour	40,539
	N2	6,702
	N6	9,764
	N7	10,463
	N8	6,389
	N9	3,667
	N10	3,719
	N11	3,102
	N12	3,101
C_4H_{10}	The highest concentration measured in one hour	26,729
	N2	4,419
	N6	6,438
	N7	6,899
	N8	4,212
	N9	2,418
	N10	2,452
	N11	2,045

Pollutant	Receiver	Pollutant concentration after 1 hour of emission (µg/m ³)
	N12	2,045
C_5H_{12}	The highest concentration measured in one hour	33,189
	N2	5,487
	N6	7,994
	N7	8,566
	N8	5,230
	N9	3,002
	N10	3,044
	N11	2,540
	N12	2,539
C_6H_{14}	The highest concentration measured in one hour	79,296
	N2	13,109
	N6	19,099
	N7	20,466
	N8	12,497
	N9	7,173
	N10	7,274
	N11	6,068
	N12	6,066

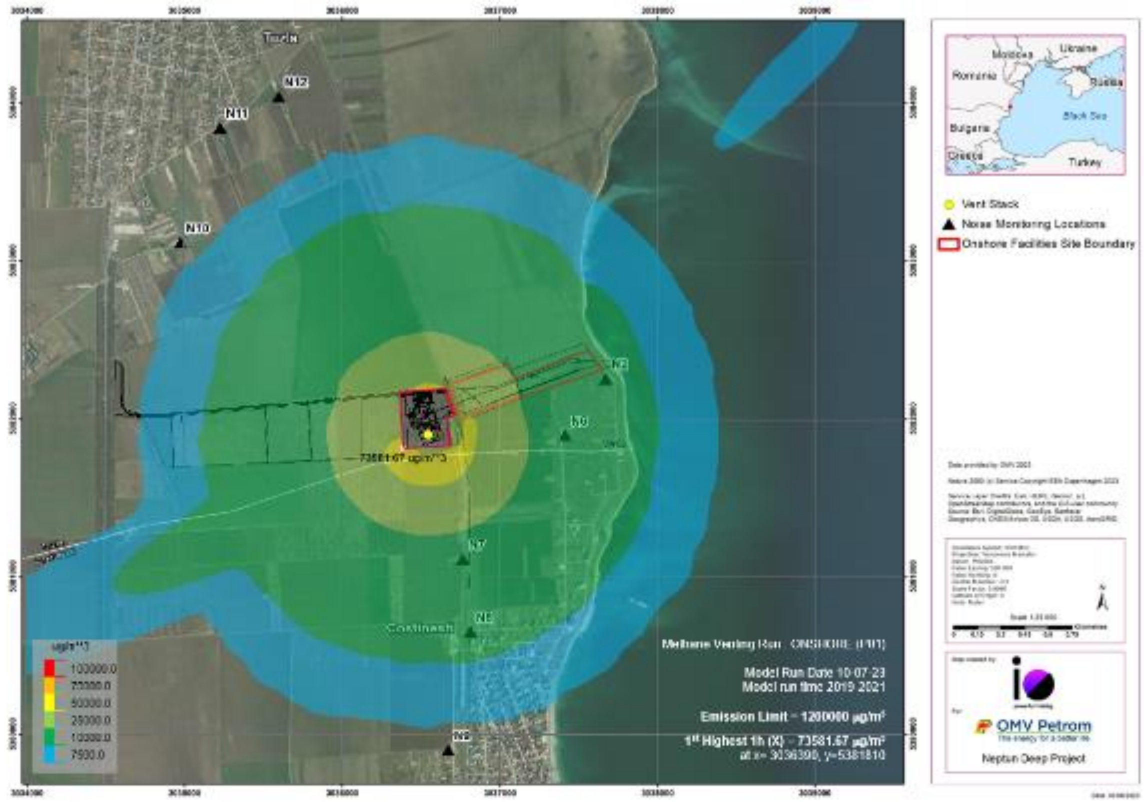


Figure 6.55 Methane dispersion graph over an Medium period of 1 hour

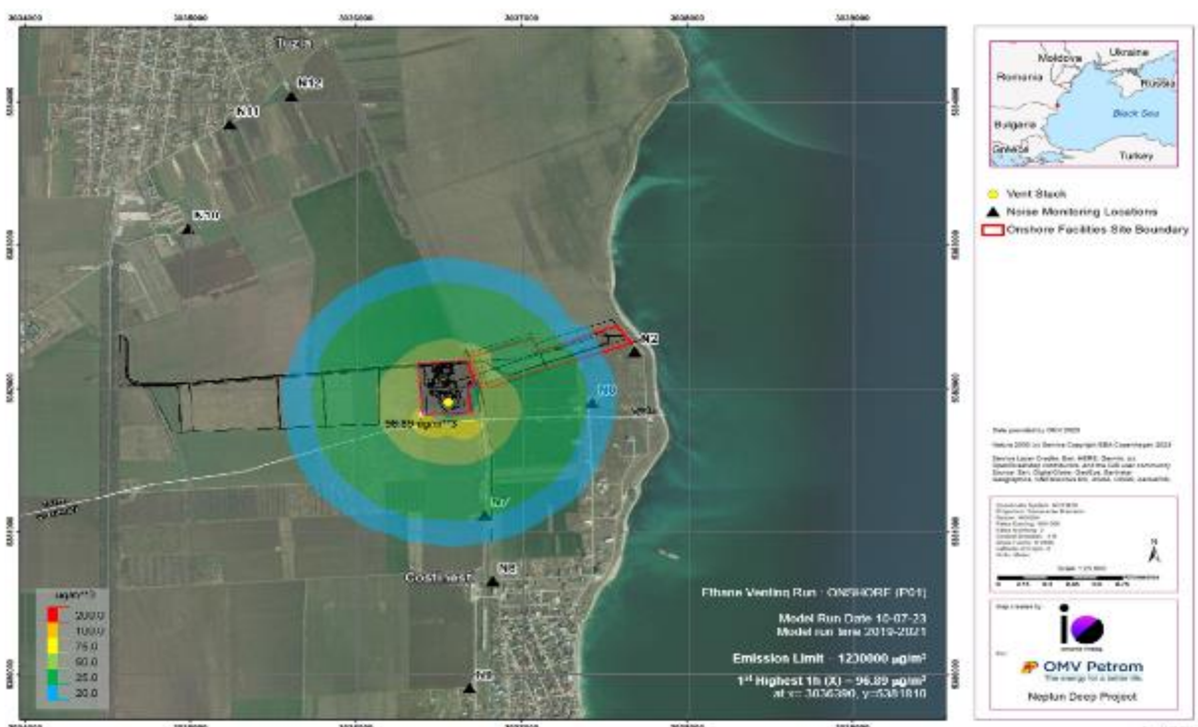


Figure 6.56 Ethane dispersion graph over an Medium period of 1 hour

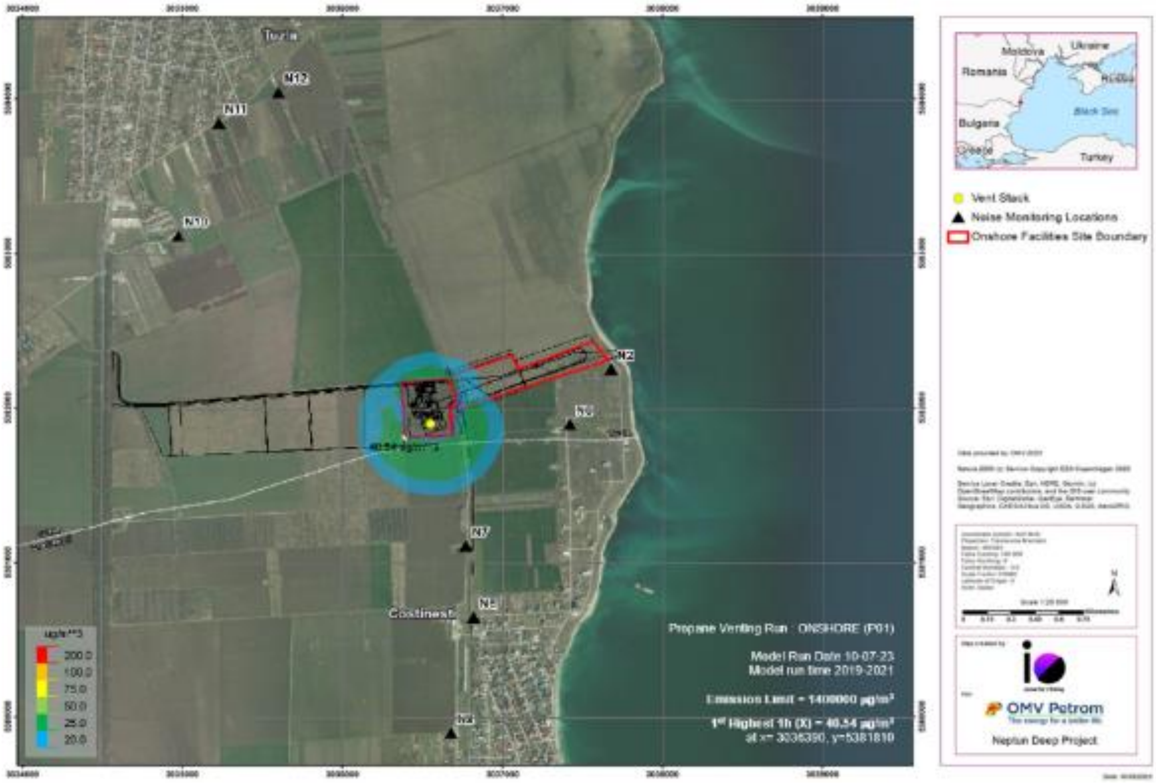


Figure 6.57 Graph of propane emission over an Medium period of 1 hour

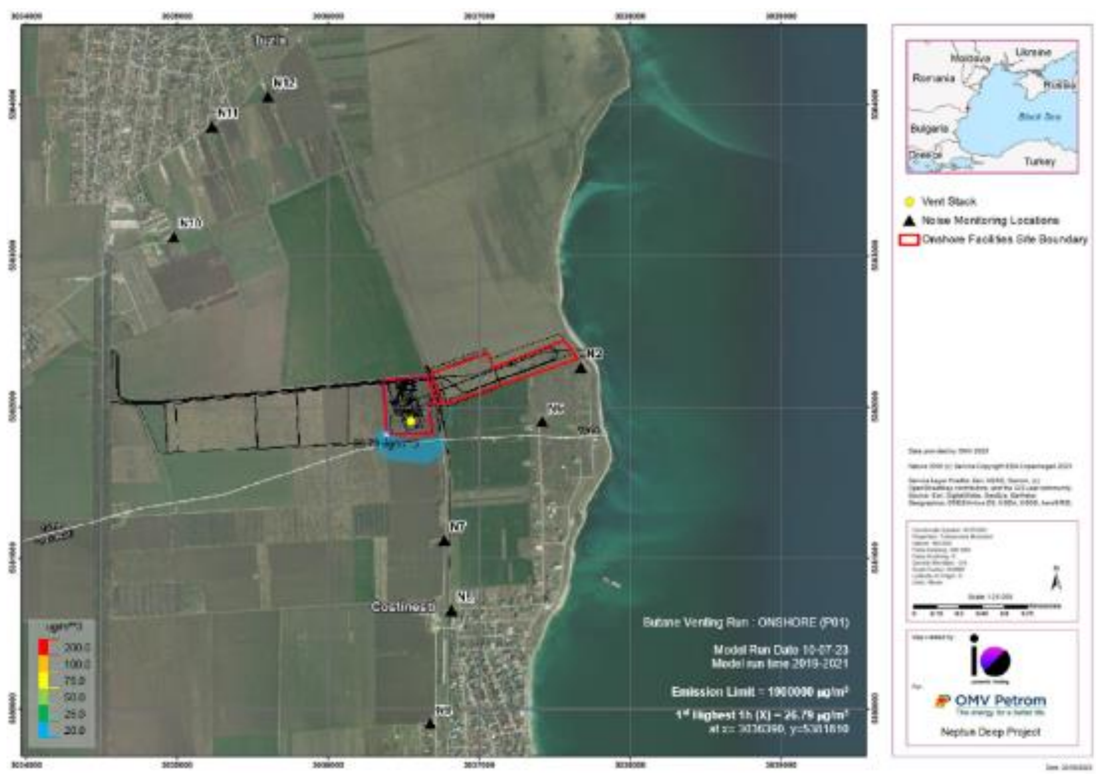


Figure 6.58 Graph of butane emission over an Medium period of 1 hour

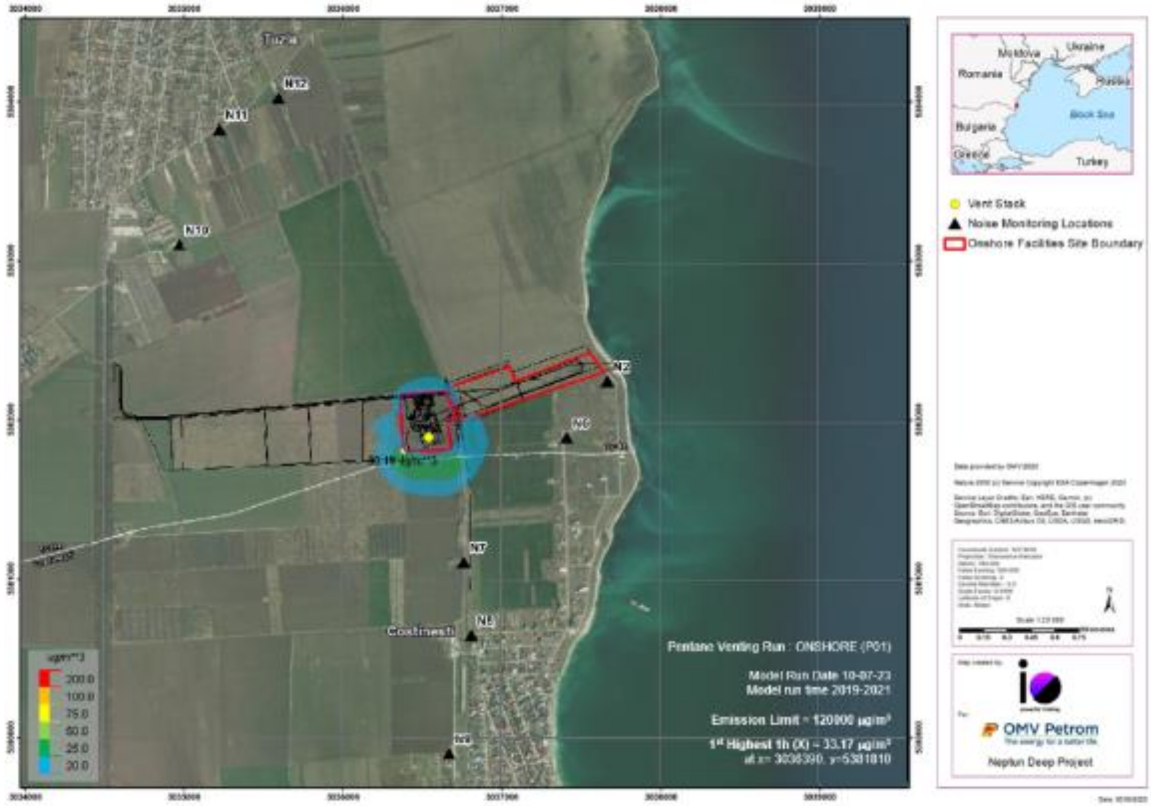


Figure 6.59 Graph of pentane emission over an Medium period of 1 hour

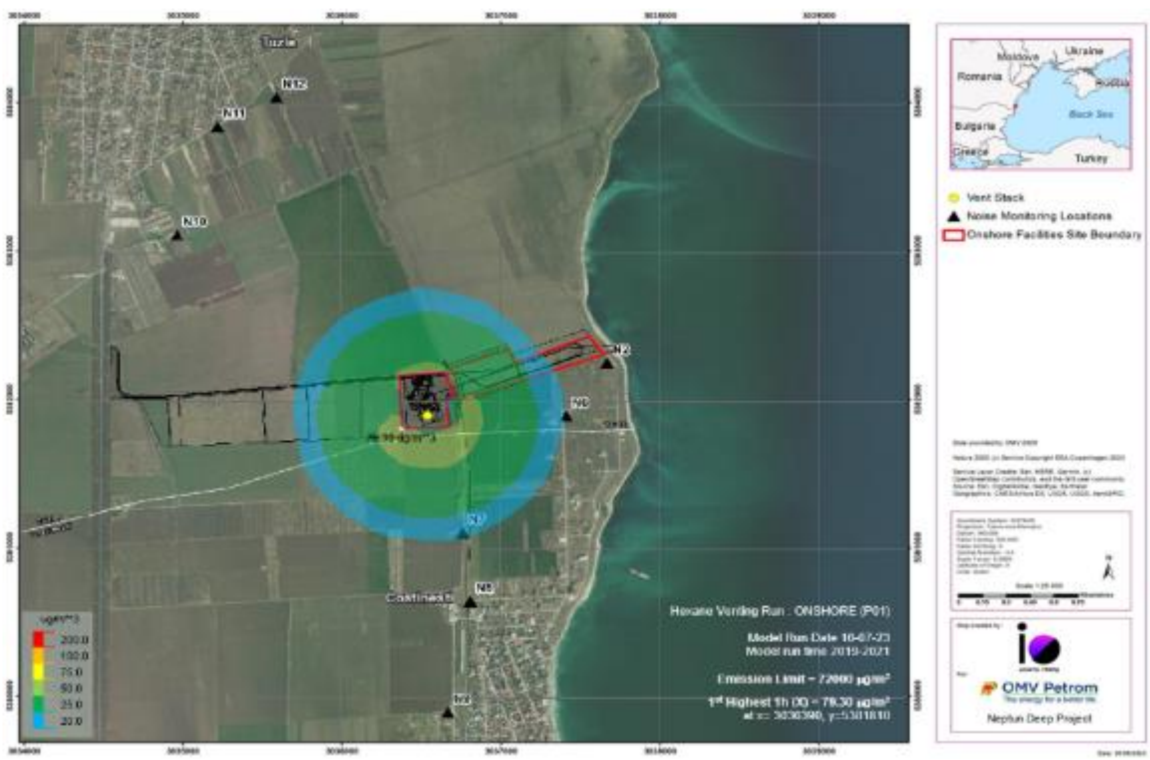


Figure 6.60 Hexane emission graph over an Medium period of 1 hour

Modeling results indicate that all pollutant concentrations from this planned and emergency venting operation are well even below occupational regulatory exposure limits for a 1-hour medium period at the specified sensitive receptors. On this basis, no additional mitigation measures are required to protect nearby communities from this event.

Based on the low sensitivity and low magnitude of the impact, the overall impact on air quality during the land area operation phase is assessed to be minor.

6.2.6.2.2 Emissions of pollutants in the offshore area

The sources of offshore emissions during the operating period are the following:

- Continuous emissions from gas turbine generators (GTGs) consist of the following types of pollutants CO_2, CO, NO_X, N_2O, CH_4, SO_2, VOCs. The GTGs are estimated to operate for 24 hours a day with 2 active units and a fuel consumption of 2,251 kg/h.
- Fugitive emissions due to flange losses, which generate CO_2, CH_4 and VOCs. An estimated number of 750 flanges (this number may increase) and each flange has an acceptable loss rate of <1.4 m^3/year. Fugitive emissions from flange losses are not connected to the platform's flare systems, so they are released into the air.
- Exhaust from the analyzer, which generates CO_2, CO, NO_X, CH_4 and VOCs. An estimate is made based on the dew point analyzer for the wet gas, which is expected to be of the "grab" type with sequential analyses. As sampling volumes and emissions will be very low, emissions are assumed to be 0.0024 t/d.
- Emissions from diesel fueled essential service generator and emergency start generator (BSG) operation generating CO_2, CO, NO_X, N_2O, CH_4, SO_2 and VOCs. It is estimated that there will be a 4-hour run test every two weeks for each generator, ESG and BSG rated at 1MW, and 800kW.
- Emissions from the testing of the fully enclosed diesel-powered survival craft (TEMPSC), which generates CO_2, CO, NO_X, N_2O, CH_4, SO_2 and VOCs. It is assumed that TEMPSC tests will take place during visits to the production platform for 4 hours per day and 4 times per year, for a total Duration of 16 hours per year.

Sources of emissions from shipping:

- Emissions from vessels resulting from the use of Field Support Vessels (FSVs) and Underwater Inspection, Repair and Maintenance (IRM) FSVs, as well as Domino pigging, include the following pollutants CO_2, CO, NO_X, CH_4, SO_2 and VOCs. The FSV and FSV for underwater MRI, the Domino pigging is assumed to be operational for 90 and 30 days per year, respectively, with a fuel consumption of 20 tons/day.

Sources of emissions from flare systems, fugitive emissions during operation under normal conditions of activity:

- Continuous emissions from the LP Flare from the TEG regenerator and produced water degasser, as well as the Header Purge, generate gaseous combustion products including CO_2, CO, NO_X, CH_4, PM and VOCs;
- Purging LP/HP Flare Systems and pilots generate CO_2, CO, NO_X, CH_4 and VOCs. It is estimated that a continuous supply of purge gases to the LP, LP head and HP head is required, and fuel consumption is based on GBA combustion peaks.
- Fugitive emissions due to losses at pressure relief valves (PSVs) and pressure control valves (PCVs) generate CO_2, CH_4 and VOCs. The PSVs are expected to be "leak tight" as they will be tested and replaced in service in the event of lifting to confirm tightness. Losses from the PCV are caused by wear and tear during operation. The loss class is assumed to be V for both PSVs and PCVs. Emissions with a 100% margin are estimated to be 1.2 tons/year.
- Methanol, the blanket gas of TEG tanks (flame) generates CO_2, CO, NO_X, CH_4 and VOCs. It is estimated that full refilling of the storage tanks occurs quarterly, with a low pressure, assuming a density of 1 kg/m ^{3} and an additional loss of 20% during the year.
- Emissions during planned technical maintenance (TAR) at Flare HP generate CO_2, CO, NO_X, N_2O, CH_4, SO_2 and VOCs. Five TARs are planned per production period, one every 4 years, with a Duration of 2 days and a total volume of 4,000 tons/event.
- The cleaning of the pig launcher for the production platform will occur annually in the first two years, and then it will be carried out with the TAR of the PRODUCTION PLATFORM. Therefore, two additional inspections will take place during production, with emissions of 0.72 tons per event lasting 27 seconds.

At point 2.5.3.1, b. the calculation of the pollutant flows emitted during the offshore operation period is presented.

The total annual quantity of pollutants emitted into the air during the operating period from the offshore activity is presented in the table below:

Table 6.53 The total annual quantity of pollutants emitted into the air during the operating period from the offshore activity

pollutant	Medium quantity (tons/year)	
	Continuous emissions	Intermittent emissions
NO_X	159.79	179.96
CO	46.72	45,57
PM	3.31	0.2279
CH4	8.42	13.76
COV	-	4.20
SO_2	-	4.37
N_2O	0.01	-

pollutant	Medium quantity (tons/year)	
	Continuous emissions	Intermittent emissions
CO_2	70,453.61	18,743.95

In 2021, Romania reported CO2 emissions of 78.75 Mt and greenhouse gas (GHG) emissions of 117.09 Mt in 2022. The emissions associated with the operational stage in the terrestrial area are estimated to be 9.22652 tons, representing 0.00012% of Romania's total CO2 emissions reported in 2021.

The estimated GHG emissions are 9.22652 tCO2 (9.22652 tCO2e), 9.66260 t CH4 (270.5528 tCO2e), and 0.00009 t NO2 (0.024 t CO2e), totaling 279.80332 tCO2e or 0.00024% of Romania's total GHG emissions reported in 2022.

The effects on air quality associated with operational works in the terrestrial area are minimal, short-term, and reversible once the activity ceases. Given the project's location, there will not be a transboundary impact.

Based on the low sensitivity and low impact magnitude, the overall impact on air quality from the operational works in the terrestrial area is assessed to be minor.

The effects of greenhouse gas emissions will be long-term, irreversible, and the emission quantity is low, with a transboundary extension.

Based on the characteristics and works of the project, and considering the high sensitivity and medium magnitude, a moderate impact on the climate is expected during the operational phase.

6.2.6.2.2.1 Modeling of pollutant dispersion in the operating stage under normal operating conditions

In order to determine the pollutant concentration during different averaging periods under normal platform operating conditions, the[34] Air Pollutant Dispersion Model was performed using the commercially available BREEZE AERMOD v11 Pro Plus software provided by Trinity Consultants.

When modeling the dispersion of pollutants in the air, emissions from the continuous operation, under normal operating conditions, of the stationary combustion equipment and the torch systems located on the Neptun Alpha platform were considered, respectively:

- Flue gas emissions from gas turbine generators;
- LP and pilot purge gas emissions ;
- HP and pilot purge gas emissions;
- Continuous emissions from the LP torch

[34]Source: IO Consulting – Neptun Deep Project - NEPTUN DEEP AIR DISPERSION STUDY

Table 6.54 Concentration of pollutants in different averaging periods under normal operating conditions of the platform

Pollutant	Mediation period	Limits according to regulations (µg/m ³)		Contribution of emissions generated by the platform to ambient air quality (µg/m ³)	
Nox	1 hour	Legislative Decree 114/2011	two hundred	100 percentiles	190[35]
				95th percentile	135
				Constant	0.334
				NGMS	0.418
	24 hours	WHO	25	100 percentiles	100
				Constant	0.035
				NGMS	0.034
	Annual	Legislative Decree 114/2011 WHO	40 10	Annual Medium	1.83
				Constant	0.002
				NGMS	0.002
PM10	24 hours	WHO	45	100 percentiles	3.78
				95th percentile	3.65
				Constant	0.0007
				NGMS	0.0007
	Annual	Legislative Decree 114/2011 WHO	40 15	Annual Medium	0.0365
				Constant	0.00003
				NGMS	0.00003

[35] 190 µg/m ³ represents the value at which 100% of the measured values are less than or equal to this amount.

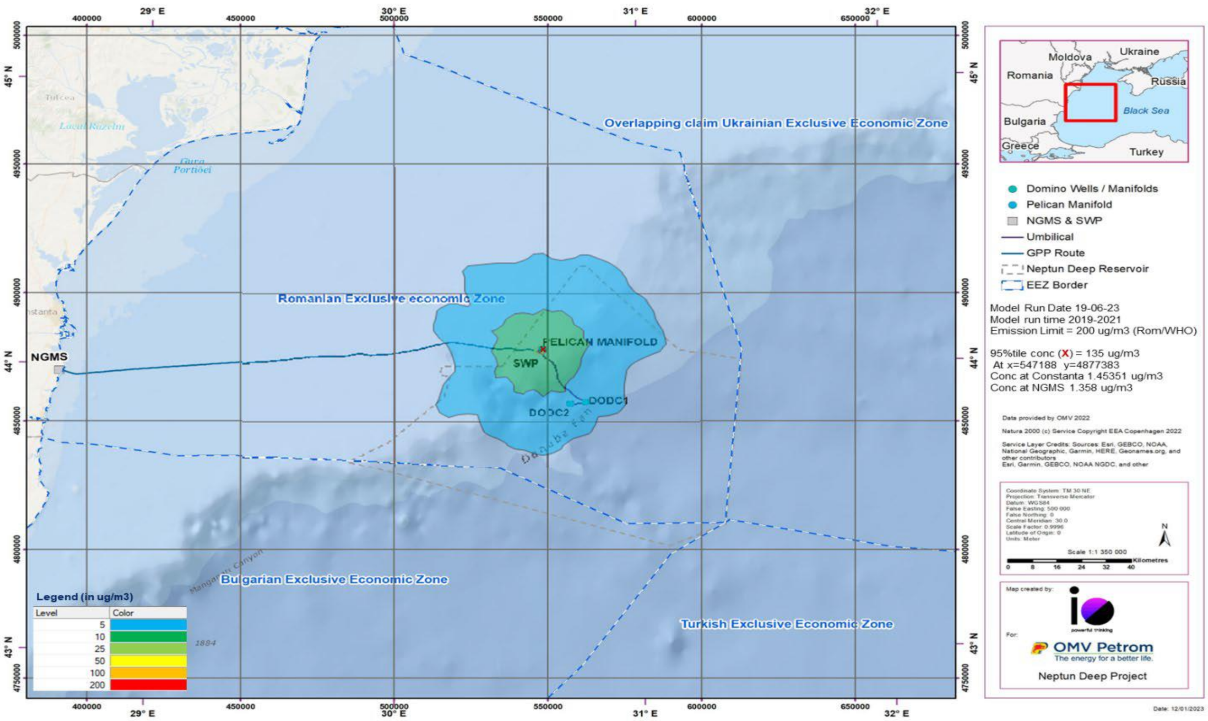


Figure 6.61 NOx emissions in one hour from the platform under normal operating conditions

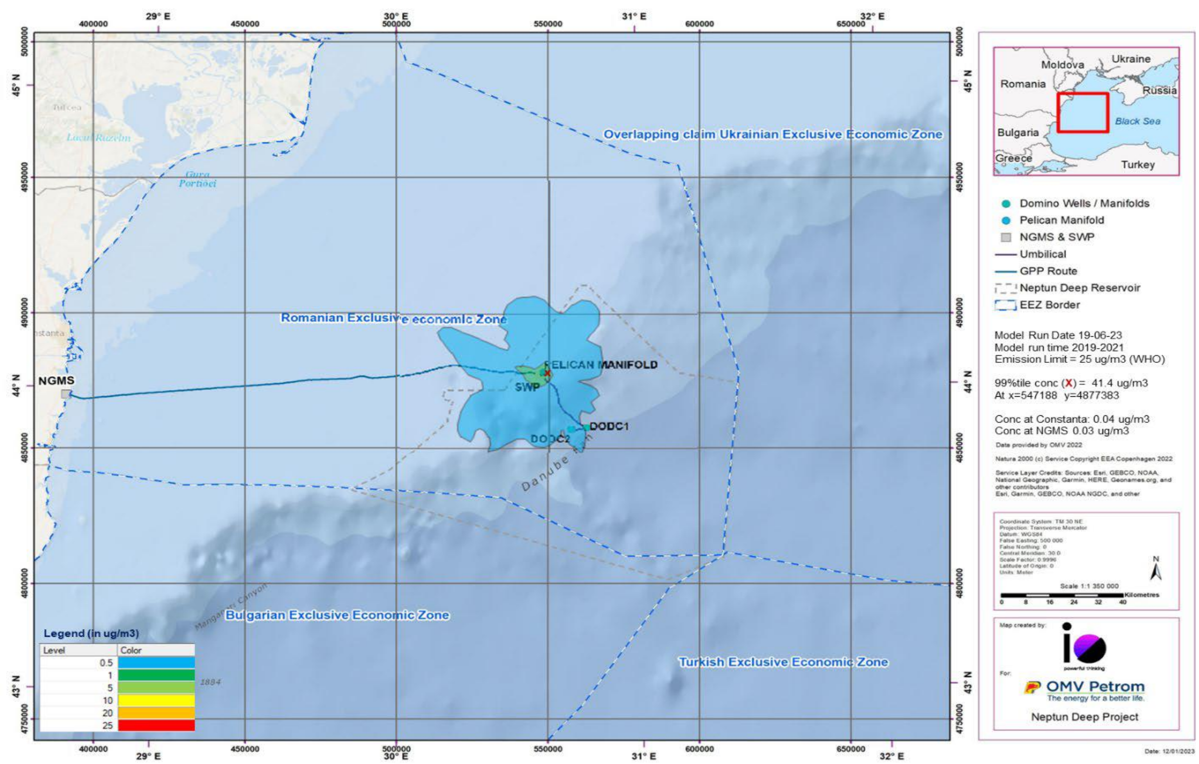


Figure 6.62 Graph of NOx emissions in 24 hours from the platform under normal operating conditions

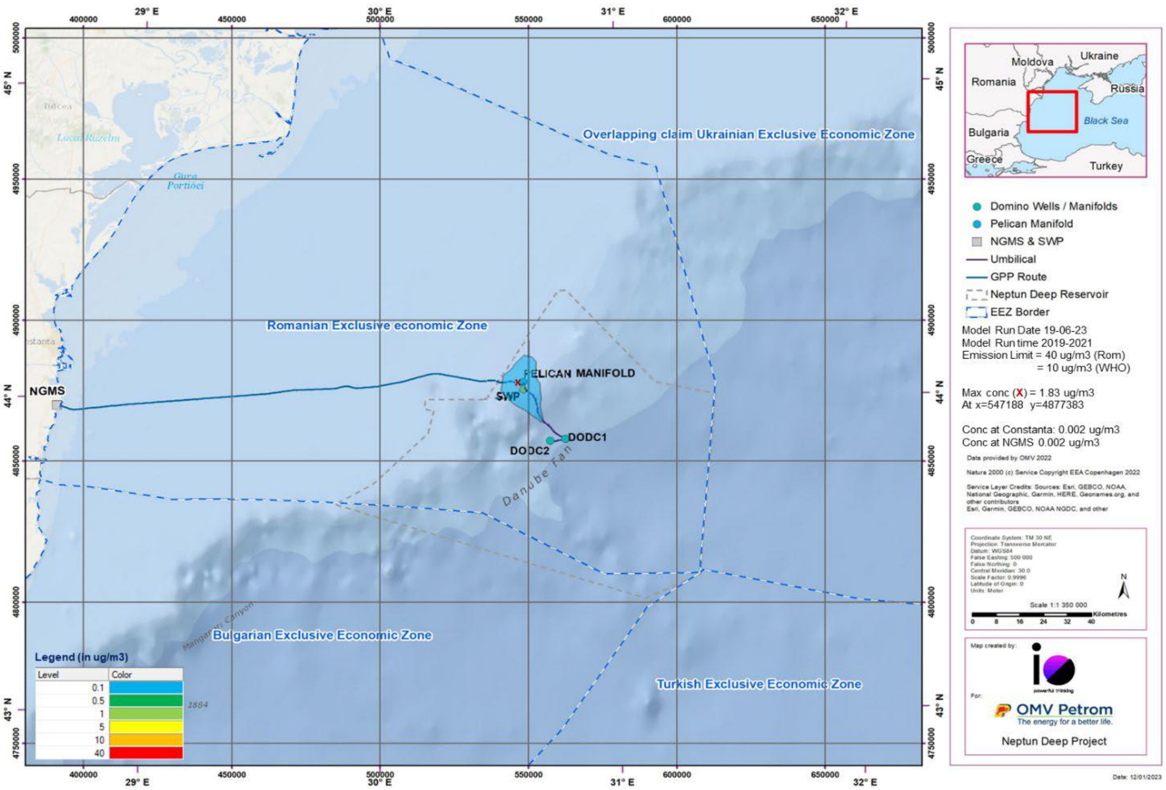


Figure 6.63 Graph of NOx emissions in one year from the platform under normal operating conditions

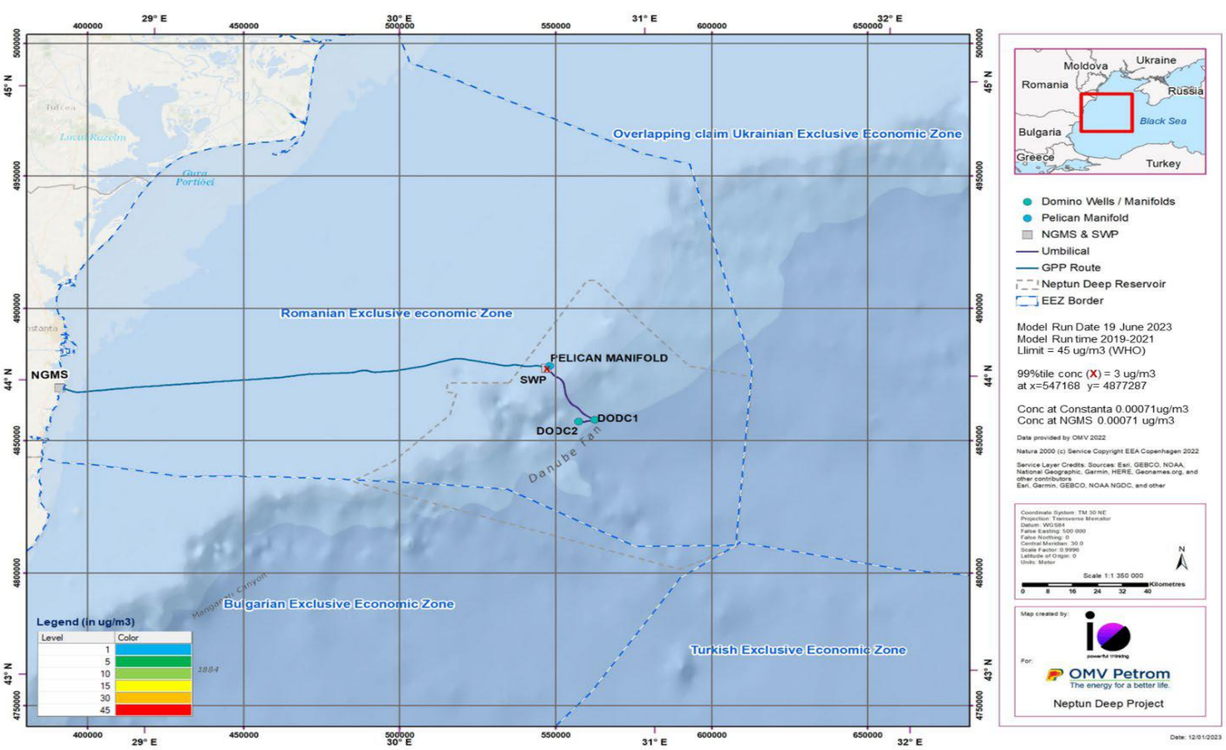


Figure 6.64 Graph of PM 10 emissions in 24 hours from the platform under normal operating conditions

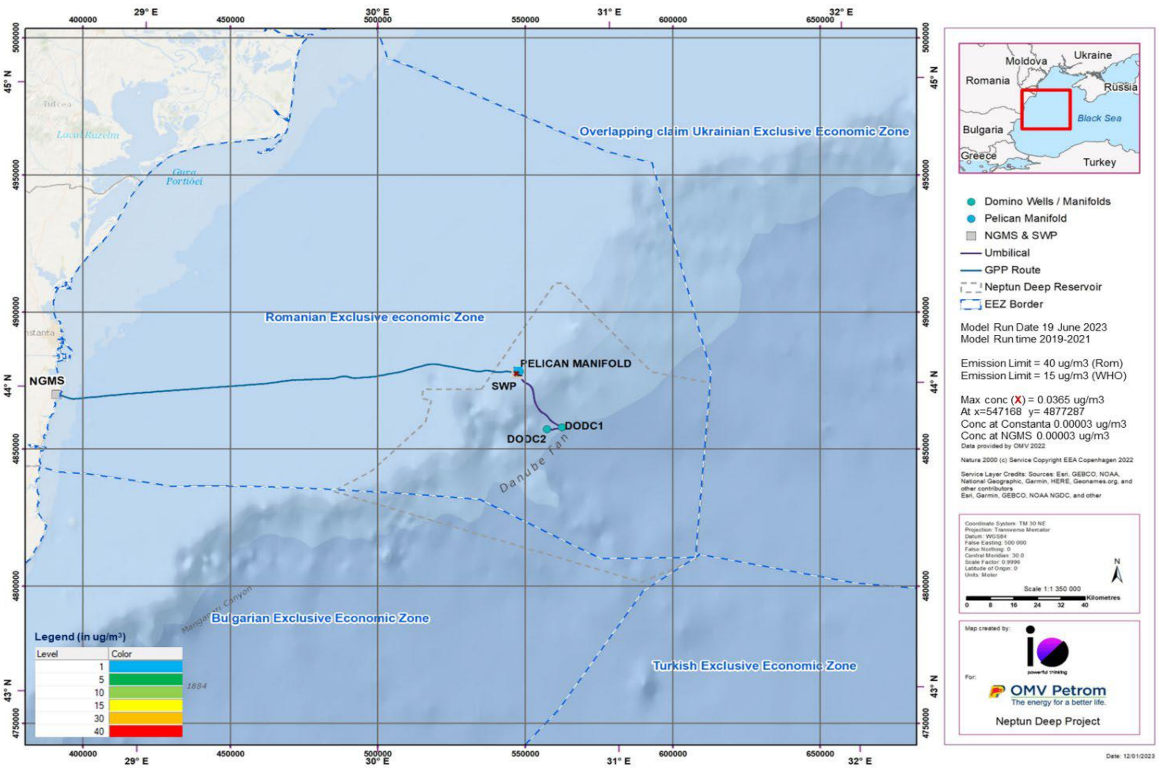


Figure 6.65 Graph of PM10 emissions in one year from the platform under normal operating conditions

NOx emissions under normal operating conditions

Modeling indicates that under normal operating conditions, the 1-hour NOx emission will not exceed the permitted concentration in the platform area, nor at the sensitive receptors identified onshore. Modeling was also performed over the more stringent WHO (IFC) 24-h NOx averaging Duration. Modeling results for the 24-hour NOx concentration indicate at the platform an exceeded NOx concentration in the immediate vicinity of the platform. Additional year-by-year modeling was performed to determine how likely 24-hour NOx concentrations were to be exceeded for the 2019, 2020, and 2021 weather data sets. A 99th percentile (99% of measured values) can be reached for meteorological data for 2019, where the 4th highest 24-hour value resulted in 18.9 µg/m^3 (at x=547188, y=4877383) against the WHO limit of 25 µg /m3. 2020 similarly achieves a 99th percentile as the fourth highest NOx concentration was 18.7 µg/m3 (at x=547188, y=4877383) near the production platform. This confirms that the expected emissions at the sea level receiver near the production platform must not exceed the limits of the allowable number of exceedances per year.

PM10 emissions under normal operating conditions

In air dispersion modeling, no exceedances of the 24-hour OMS (World Health Organization) limits for PM10 were observed at sea level in the immediate vicinity of the production platform and/or at the specified onshore receptors. Additionally, annual averages for PM10 (national limits) and WHO guideline limits were not exceeded, both at sea level and at the specified sensitive receptors.

6.2.6.2.2.2 Modeling the dispersion of pollutants in the operating stage under abnormal operating conditions

Emissions from 3 HP flare ignition scenarios, under abnormal operating conditions with a low probability of occurrence, for gas venting in the following situations:

- Partial Shutdown - Warm Restart (WRS)
- Emergency Stop - Cold Restart (CRS)
- At the start of production - Maximum Pressure - Partial Bleed (PBD)

Table 6.55 The concentration of pollutants emitted during the hot restart mediation period

Pollutant	Mediation period	Limits according to regulations (µg/m³)		Contribution of emissions generated by the platform to ambient air quality (µg/m³)	
NOx	1 hour	Lg114/2011	200	2 m from the source	137
				Constanta	3.14
				NGMS	2.16
	24 hours	OMS	25	2 m from the source	24
				Constanta	0.036
				NGMS	0.037
PM10	24 hours	OMS	45	2 m from the source	0.82
				Constanta	0.011
				NGMS	0.012

Table 6.56 The concentration of pollutants emitted during the mediation period at the cold restart

Pollutant	Mediation period	Limits according to regulations (µg/m³)		Contribution of emissions generated by the platform to ambient air quality (µg/m³)	
NOx	1 hour	Lg114/2011	200	2 m from the source	138
				Constanta	3.17
				NGMS	2.68
	24 hours	OMS	25	2 m from the source	24.2
				Constanta	0.339
				NGMS	0.340
PM10	24 hours	OMS	45	2 m from the source	0.82
				Constanta	0.012
				NGMS	0.012

Table 6.57 The concentration of pollutants emitted during the mediation period at the partial shutdown of the Domino pipeline

Pollutant	Mediation period	Limits according to regulations (μg/m³)		Contribution of emissions generated by the platform to ambient air quality (μg/m³)	
NOx	1 hour	Legislative Decree 114/2011	two hundred	2 m from the source	154
				Constanta	3.61
				NGMS	3.04
	24 hours	OMS	25	2 m from the source	27
				Constant	0.388
				NGMS	0.395
PM10	24 hours	OMS	45	2 m from the source	0.92
				Constanta	0.013
				NGMS	0.013

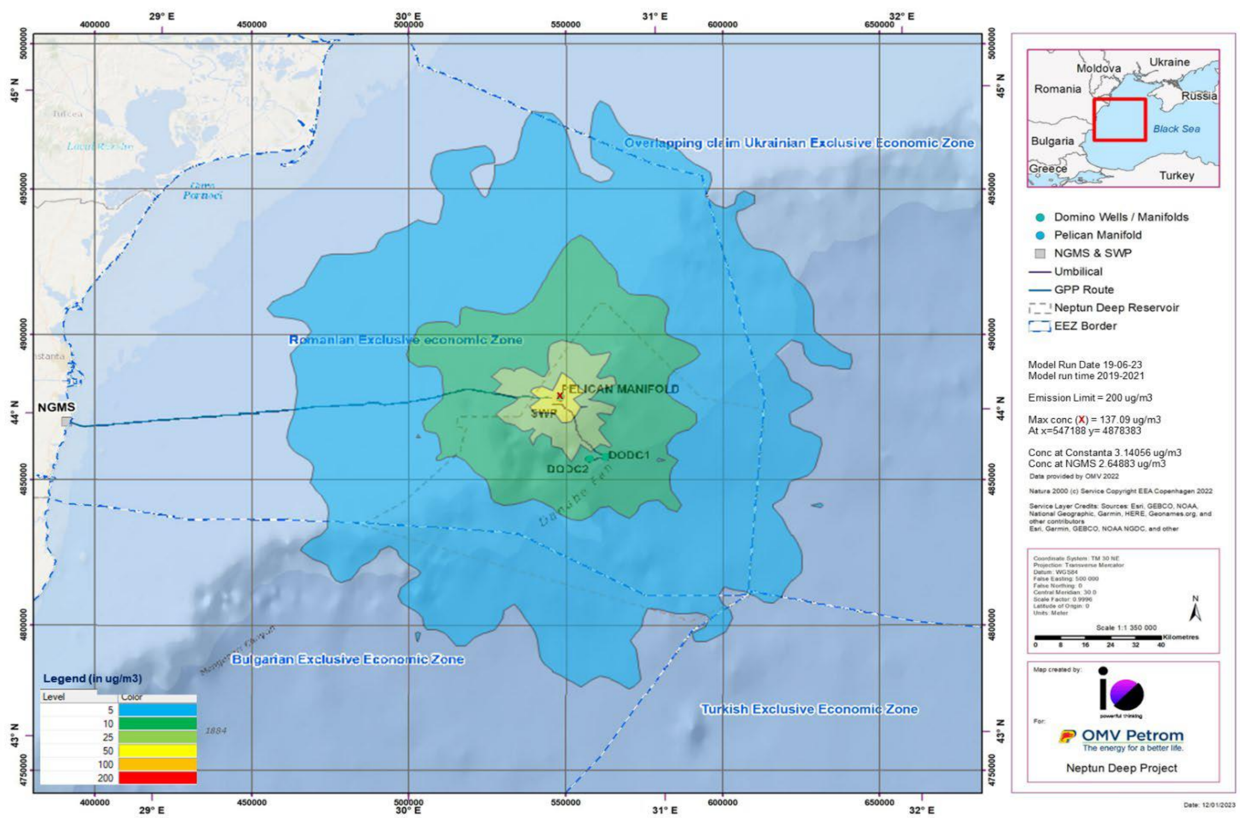
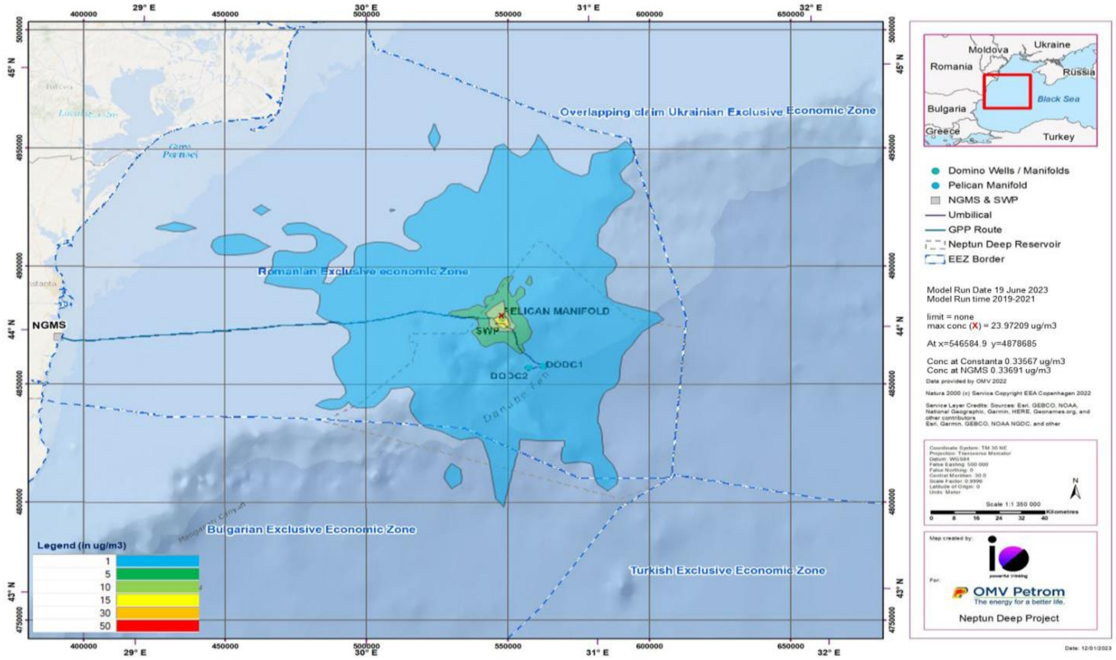


Figure 6.66 Plot of NOx emissions in 1 hour from the platform on hot start



*

Figure 6.67 Graph of NOx emissions in 24 hours from platform to hot start

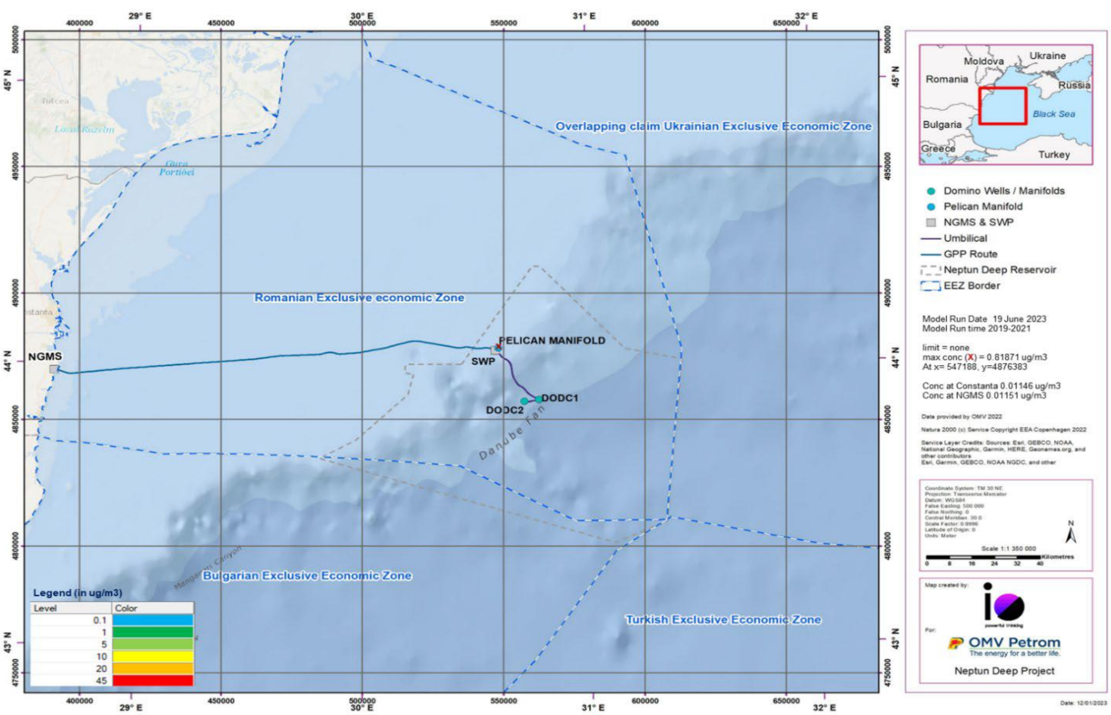


Figure 6.68 Graph of PM10 emissions in 24 hours from platform to hot start

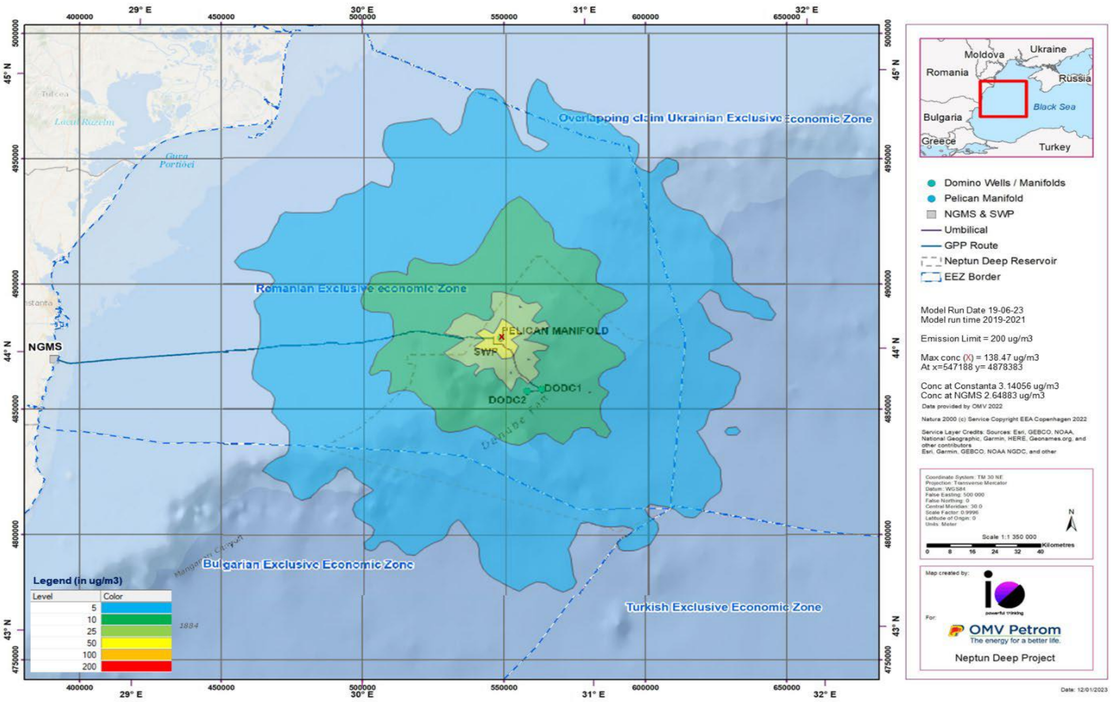


Figure 6.69 Graph of NOx emissions in 1 hour from platform to cold start

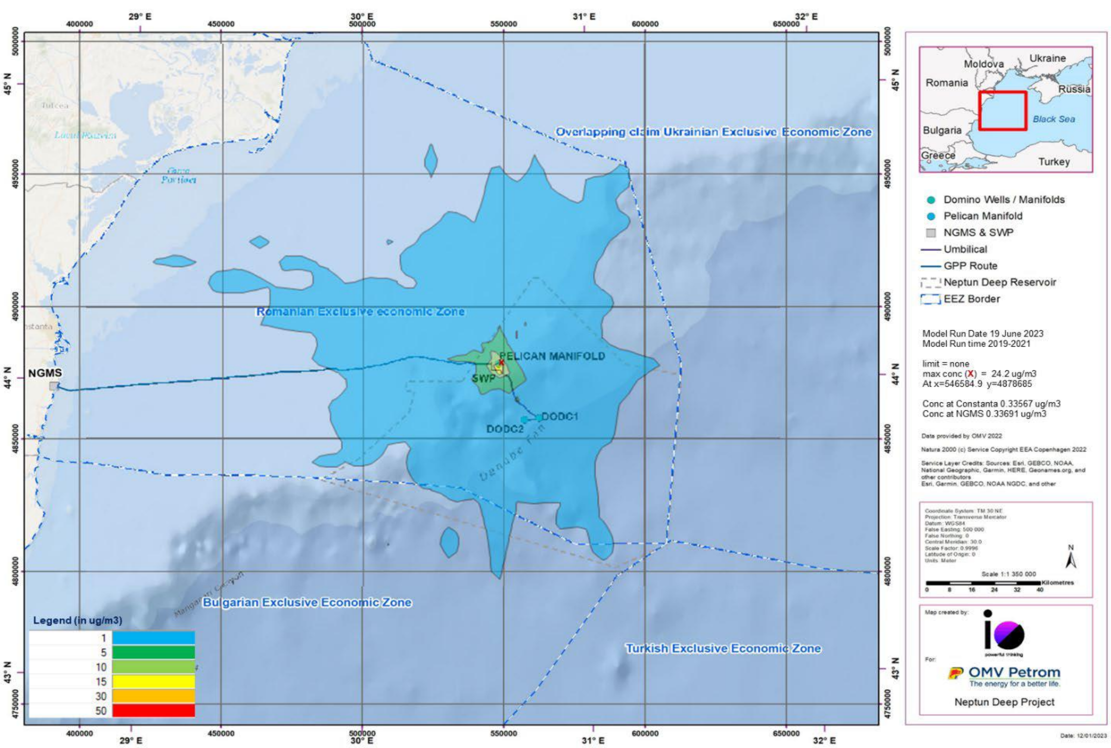


Figure 6.70 Graph of NOx emissions in 24 hours from platform to cold start

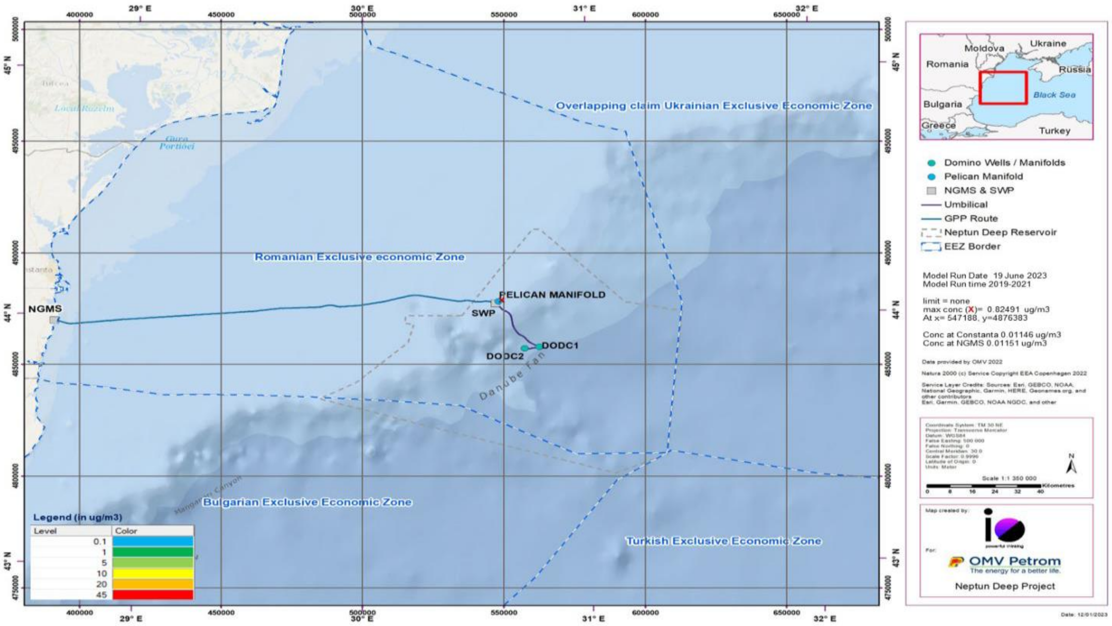


Figure 6.71 Graph of PM10 emissions in 24 hours from platform to cold start

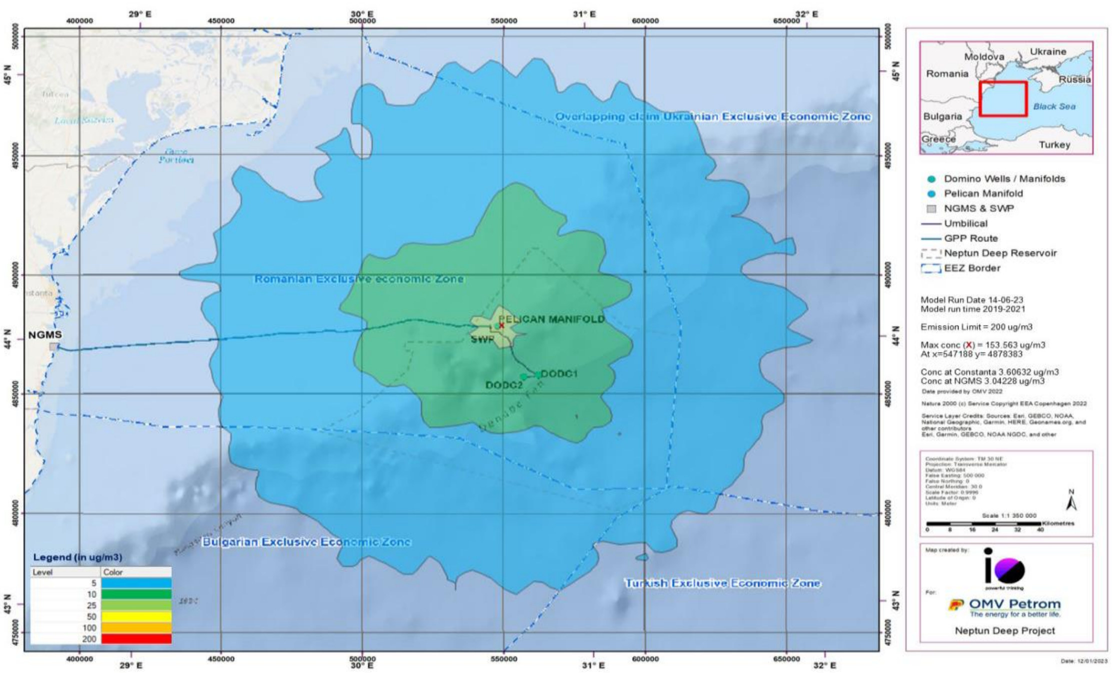


Figure 6.72 Graph of NOx emissions in 1 hour from platform to partial shutdown of Domino pipeline

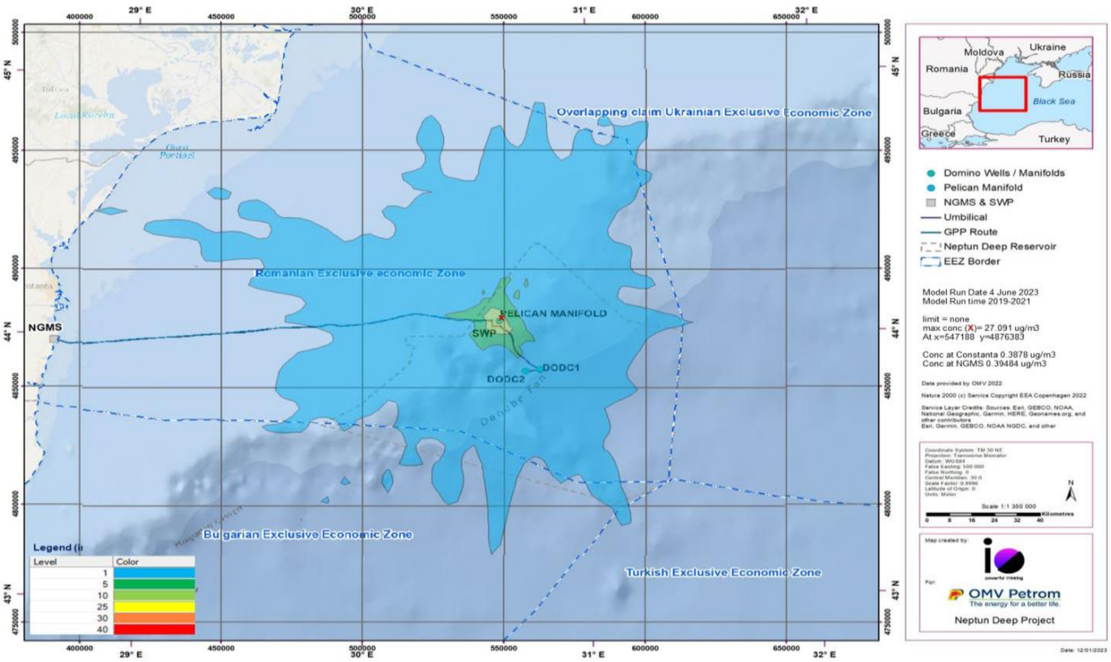


Figure 6.73 Graph of NOx emissions in 24 hours from the platform at the partial shutdown of the Domino pipeline

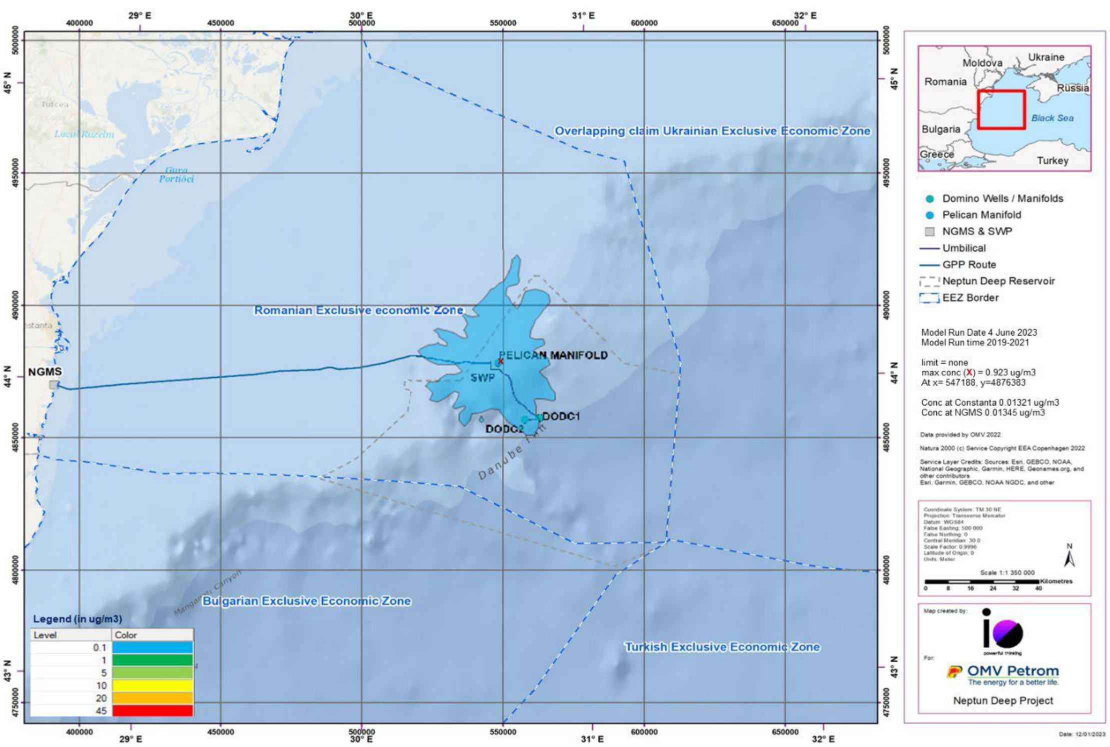


Figure 6.74 Graph of PM 10 emissions in 24 hours from the platform at the partial shutdown of the Domino pipeline

a) *Case 1 Warm Restart (WRS)*

The air dispersion modeling was conducted for the hot restart purge case. Emissions were measured in accordance with Law 114/2011 for 1-hour NOx, OMS's 24-hour guideline limits for NOx, and OMS's 24-hour PM10 limits. The modeling indicates no exceedance of pollutant limits of national law and/or OMS at sea level or at the specified sensitive onshore receptors.

b) *Case 2 Cold Restart (CRS)*

Modeling indicates no pollutant exceedances of either national and/or OMS guidance limits either at the sea level location near the production platform or at the specified sensitive receptors on shore.

c) *Partial Domino Pipe Drain (PBD)*

Modeling indicates that there will be no exceedances of any of the Law 114/2011 limits for 1-hour NOx and 24-hour OMS PM10 at sea level and specified sensitive receptors on land. However, a small exceedance of the 24-hour NOx limit was observed compared to the OMS limit. The first highest 100 percentile concentration value, located near the production platform at sea level, shows a concentration of 27 $\mu g/m^3$, against a OMS threshold limit of 25 $\mu g/m^3$, which represents a 8% rise above sea level. This should not be considered an area of concern because the production platform is normally unattended and there are no airborne sensitive receptors in the vicinity of the production platform. In addition, these emergency operations result in no land-based receivers exceeding specifications (on the entire metrological data set from 2019 to 2021). The contribution of 24-hour NOx emissions at Constanta and NGMS is 0.388 $\mu g/m^3$ and 0.395 $\mu g/m^3$, respectively, which are well below the OMS 24-hour NOx limit.

6.2.6.3 Impact assessment in the decommissioning stage

During the decommissioning stage, dust and pollutant emissions are estimated as during the construction period.

The decommissioning period is estimated at 12 months in the land area and 18 months in the marine area.

6.2.6.4 Summary of air impacts at all stages of the project

The table below shows the impact assessment by magnitude and receiver sensitivity without the application of impact mitigation measures. The impact significance matrix is presented in point 6.1.4.3.

Table 6.58 Assessment of the impact on the environmental factor: air

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
Construction stage						
Emissions of	*Nature effect*	Negative	Low	Low	Minor	No
	Effect type	Direct				

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
pollutants in the terrestrial area	*Reversibility of the effect*	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
Emissions of pollutants in the offshore area	*Nature effect*	Negative	Low	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	Intension	Low				
GHG emissions	*Nature effect*	Negative	Low	High	Moderate	Yes
	Effect type	Direct				
	Reversibility of the effect	Irreversible				
	Extension	Transboundary				
	Term	Long term				
	The intensity	Low				
Operation stage						
Emissions of pollutants in the terrestrial area	*Nature effect*	Negative	Low	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Temporarily				
	The intensity	Low				
Emissions of pollutants in the offshore area	*Nature effect*	Negative	Low	Low	Minor	Yes, in the event of abnormal operating conditions but under the WHO limits
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Long term				
	The intensity	Low				
GHG emissions	*Nature effect*	Negative	Medium	High	Moderate	Yes
	Effect type	Direct				
	Reversibility of the effect	Irreversible				
	Extension	Transboundary				
	Term	Long term				

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
	The intensity	Low				
Decommissioning stage						
Emissions of pollutants in the terrestrial area	*Nature effect*	Negative	Low	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
Emissions of pollutants in the offshore area	*Nature effect*	Negative	Low	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
GHG emissions	*Nature effect*	Negative	Low	High	Moderat	Yes
	Effect type	Direct				
	Reversibility of the effect	Irreversible				
	Extension	Transboundary				
	Term	Long term				
	The intensity	Low				

6.2.6.5 Mitigation measures air quality and climate

- In periods without precipitation, wetting of access roads and areas with active works will be ensured in order to reduce particle emissions and bring concentrations (PM10/PM2.5) within the limit values provided by the legislation in force;
- Avoiding the execution of works that involve the handling of soil quantities (excavation/filling) during periods of strong winds;
- When placing topsoil and excavated soil deposits, the prevailing wind direction will be taken into account to reduce the likelihood of affecting sensitive receptors;
- In strong wind conditions, dust-generating activities will be reduced, or surfaces will be sprinkled with water to reduce dust dispersion;
- Setting a maximum speed limit on temporary access roads;
- Vehicles carrying powdery materials will be covered;
- Machinery and vehicles engaged in construction activities should meet at least EURO5 standards for reduced fuel consumption and a lower volume of emissions.
- Use of MARPOL 73/78 Annex VI class certified vessels and drilling platform – Prevention of air pollution from ships;

- Use of ships and drilling platform holding the "Ship Energy Efficiency Management" class certification
- Use of low Sulphur fuel in accordance with IMO requirements
- Maintaining good operating practices, inspection and maintenance schedules for all equipment, facilities and vehicles involved in the project
- Adhere to relevant design guidelines and include mitigation measures to reduce accidental gas leaks
- Incorporating BAT studies into the design and operation process, including review of design, equipment efficiency and appropriate sizing of equipment as needed, in later stages of the project
- Compliance with any relevant legal requirements regarding emission limits
- Inform and impose the emission reduction company policies to the Neptun Deep Project contractors.
- Use of equipment and machinery with low fuel consumption to limit GHG emissions
- Maintaining routine maintenance procedures to ensure that engines of machines, equipment, ships are operational at the defined operational performance and at the specified emission level
- Implementation of environmental management plans, preparation and response for emergency situations and intervention in case of accidents that might generate additional GHG

6.2.7 The acoustic environment

Increased noise levels at all stages of the project will lead to potential impacts on the population, marine mammals, and fish.

The effects on the acoustic environment during the construction, operation and decommissioning stages of the project are presented in table 6.59.

Table 6.59 Effects on the acoustic environment during the construction, operation and decommissioning stage

Effect	Construction stage	Operation stage	Decommissioning stage
Increase in ambient noise due to land-based activities	x	x	x
Increase in underwater noise due to offshore works	x	-	x

The evaluation criteria for assessing sensitivity and magnitude are as follows:

Evaluation criteria

Magnitude criteria

Magnitude	Description
Negligible	The impact does not generate quantifiable (visible or measurable) effects in the natural state of the environment.

Low	Localizable and detectable temporary or short-term impact on the acoustic environment that causes changes beyond natural variability without altering functionality or air quality. The acoustic environment returns to its pre-impact state after the activity causing the impact ceases.
Medium	Temporary or short-term impact on the acoustic environment that may extend beyond the local scale and result in alteration of the acoustic environment. However, the long-term integrity of the acoustic environment or any dependent receptor is not affected. If the extent of the impact is large, then the magnitude can also be large.
High	Impact on the acoustic environment that can cause irreversible changes and beyond the permissible limits, on a local or larger scale. The changes may alter the long-term character of the acoustic environment and other dependent receptors. An impact that persists after the cessation of the activity producing it has a high magnitude.
Positive	The activity carried out improves the acoustic environment.

Sensitivity criteria

Sensitivity	Description
Low	The acoustic environment is important but resistant to change (in the context of the proposed activities) and will quickly naturally return to its pre-impact state once the impact generating activity stops.
Medium	The acoustic environment is important for the functioning of ecosystems. It can be less resistant to changes but can be returned to its original state through specific actions, or it can recover naturally over time.
High	The acoustic environment is critical for ecosystems, it is not resistant to change and cannot be returned to its original state.

Sensitivity to the acoustic environment

Based on the information regarding the current state presented in Chapter 4, the physical acoustic environment component was assessed as having medium sensitivity due to the temporary increase in the level of ambient noise generated by the activities carried out both on land and at sea, the presence of homes near the land area of the project and of sensitive receptors in the sea (dolphins and fish).

As such, although important, this environmental factor is resistant to change (in the context of the proposed activities) and will quickly naturally return to its pre-impact state once the impacting activity ceases.

6.2.7.1 Impact assessment in the construction phase

6.2.7.1.1 Increase in ambient noise level during construction work on land

According to Order no. 119/2014 for the approval of the Hygiene and Public Health Norms regarding the living environment of the population, the maximum levels allowed will be 50 dB(A) during the day ((7.00 - 23.00) and 45 dB(A) during at night (23.00 - 7.00).

The noise-generating sources are the activities carried out on land, namely the development of the temporary access road, the development of the site organizations, the digging of the microtunnel launch pit, the digging of the trench for laying the gas production pipeline.

In order to determine the level of ambient noise coming from a set of point sources at different distances during the construction stage, dBmap software was used, which shows the attenuation of the sound propagated in the open air.

The calculation scenario considered is the one in which all machines are operating at the same time, including the noise generated by the passing of the train.

Under normal conditions, the construction works will be carried out in stages, the trains pass at different times and the cumulative noise generation Duration in the area is a maximum of 5 minutes.

Modeling results indicate that the receivers closest to the work areas will be exposed to an acceptable level of noise for a short period of time. The weighted acoustic pressure level indicated for each sensitive receiver is between 44÷53 dB(A) (points 1-7, represent the noise generating sources and the receiver is the sensitive receivers). The construction work will not be carried out during the night which could lead to potential discomfort for the residents of the area.

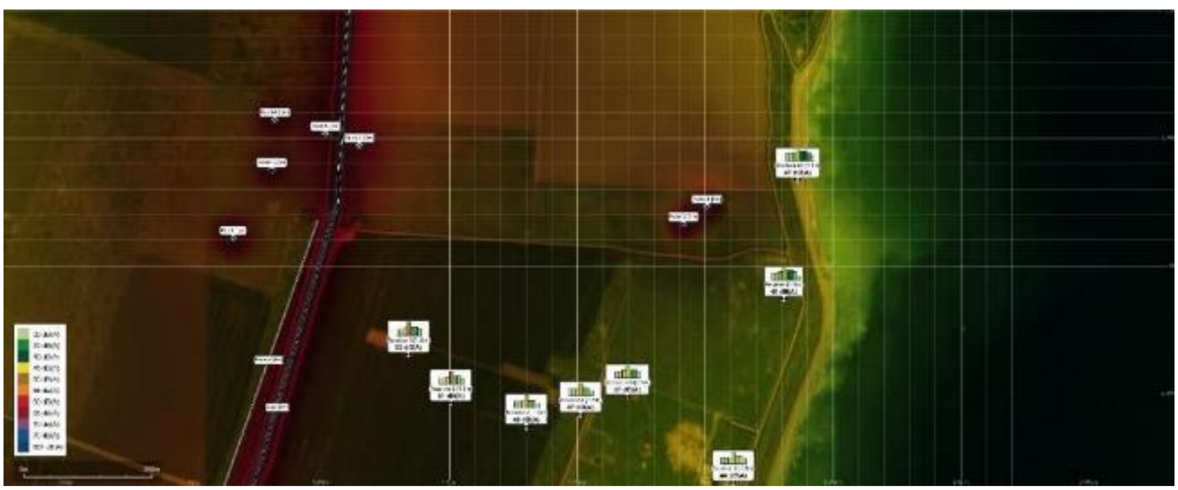


Figure 6.75 Noise level modeling results from a set of point sources

From this perspective, the significance of the impact on the acoustic environment is insignificant, in the conditions of a medium sensitivity class, and of a negligible impact magnitude, with local extension, in the short term and reversible, with a low intensity.

<u>6.2. 7.1.2 Increase in underwater noise level during offshore construction works</u>

6.2.7.1.2.1 General

"Underwater noise" is defined as unwanted or potentially harmful sound. Marine fauna use sound for navigation, communication and prey detection (e.g. reviews in Southall et al., 2007; Richardson et al., 1995), and anthropogenic underwater sound generation can potentially impact marine mammals by interfering with the animal's ability to use and receive sound (eg OSPAR, 2009).

The activity of drilling, construction/installation of marine infrastructure will generate underwater noise and the level and frequency of the sound varies and depends on the activity carried out.

The impact of sound on a marine mammal depends on many factors including the level and characteristics of the sound, the sensitivity of hearing and the behavior of the species.

These can range from insignificant impacts such as disruption of activity to significant changes in behavior. Activities that generate very high noise levels can cause hearing damage and other physical injuries (Southall et al., 2007; Richardson et al., 1995). Auditory effects include temporary or permanent reduction in hearing sensitivity. Non-auditory impacts can include damage to body tissues, particularly air-filled cavities, including the swim bladder and musculature in fish (reviewed by Richardson et al., 1995) and effects such as masking of biologically relevant substances.

The sources of underwater noise are the following: excavation of the microtunnel outlet and transition trench, drilling of production wells, installation of the Neptun Alpha platform jacket piers, digging of trenches for the laying of supply/adduction pipelines, noise produced by ships.

The noise sources identified were of impulse type, those from the installation of the pillars by impact and the rest are continuous sounds.

Underwater noise modeling associated with the offshore construction works of the Neptun Deep project was carried out by Subacoustech Environmental[36] using dBSea (v2.3) software.

The modeling shows the direction of propagation of the underwater sound pressure, under conditions in which the soft start mode is NOT applied.

This section presents a modeling approach used to assess the underwater noise levels generated by the proposed construction activities and noise sources of the Neptun Deep project, as well as the criteria used to assess noise impacts on relevant marine species.

The modeling approach presented is consistent with recommendations found in the National Physical Laboratory (NPL) Best Practice Guideline 133 for Underwater Noise (Robinson et al., 2014).

6.2.7.1.2.2 Inputs to underwater noise modeling[37]

Currently, there is no Romanian guide that sets limits on the exposure of marine life. The modeling used noise exposure limits for marine mammals and fish from existing expert studies and experience from offshore natural gas development to establish criteria for likely effects on marine mammals and fish.

---

[36] Subacoustech Environmental Report No. P347R0103, Modeling of underwater noise from activities related to the construction of the Neptun Deep project in the Black Sea, March 2023

[37] Environmental and Social Impact Assessment Report, Neptun Deep Project, IO Consulting Ltd

In the guidelines[38] developed by the JNCC (UK Nature Conservation Committee) it is recommended to use the damage criteria proposed by Southall et al. (2007), which is based on a combination of unweighted peak sound pressure levels and weighted sound exposure levels (SELs) for mammals and fish.

In the Southall et al. (2019) guide, a classification of marine mammals is presented based on groups of similar species and their auditory sensitivities, namely: low-frequency cetaceans (LF - whales), high-frequency cetaceans (HF - dolphins, toothed whales, beaked whales, beaked dolphins, including bottlenose dolphins), and very high-frequency cetaceans (VHF - porpoises), as well as pinnipeds (PCW - seals). Cetaceans found in the Black Sea fall into the high-frequency and very high-frequency cetacean categories.

The following scales are generally used for noise in the underwater environment: peak sound pressure level (SPL), noise exposure level (SEL) and cumulative noise exposure level.

The peak sound pressure level (SPL) refers to the magnitude of a sound at a given point, i.e. how loud the sound is and is measured in decibels relative to 1 micropascal, so dB re 1 µPa. SPL does not provide information about the impact on the biological environment, but rather presents the maximum sound level at a certain distance.

The noise exposure level (SEL) describes the sound pressure level received by a receiver (e.g. a marine mammal) from a noise source over a nominal time interval of one second (unit of measurement in dB re 1 $\mu Pa^2 s$).

Cumulative Noise Exposure Level (SEL_{cum})- describes the receiver's exposure to multiple sounds or multiple noises/sounds over a period of time.

6.2.7.1.2.3 Scenarios used in modeling

Modeling was performed for the following noise sources associated with the Neptun Deep project:

- Dredging operations: backhoe dredging, in which material is removed from the seabed using a bucket on the arm of a mechanical excavator, and cutter suction dredging, in which a cutting head breaks the hard soil or rock into fragments from the bottom the sea, and a suction pipe brings the material to the surface;
- Well drilling;
- Installation of the jacket by driving the pillars;
- Excavate trenches for umbilical system and feed/supply pipes;
- Naval traffic.

The modeling in detail is presented in appendix M.

3 workspaces were used in the modeling, which represent the worst-case scenario for the works presented above:

[38] JNCC(2010)

- High seas (drilling, installation of the jacket, trenching for laying pipes and noise from ships (sea depth of approximately 124 m);
- Shallow sea area – dredging works (sea depth of about 24 m);
- Coastal area - execution of the microtunnel (sea depth of approximately 10 m).

Some noise sources are in motion but based on the precautionary principle in modeling they were considered point sources.

For equipment there are noise levels from equivalent sources appropriate to the frequency range used for modeling (12.5 Hz to 100 kHz). The peak sound pressure level (SPL_{peak}) was given only for the pounding of the piers, as this is the only noise considered as impulse. All other sources are designated as continuous (non-impulse) noises and are represented by the noise exposure level (SEL). All SELs shown are adjusted to 1 second.

The peak sound pressure level (SPL_{peak}) as well as the noise exposure level (SEL) for the noise sources used in the modeling are as follows:

Table 6.60 Peak sound pressure level (SPL_{peak}) and noise exposure level (SEL) for noise sources

Noise source		Peak sound pressure level (SPL_{peak})	Noise Exposure Level (SEL)
Backhoe dredging		N/A	176.0 dB re 1 $\mu Pa^2 s$ @ 1m (1 second)
Suction and cutter dredging		N/A	177.0 dB re 1 $\mu Pa^2 s$ @ 1m (1 second)
Drilling production wells		N/A	171.8 dB re 1 $\mu Pa^2 s$ @ 1m (1 second)
Installation of the jacket pillars by hammering	Menck 800 S maximum energy (820KJ)	237.1 dB re 1 μPa @ 1 m	217.7 dB re 1 $\mu Pa^2 s$ @ 1 m (a hit)
	Menck 800 S soft start (164 KJ)	255.2 dB re 1 μPa @ 1 m	207.4 dB re 1 $\mu Pa^2 s$ @ 1 m (single strike)
	Menck 3200iS maximum energy (3.201KJ)	241.7 dB re 1 μPa @ 1 m	222.4 dB re 1 $\mu Pa^2 s$ @ 1 m (single strike)
	Menck 3200iS soft start (640 KJ)	235.8 dB re 1 μPa @ 1 m	216.5 dB re 1 $\mu Pa^2 s$ @ 1 m (single strike)
Microtunneling		N/A	177.0 dB re 1 $\mu Pa^2 s$ @ 1m (1 second)
Digging the trenches for the installation of the supply pipe		N/A	197.0 dB re 1 $\mu Pa^2 s$ @ 1m (1 second)
Noise generated by ships		N/A	198.3 dB re 1 $\mu Pa^2 s$ @ 1m (1 second)

6.2.7.1.2.4 Modeling results

Dredging works

Noise levels for dredging operations performed with the backhoe dredge are slightly higher at distance than the suction and cutter dredge. The result of the modeling indicates a noise exposure level that does not produce significant effects on marine mammals and fish, as shown in Tables 6.61 – 6.63.

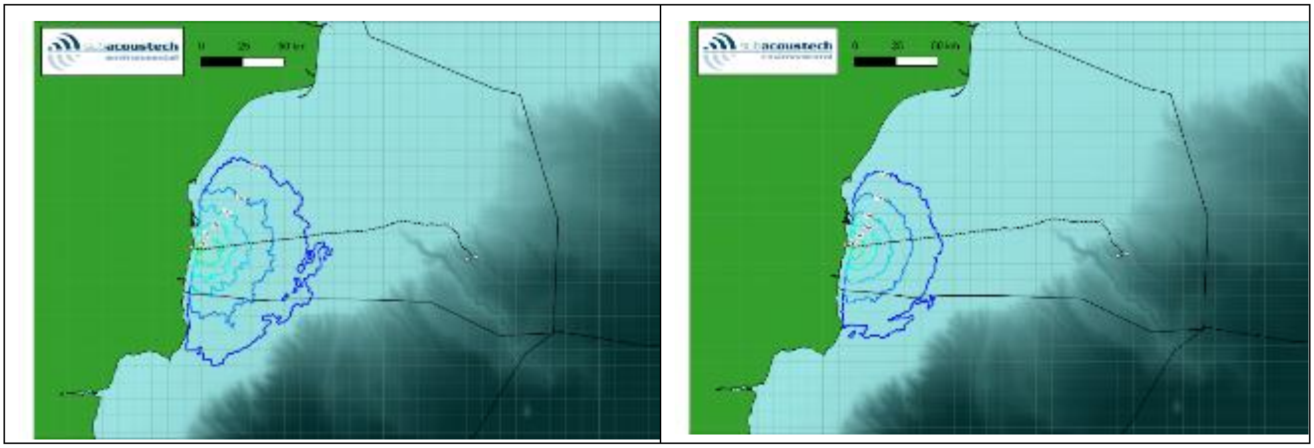


Figure 6.76 Graph of the noise level generated during dredging works with a bulldozer and with suction and cutting (isolines between 125 - 100 dB)

Table 6.61 Synthesis of the Southall et al. (2019) model of cumulative PTS impact range for marine mammals associated with dredging noise

Southall et al. (2019)		**SEL $_{as}$ weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)	
		Continuous noise	
		HF (198 dB)	**VHF (173dB)**
PTS	Maximum	< 100 m	< 100 m
	Minimum	< 100 m	< 100 m
	Mean	< 100 m	< 100 m

Where :
SEL $_{cum}$ - cumulative noise exposure level - Single value for the collected, combined total of sound exposure over a specified time or several instances of a noise source.
PTS (Permanent Threshold Shift-permanent hearing loss) - A permanent total or partial hearing loss caused by acoustic trauma.
HF(198dB) - high frequency cetaceans with a noise exposure level limit of 198 dB.

The table above indicates that exposure to underwater noise levels above 198 dB for HF cetaceans and 173 dB for VHF cetaceans, at a distance of less than 100 meters from the sound source, may represent a significant risk for marine mammals, including the risk of PTS.

Table 6.62 Synthesis of the Southall et al. (2019) model of the cumulative TTS impact range for marine mammals associated with noise generated from dredging

Southall et al. (2019)		SEL $_{as}$ **weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)	
		Continuous noise	
		HF (178 dB)	**VHF (153dB)**
TTS	Maximum	< 100 m	< 100 m
	Minimum	< 100 m	< 100 m
	Mean	< 100 m	< 100 m

where - TTS (TemporaryThreshold Shift-temporary hearing loss).

The table above indicates that exposure to underwater noise levels above 178 dB for HF cetaceans and 153 dB for VHF cetaceans, at a distance of less than 100 meters from the sound source, may pose a significant risk to marine mammals, including the risk of TTS and other severe hearing damage.

Table 6.63 Synthesis of the model Popper et al. (2014) of the impact range for fish associated with dredging noise

Popper et al. (2014)		Unweighted $_{RMS}$ SPL	
		Continuous noise	
		170 dB.	**158 dB**
TTS	Maximum	< 50 m	< 50 m
	Minimum	< 50 m	< 50 m
	Mean	< 50 m	< 50 m

In the case of fish, the noise exposure level of 170 dB and 158 dB, at a distance of less than 50 m from the source, can cause recoverable damage, respectively TTS.

Drilling wells

The noise level from well drilling in the offshore area, with the impact area for marine mammals and fish are presented in Tables 6.64 - 6.66. Modeling results indicate a level of noise exposure from drilling that does not produce significant effects on marine mammals and fish. The modeling was done considering a continuous operation for 24 hours.

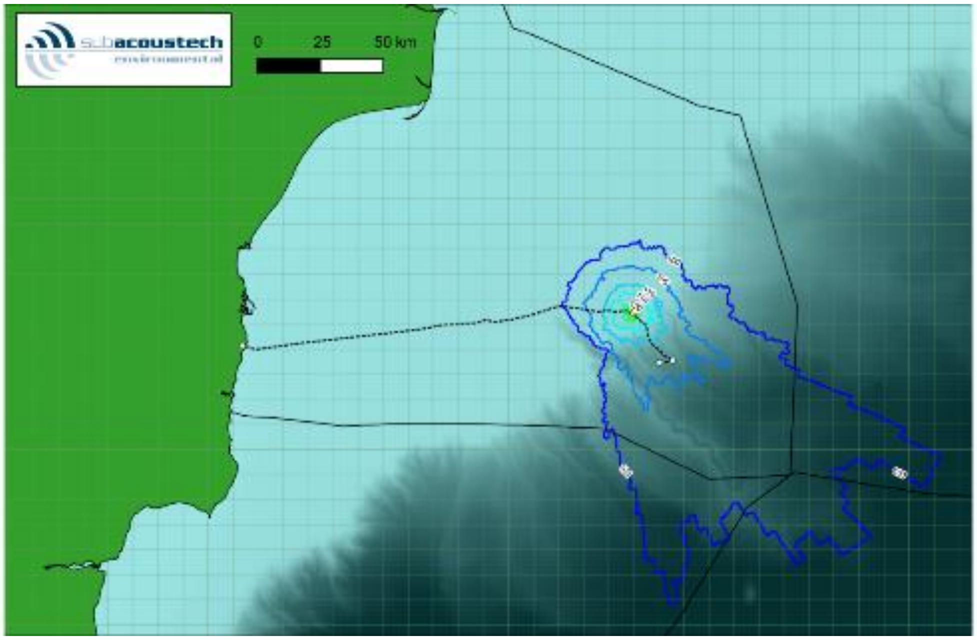


Figure 6.77 Unweighted noise exposure levels (SEL at 1s)

Table 6.64 Synthesis of the Southall et al. (2019) model of the cumulative PTS impact range for marine mammals associated with noise generated from drilling

Southall et al. (2019) Well drilling		**SEL $_{as}$ weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)	
		Continuous noise	
		HF (198 dB)	**VHF (173dB)**
PTS	Maximum	< 100 m	< 100 m
	Minimum	< 100 m	< 100 m
	Mean	< 100 m	< 100 m

where:

SEL $_{cum}$ - cumulative noise exposure level - Single value for the collected, combined total of sound exposure over a specified time or several instances of a noise source.

PTS (Permanent Threshold Shift-permanent hearing loss) - A permanent total or partial hearing loss caused by acoustic trauma.

HF(198dB) - high frequency cetaceans with a noise exposure level limit of 198 dB.

The data in the table indicate that exposure to underwater noise levels above 198 dB for HF cetaceans and 173 dB for VHF cetaceans, at a distance of less than 100 meters from the sound source, may represent a significant risk to mammal's marine, including the risk of PTS.

Table 6.65 Southall et al. (2019) Model Synthesis of Cumulative TTS Impact Range for Marine Mammals Associated with Drilling Noise

Southall et al. (2019) Well drilling		SEL $_{how}$ weighted (the mammal moves away from the noise source at a speed of 1.5 m/s)	
		Continuous noise	
		HF (178 dB)	VHF (153dB)
TTS	Maximum	< 100 m	< 100 m
	Minimum	< 100 m	< 100 m
	Mean	< 100 m	< 100 m

TTS (TemporaryThreshold Shift-temporary hearing loss)

The data in the table indicate that exposure to underwater noise levels above 178 dB for HF cetaceans and 153 dB for VHF cetaceans, at a distance of less than 100 meters from the sound source, may pose a significant risk to marine mammals, respectively the risk of TTS.

Table 6.66 Synthesis of the model Popper et al. (2014) of the impact range for fish associated with drilling noise

Popper et al. (2014) Well drilling		Unweighted $_{RMS}$ SPL	
		Continuous noise	
		170 dB	158 dB
TTS	Maximum	< 50 m	< 50 m
	Minimum	< 50 m	< 50 m
	Mean	< 50 m	< 50 m

In the case of fish, the noise exposure level of 170 dB and 158 dB, at a distance of less than 50 m from the source can cause recoverable damage and TTS respectively.

Driving the pillars for the installation of the jacket

The jacket has four legs with 2 pillars per leg.

2.44 m diameter piles will be installed in the seabed between 92 and 102 m deep. The impact installation method is considered the worst-case scenario.

Impact pile installation will have 2 stages depending on the type of hammer used, as follows: a MENCK 800S hammer which will partially install a set of four piles, then the hammer is changed to the larger MENCK 3200iS hammer to fully install them. Given the length of time it takes to install a pier as well as the time it takes to change hammers, it is not expected that the two hammers will be used in the same 24-hour period.

The soft start and acceleration processes for the two pile drivers are summarized in Tables 6.67 – 6.70. For the installation of one pillar, modeling was carried out on four driving scenarios, with the presentation of the worst scenario and an optimal scenario both for the installation of one pillar and for the installation of four successive pillars.

Table 6.67 Pile driving method parameters for the maximum limit scenario using the MENCK 800S hammer

MENCK 800S (maximum limit)	164 kJ	410 kJ	492 kJ	574 kJ	656 kJ	820 kJ
Number of hits	100	483	3,281	2,887	3,483	4,063
Duration	10 minutes	16 min	82 min	72 min	87 min	90 min
Hit rate	10 bl/min	~30 bl/min	~40 bl/min			~45 bl/min
1 pillar: 14,297 shots, 5.95 hours 4 pillars: 57,188 shots, 23.8 hours						

Table 6.68 Parameters of the pile driving method for the best estimated scenario using the MENCK 800S hammer

MENCK 800S (best estimate)	164 kJ	410 kJ	492 kJ	574 kJ	656 kJ	820 kJ
Number of hits	100	260	2,398	1,702	1,827	1,893
Duration	10 minutes	9 min	60 min	43 min	46 min	42 min
Hit rate	10 bl/min	~29 bl/min	~40 bl/min			~45 bl/min
1 pillar: 8,180 shots, 3.5 hours 4 pillars: 32,720 shots, 14 hours						

Table 6.69 Pile driving method parameters for the maximum limit scenario using the MENCK 3200iS hammer

MENCK 3200iS (maximum limit)	640 kJ	1,600 kJ	2.401 kJ	3.201 kJ
Number of hits	100	3,606	3,205	5,206
Duration	10 minutes	120 min	80 min	116 min
Hit rate	10 bl/min	~30 bl/min	~40 bl/min	~45 bl/min
1 pillar: 12,117 shots, 5.43 hours 4 pillars: 48,468 shots, 21.73 hours				

Table 6.70 Parameters of the pile driving method for the best estimated scenario using the MENCK 3200iS hammer

MENCK 3200iS (best estimate)	640 kJ	1,600 kJ	2.401 kJ	3.201 kJ
Number of hits	100	1,383	1,190	1,432
Duration	10 minutes	46 min	30 minutes	32 min
Hit rate	10 bl/min	~30 bl/min	~40 bl/min	~45 bl/min
1 pillar: 4,105 shots, 1.97 hours 4 pillars: 16,420 shots, 7.87 hours				

Figure 6.78 to Figure 6.81 show the unweighted sound pressure levels SPLpeak and sound exposure level SEL for a safe blow, showing the noise levels from both full power hammer use and soft start. Due to the combination of a high level of source noise and the type of impulse noise, the noise propagates over greater distances compared to the other sources considered in this study.

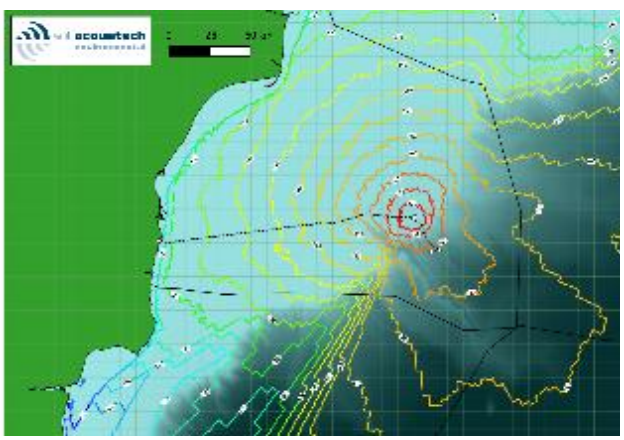
The modeled impact ranges are shown in Tables 6.67 – 6.70 for the single impact SPLpeak criteria and in Tables 6.71 -6.73. for the SELcum criteria, which with maximum hammer energy, the best estimate, the scenario with a single pile and with 4m piles driven in succession.

The largest impact intervals, according to Southall et al. (2019) criteria for marine mammals, are predicted for the LF and VHF groups of cetaceans, with maximum PTS ranges of 33 km and 15 km, respectively, when considering the installation of a single MENCK 3200iC hammer pilot for the maximum limit. These ranges increase to 57 km for LF cetaceans and remain at 15 km for VHF cetaceans when the sequential deployment of four pilots is considered; the increase in noise when installing four pilots in sequence is less noticeable to VHF cetaceans due to the reduction in the level for the higher frequencies to which this group of species is most sensitive, meaning that the additional sound energy is less of a problem when the receiver has moved away at a distance, after installation of the first pilot.

For fish, the highest recoverable injury ranges (203 dB threshold) using Popper et al. (2014) criteria are estimated at 5.5 km for a stationary receiver, and this drops to 370 m when a receding receiver is considered. When four pylons are installed sequentially, the maximum recoverable impact range increases to 13 km for stationary species.

<u>The single-strike version with a hammer</u>

This subsection describes the impact ranges specifically associated with instantaneous noise limits and covers the noise levels generated by maximum energy impacts as well as soft start (namely first impact). Cumulative thresholds (SELcum) are considered in the following subsections.



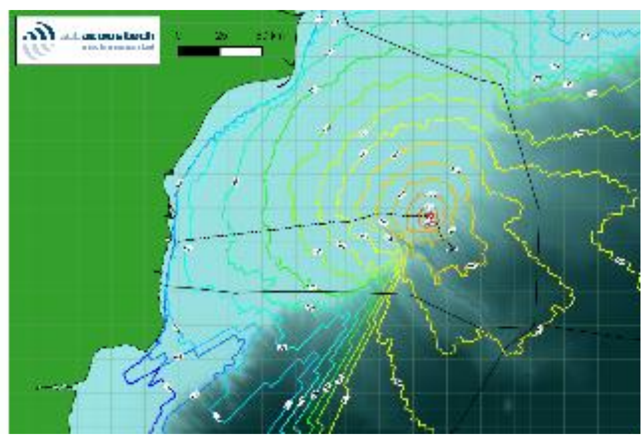


Figure 6.78 Unweighted peak sound pressure levels, SPLpeak, generated by hammering with the MENCK 800S in the open sea, at full power (left) and soft start (right), with isolines from 100 dB (dark blue) to 175 dB (red)

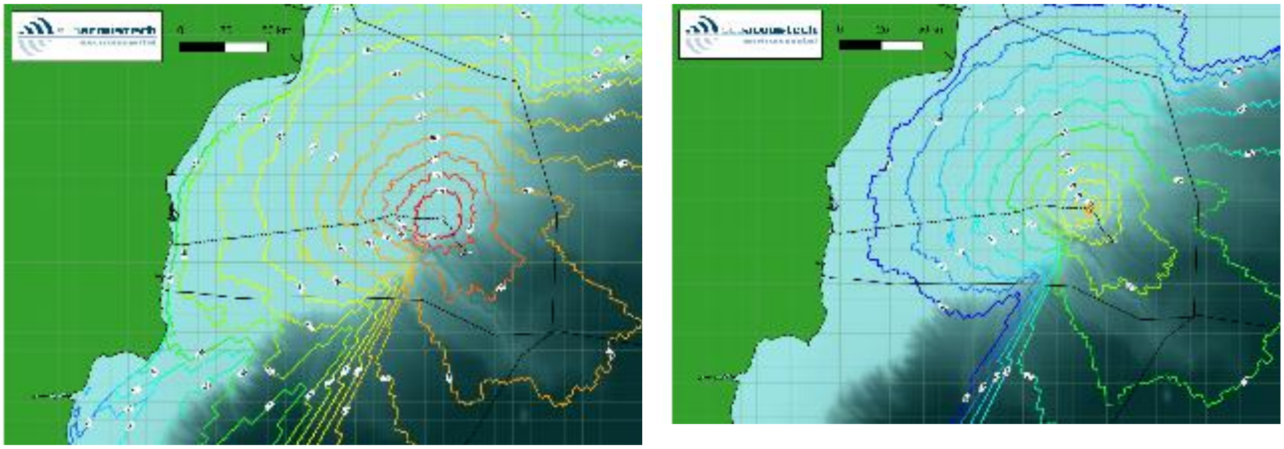


Figure 6.79 Unweighted peak sound pressure levels, SPLpeak, generated by hammering with the MENCK 3200iS in the open sea, at full power (left) and soft start (right), with isolines from 100 dB (dark blue) to 175 dB (red)

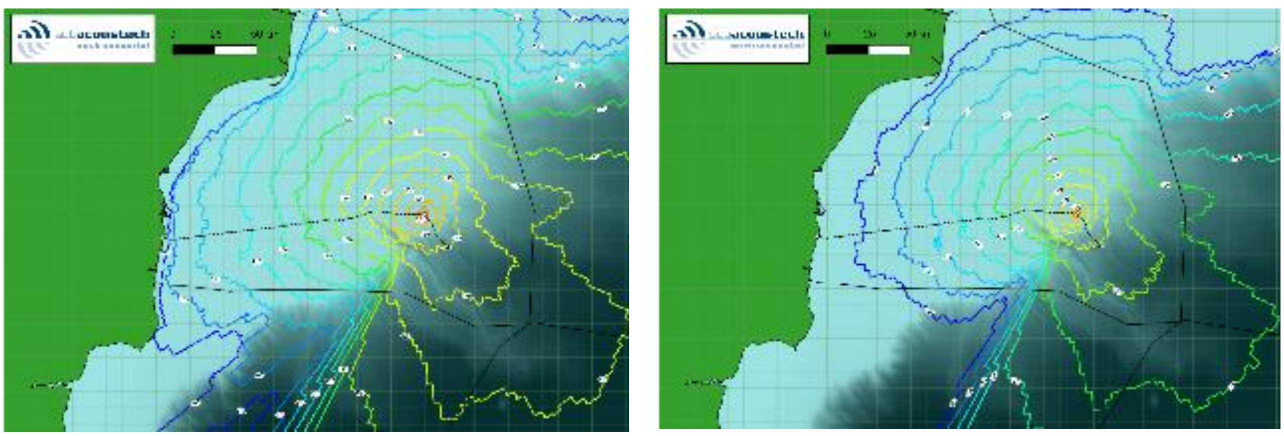


Figure 6.80 Unweighted noise exposure levels, SEL, generated by hammering the MENCK 800S in the open sea at full power (left) and soft start (right), with isolines from 100 dB (dark blue) to 175 dB (red)

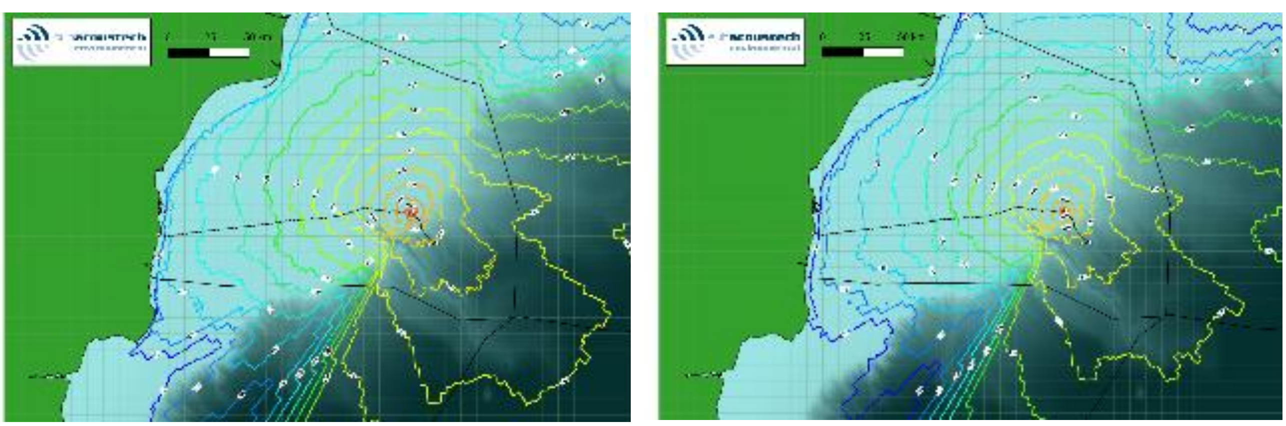


Figure 6.81 Noise exposure levels, SEL, generated by hammering the MENCK 3200iS in the open sea, at full power (left) and soft start (right), with isolines from 100 dB (dark blue) to 175 dB (Red)

Table 6.71 Southall et al. (2019) Model Synthesis of PTS Impact Range for Marine Mammals Associated with Noise Generated by a Single Hammer Blow in Piling Installation Using MENCK 800S and 3200iS Hammers

Southall et al. (2019) PTS		Unweighted $_{peak}$ SPL			
		Maximum energy		Soft start	
		HF (230 dB)	VHF (202dB)	HF (230 dB)	VHF (202dB)
MENCK 800S	Maximum	< 50 m	260 m	< 50 m	< 50 m
	Minimum	< 50 m	220 m	< 50 m	< 50 m
	Mean	< 50 m	230 m	< 50 m	< 50 m
MENCK 3200iS	Maximum	< 50 m	540 m	< 50 m	210 m
	Minimum	< 50 m	450 m	< 50 m	180 m
	Mean	< 50 m	490 m	< 50 m	190 m

Where,

SPL $_{peak}$ - peak sound pressure level.

PTS (Permanent Threshold Shift-permanent hearing loss) - A permanent total or partial hearing loss caused by an acoustic trauma.

HF(230dB) - high frequency cetaceans with a peak sound pressure limit of 230 dB.

Exposure to peak sound pressure levels of 230 dB for HF cetaceans less than 50 meters from the sound source, both at maximum power use and soft start may pose a significant risk to marine mammals, including the risk of PTS.

Exposure to peak sound pressure levels of 202 dB in the case of VHF cetaceans at a maximum distance of 540 meters from the sound source and an Medium distance of 490 m may pose a significant risk to marine mammals, including the risk of PTS when using maximum energy and in case of soft start maximum 210 m and medium 190 m.

Table 6.72 Southall et al.'s (2019) Model Synthesis of Marine Mammal TTS Impact Range Associated with Noise Generated at a Single Hammer Blow of Piling Installation Using MENCK 800S and 3200iS Hammers

Southall et al. (2019) TTS		Unweighted $_{peak}$ SPL			
		Maximum energy		Soft start	
		HF (224 dB)	VHF (196dB)	HF (224 dB)	VHF (196dB)
MENCK 800S	Maximum	< 50 m	670 m	< 50 m	100 m
	Minimum	< 50 m	550 m	< 50 m	90 m
	Mean	< 50 m	600 m	< 50 m	100 m
MENCK 3200iS	Maximum	< 50 m	1.2 km	< 50 m	540 m
	Minimum	< 50 m	1.0 km	< 50 m	460 m
	Mean	< 50 m	1.1 km	< 50 m	500 m

TTS (Temporary Threshold Shift-temporary hearing loss)

Exposure to peak sound pressure levels of 224 dB in HF cetaceans less than 50 meters from the sound source may pose a significant risk to marine mammals, including the risk of TTS at maximum energy use as well as at soft start.

Exposure to peak sound pressure levels 196 dB in the case of VHF cetaceans at a maximum distance of 1.2 km from the sound source and a medium distance of 1.1 km at maximum power use and at a maximum of 540 m and an medium of 500 m at soft start may pose a significant risk to marine mammals, including the risk of TTS.

Table 6.73 Synthesis of the model Popper et al. (2014) of the fish impact range associated with the noise generated by a single hammer blow when installing piers using MENCK 800S and 3200iS hammers

Popper et al. (2014) Well drilling		Unweighted $_{RMS}$ SPL			
		Maximum energy		Soft start	
		213 dB	207 dB	213 dB	207 dB
MENCK 800S	Maximum	50 m	110 m	< 50 m	< 50 m
	Minimum	< 50 m	100 m	< 50 m	< 50 m
	Mean	< 50 m	100 m	< 50 m	< 50 m
MENCK 3200iS	Maximum	90 m	240 m	< 50 m	100 m
	Minimum	80 m	210 m	< 50 m	80 m
	Mean	90 m	220 m	< 50 m	90 m

<u>**Cumulative variant**</u>

a) Hammer MENCK 800S with maximum energy

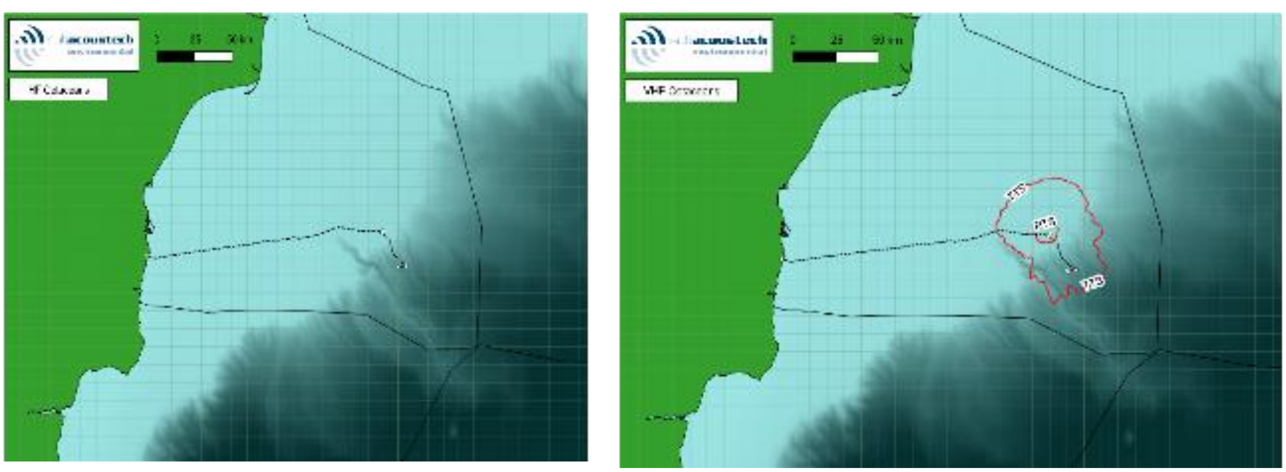


Figure 6.82 Cumulative impulse noise exposure level SEL $_{as}$ (Southall et al., 2019) with the hammer used at maximum energy for the installation of a single pillar, the inner isoline is the PTS limit and the outer isoline the TTS limit

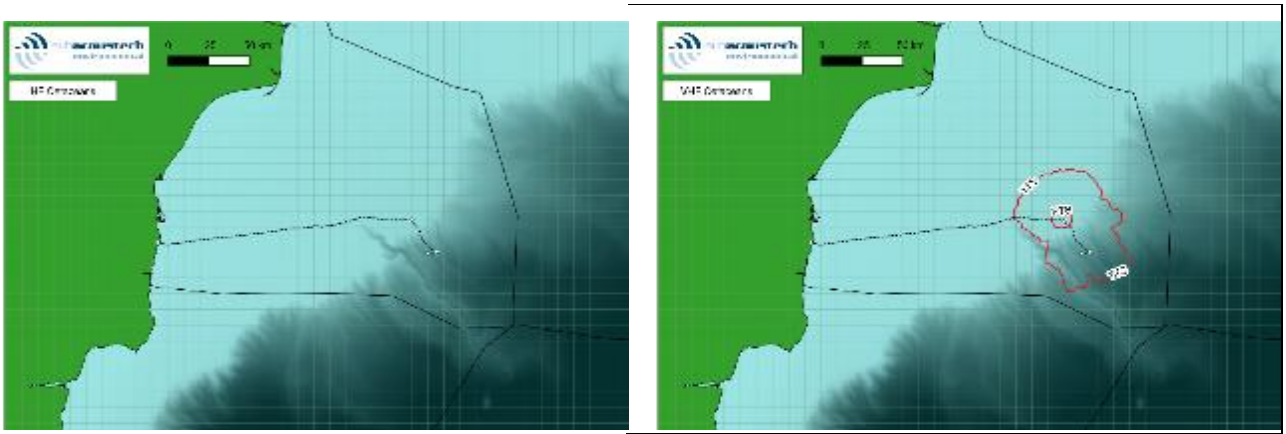


Figure 6.83 Cumulative impulse noise exposure level SEL $_{as}$ (Southall et al., 2019) with the hammer used at maximum energy for the installation of four successive piles, the inner isoline is the PTS limit and the outer one the TTS limit

Table 6.74 Synthesis of the Southall et al. (2019) model of the cumulative PTS impact for marine mammals associated with the noise generated during the installation of piles using MENCK 800S hammers

Southall et al. (2019) (MENCK 800 S maximum energy)		**SEL $_{as}$ weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)			
		Impulsive		**Incessant (continuous) - Non-impulse**	
		HF (185dB)	**VHF (155 dB)**	**HF (198 dB)**	**VHF (173dB)**
A single pillar	Maximum	< 100 m	7.7 km	< 100 m	< 100 m
	Minimum	< 100 m	3.8 km	< 100 m	< 100 m
	Mean	< 100 m	5.9 km	< 100 m	< 100 m
4 pillars	Maximum	< 100 m	7.8 km	< 100 m	< 100 m
	Minimum	< 100 m	3.9 km	< 100 m	< 100 m
	Mean	< 100 m	5.9 km	< 100 m	< 100 m

Table 6.75 Synthesis of the Southall et al. (2019) model of TTS cumulative impact for marine mammals associated with the noise generated during the installation of piles using MENCK 800S hammers

Southall et al. (2019) (MENCK 800 S maximum energy)		**SEL $_{as}$ weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)			
		Impulsive		**Non impulsive (continuous)**	
		HF (170 dB)	**VHF (140dB)**	**HF (178 dB)**	**VHF (153dB)**
A single pillar	Maximum	< 100 m	39 km	< 100 m	11 km
	Minimum	< 100 m	16 km	< 100 m	5.2 km
	Mean	< 100 m	29 km	< 100 m	7.9 km
4 pillars	Maximum	< 100 m	48 km	< 100 m	11 km
	Minimum	< 100 m	16 km	< 100 m	5.3 km
	Mean	< 100 m	32 km	< 100 m	8.0 km

Where,

SEL $_{cum}$ - Cumulative Noise Exposure Limit - Single value for the collected, combined total of sound exposure over a specified time or multiple instances of a noise source.

PTS (Permanent Threshold Shift-permanent hearing loss) - A permanent total or partial hearing loss caused by acoustic trauma.

TTS (Temporary Threshold Shift-temporary hearing loss).

HF (185dB) - high frequency cetaceans with a noise exposure limit of 185 dB.

According to Southall et al. (2019), as sound pulses propagate through water, they dissipate and also lose their most damaging characteristics (e.g., fast pulse rise time and peak sound pressure) and become more like noise "non-impulse" at longer distances. Thus, the above tables also show the distances for exposure to continuous noise that can significantly affect marine mammals.

The data in Table 6.74 indicate that exposure to noise levels using the hammer at full energy, impulse type of 185 dB in HF cetaceans at a distance of less than 100 meters from the sound source, may pose a significant risk to marine mammals, including the risk of PTS.

Table 6.74 shows exposure to noise levels using the hammer at maximum energy, pulse type of 155 dB in the case of VHF cetaceans at medium distance of 32 km from the sound source, may pose a significant risk to marine mammals, including the risk of PTS.

Exposure to impulse noise levels of 170 dB for HF cetaceans at a distance of less than 100 meters from the sound source can pose a significant risk to marine mammals, including the risk of TTS.

Exposure to impulse noise levels of 140 dB in the case of VHF cetaceans at an Medium distance of 32 km from the sound source can pose a significant risk to marine mammals, including the risk of TTS.

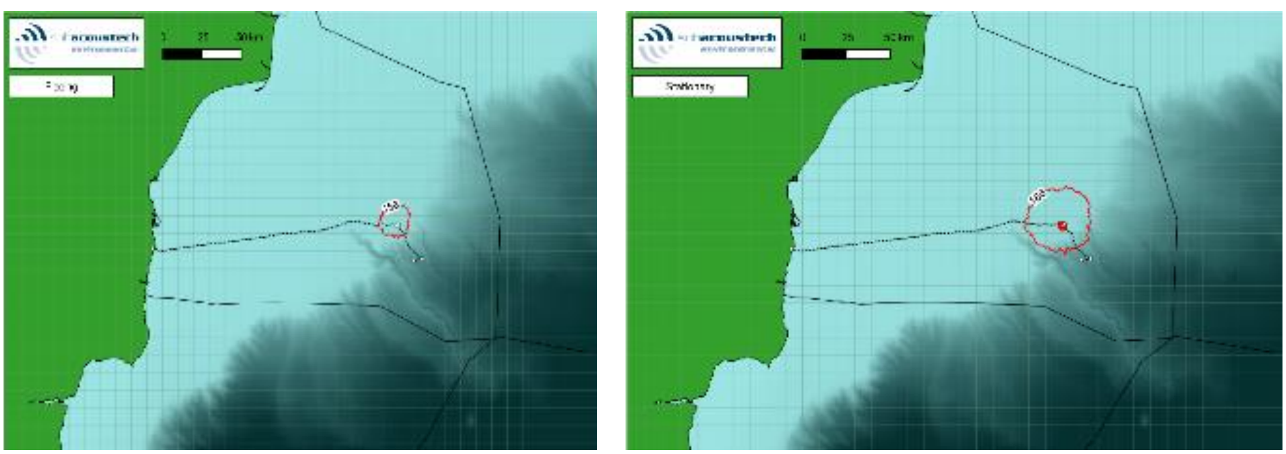
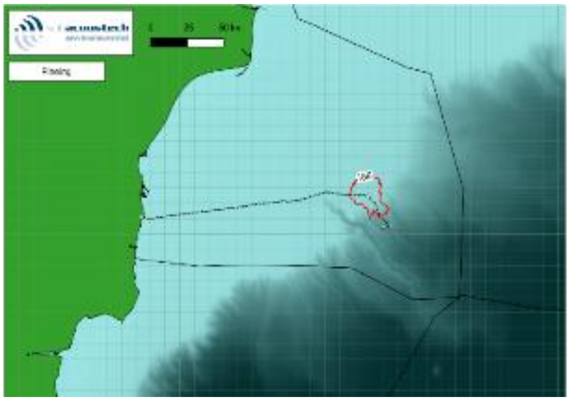


Figure 6.84 SELcum Cumulative Impulse Noise Exposure Level for Fish (Popper et al., 2014) with the hammer used at full power for a single pier installation, the outer isoline is the TTS limit and the inner isoline ≥ 203 dB



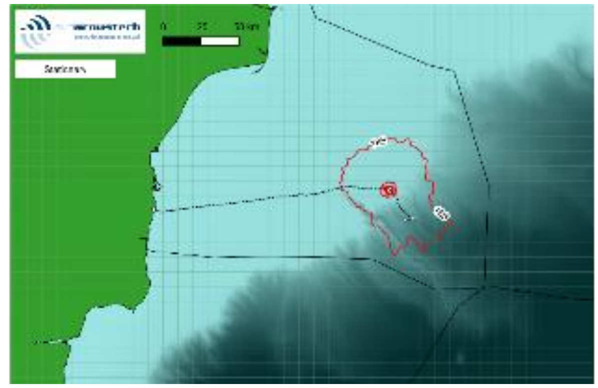


Figure 6.85 Cumulative impulse noise exposure level for fish (Popper et al., 2014) with the hammer used at maximum energy for the installation of four successive piers, the outer isoline is the TTS limit and the inner one ≥ 203 dB

Table 6.76 Synthesis of the model Popper et al. (2014) of the cumulative impact to fish associated with pile installation noise using a MENCK 800 S hammer at full power

Popper et al. (2014) (MENCK 800S maximum energy)		**SEL $_{as}$ unweighted (receiver moves)**					
		219 dB	**216 dB**	**210 dB**	**207 dB**	**203 dB**	**186 dB**
A single pillar	Maximum	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	12 km
	Minimum	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	5.8 km
	Mean	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	9.1 km
4 pillars	Maximum	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	17 km
	Minimum	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	6.4 km
	Mean	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	11 km

Table 6.77 Synthesis of the model Popper et al. (2014) of the cumulative impact for stationary receivers associated with pile installation noise using a MENCK 800 S hammer at full energy

Popper et al. (2014) (MENCK 800S maximum energy)		**SEL $_{as}$ unweighted (receiver moves)**					
		219 dB	**216 dB**	**210 dB**	**207 dB**	**203 dB**	**186 dB**
A single pillar	maximum	490m	780 m	1.8 km	2.8 km	4.0 km	28 km
	minimum	410 m	650 m	1.4 km	1.8 km	2.7 km	17 km
	Mean	440 m	710 m	1.5 km	2.1 km	3.3 km	23 km
4 pillars	maximum	1.2 km	1.8 km	3.7 km	5.0 km	9.2 km	76 km
	minimum	990 m	1.4 km	2.5 km	3.7 km	5.8 km	20 km
	Mean	1.1 km	1.5 km	2.9 km	4.2 km	7.1 km	41 km

In the case of fish and stationary species, exposure to noise levels between 219 dB and 186 dB at the indicated distances from the source can cause injuries.

b) MENCK 800S best case scenario hammer

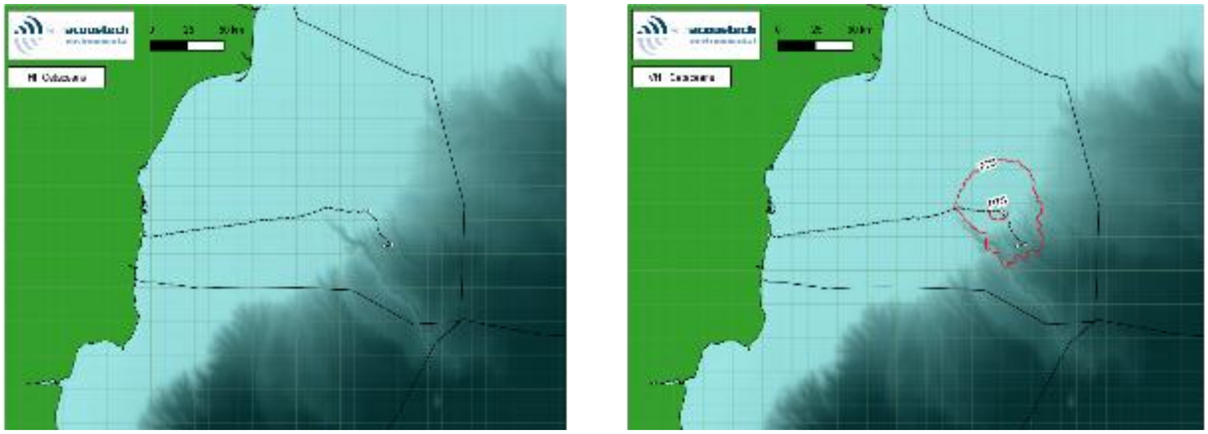


Figure 6.86 Cumulative impulse noise exposure level SELcum (Southall et al., 2019) with the hammer used in the best scenario for the installation of a single pillar, the inner isoline is the PTS limit and the outer isoline the TTS limit

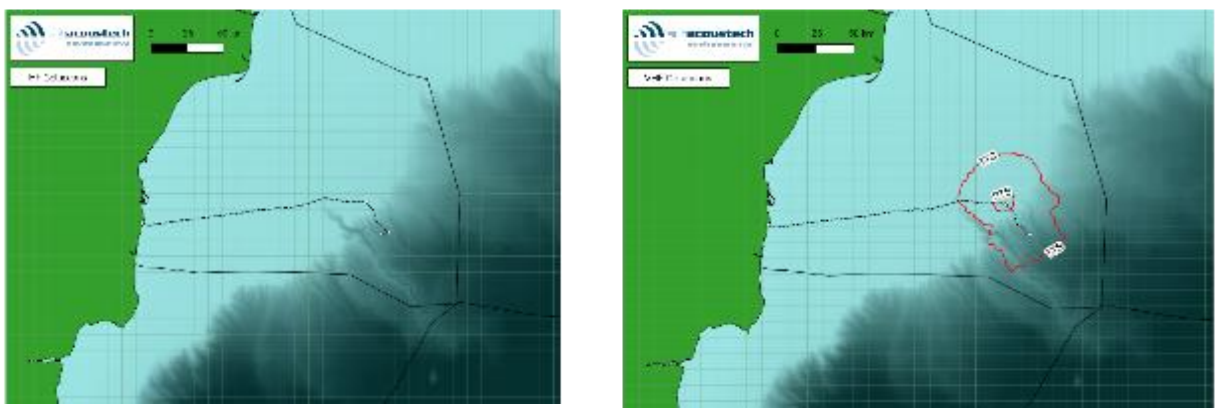


Figure 6.87 Cumulative impulse noise exposure level SEL $_{as}$ (Southall et al., 2019) with the hammer in the best scenario for the installation of four successive piles, the inner isoline is the PTS limit and the outer isoline the TTS limit

Table 6.78 Synthesis of the Southall et al. (2019) model of the cumulative PTS impact on marine mammals associated with the noise generated during the installation of piles using MENCK 800S hammers

Southall et al. (2019) (MENCK 800 S best case scenario)		**SEL $_{as}$ weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)			
		Impulsive		**Non impulsive (continuous)**	
		HF (185dB)	**VHF (155 dB)**	**HF (198 dB)**	**VHF (173dB)**
A single pillar	Maximum	< 100 m	7.9 km	< 100 m	< 100 m
	Minimum	< 100 m	3.9 km	< 100 m	< 100 m
	Mean	< 100 m	6.0 km	< 100 m	< 100 m
4 pillars	Maximum	< 100 m	8.2 km	< 100 m	< 100 m
	Minimum	< 100 m	4.1 km	< 100 m	< 100 m
	Mean	< 100 m	6.2 km	< 100 m	< 100 m

Table 6.79 Synthesis of the Southall et al. (2019) model of TTS cumulative impact for marine mammals associated with the noise generated during the installation of piles using MENCK 800S hammers

Southall et al. (2019) (MENCK 800 S best case scenario)		**SEL $_{as}$ weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)			
		Impulsive		**Non impulsive (continuous)**	
		HF (170 dB)	**VHF (140dB)**	**HF (178 dB)**	**VHF (153dB)**
A single pillar	Maximum	< 100 m	34 km	< 100 m	11 km
	Minimum	< 100 m	16 km	< 100 m	5.2 km
	Mean	< 100 m	28 km	< 100 m	8.0 km
4 pillars	Maximum	< 100 m	45 km	< 100 m	11 km
	Minimum	< 100 m	16 km	< 100 m	5.5 km
	Mean	< 100 m	31 km	< 100 m	8.4 km

Where,
SEL $_{cum}$ - Cumulative Noise Exposure Limit - Single value for the collected, combined total of sound exposure over a specified time or multiple instances of a noise source.
PTS (Permanent Threshold Shift-permanent hearing loss) - A permanent total or partial hearing loss caused by an acoustic trauma.
TTS (TemporaryThreshold Shift-temporary hearing loss)
HF (185dB) - high frequency cetaceans with a noise exposure limit of 185 dB.

According to Southall et al. (2019), as sound pulses propagate through water, they dissipate and also lose their most damaging characteristics (e.g., fast pulse rise time and peak sound pressure) and become more like noise "non-impulsive" at longer distances. Thus, the above tables also show the distances for exposure to continuous noise that can significantly affect marine mammals.

The data in Table 6.86 indicate that exposure to noise levels using the hammer at maximum energy, impulse type of 185 dB in HF cetaceans at a distance of less than 100 meters from the sound source, may pose a significant risk to marine mammals, including the risk of PTS.

Table 6.86 shows exposure to noise levels using the hammer at maximum energy, pulse type of 155 dB in the case of VHF cetaceans at medium distance of 6.2 km from the sound source, may represent a significant risk to marine mammals, including the risk of PTS.

Exposure to impulse noise levels of 170 dB for HF cetaceans at a distance of less than 100 meters from the sound source can pose a significant risk to marine mammals, including the risk of TTS.

Exposure to noise levels of 140 dB impulse type in the case of VHF cetaceans at an Medium distance of 31 km from the sound source can pose a significant risk to marine mammals, including the risk of TTS.

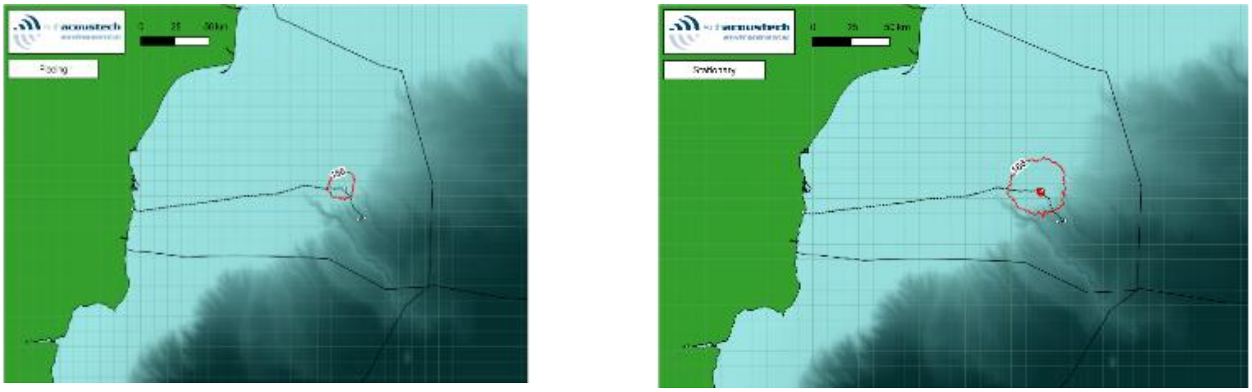


Figure 6.88 Cumulative impulse noise exposure level SELcum for fish (Popper et al., 2014) with the hammer in the best case scenario for a single pier installation, the outer isoline is the TTS limit and the inner isoline ≥ 203 dB

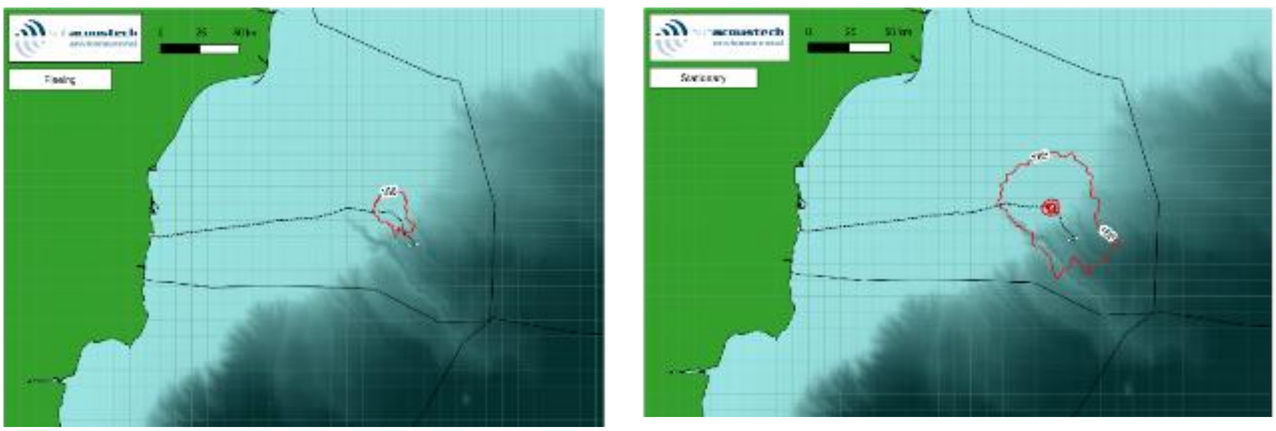


Figure 6.89 Cumulative impulse noise exposure level for fish (Popper et al., 2014) with the hammer in the best scenario for the installation of four successive piers, the outer isoline is the TTS limit and the inner one ≥ 203 dB

Table 6.80 Synthesis of the model Popper et al. (2014) of the cumulative impact to fish associated with the noise generated during piling installation using a MENCK 800 S hammer in the best case scenario

Popper et al. (2014) (MENCK 800S best case scenario)		**SEL $_{as}$ unweighted (receiver moves)**					
		219 dB	**216 dB**	**210 dB**	**207 dB**	**203 dB**	**186 dB**
A single pillar	Maximum	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	12 km
	Minimum	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	5.8 km
	Mean	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	9.1 km
4 pillars	Maximum	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	17 km
	Minimum	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	6.4 km
	Mean	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	11 km

Table 6.81 Synthesis of the model Popper et al. (2014) of the cumulative impact to stationary receivers associated with the noise generated when installing piles using a MENCK 800 S hammer in the best case scenario

Popper et al. (2014) (MENCK 800S best case scenario)		SEL $_{as}$ unweighted (receiver moves)					
		219 dB	**216 dB**	**210 dB**	**207 dB**	**203 dB**	**186 dB**
A single pillar	Maximum	320 m	520 m	1.2 km	1.9 km	3.1 km	23 km
	Minimum	280 m	440 m	1.1 km	1.4 km	2.2 km	13 km
	Mean	300 m	470 m	1.2 km	1.6 km	2.5 km	18 km
4 pillars	Maximum	830 m	1.3 km	2.9 km	3.9 km	6.1 km	48 km
	Minimum	690 m	1.1 km	1.9 km	2.6 km	4.4 km	19 km
	Mean	760 m	1.2 km	2.2 km	3.0 km	5.1 km	32 km

For fish and stationary species, exposure to noise levels between 219dB and 186dB at the indicated distances from the source may cause injury.

c) Hammer MENCK 3200iS with maximum energy

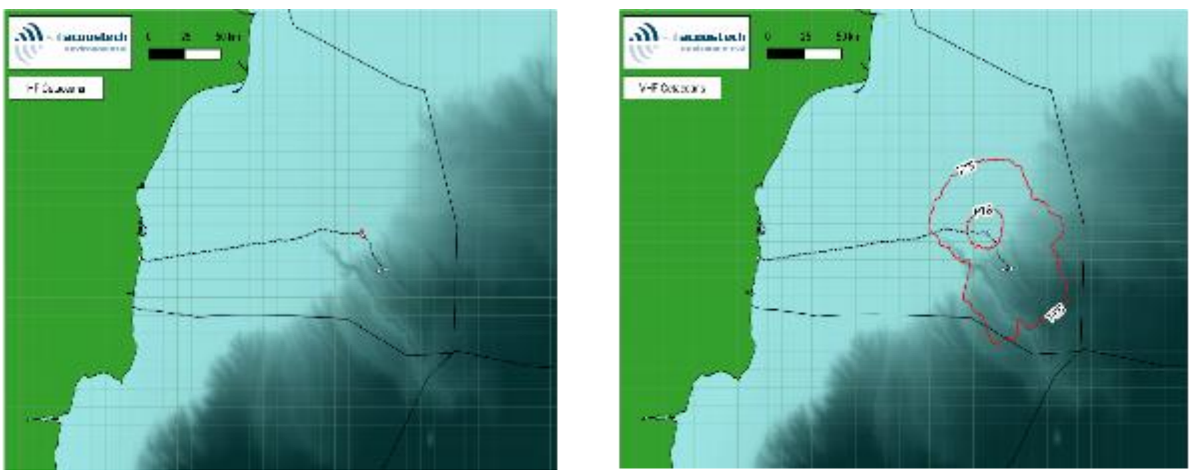
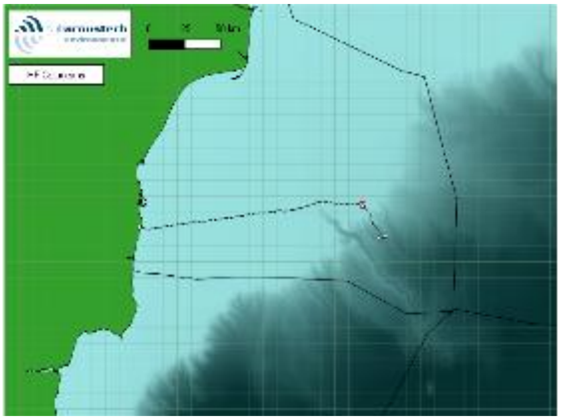


Figure 6.90 Cumulative impulse noise exposure level SEL $_{as}$ (Southall et al., 2019) with the hammer used at maximum energy for the installation of a single pier, the inner isoline is the PTS limit and the outer isoline the TTS limit



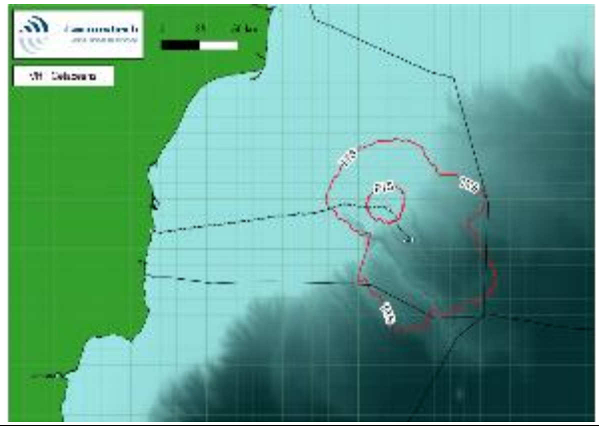


Figure 6.91 Cumulative impulse noise exposure level SEL as (Southall et al., 2019) with the hammer used in the maximum energy of four successive pillars, the inner isoline is the PTS limit and the outer one the TTS limit

Table 6.82 Synthesis of the Southall et al. (2019) model of the cumulative PTS impact for marine mammals associated with the noise generated during the installation of piles using MENCK 3200 iS hammers

Southall et al. (2019) (MENCK 3200iS maximum energy)		**SEL $_{as}$ weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)			
		Impulsive		**Incessant (continuous) - Non-Impulsive**	
		HF (185dB)	**VHF (155 dB)**	**HF (198 dB)**	**VHF (173dB)**
A single pillar	Maximum	< 100 m	15 km	< 100 m	< 100 m
	Minimum	< 100 m	7.5 km	< 100 m	< 100 m
	Mean	< 100 m	11 km	< 100 m	< 100 m
4 pillars	Maximum	< 100 m	15 km	< 100 m	< 100 m
	Minimum	< 100 m	7.9 km	< 100 m	< 100 m
	Mean	< 100 m	12 km	< 100 m	< 100 m

Table 6.83 Synthesis of the Southall et al. (2019) model of TTS cumulative impact for marine mammals associated with the noise generated during the installation of piles using MENCK 3200iS hammers

Southall et al. (2019) (MENCK 3200iS maximum energy)		**SEL $_{as}$ weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)			
		Impulsive		**Incessant (continuous) - Non-Impulsive**	
		HF (170 dB)	**VHF (140dB)**	**HF (178 dB)**	**VHF (153dB)**
A single pillar	Maximum	2.5 km	66 km	< 100 m	17 km
	Minimum	1.1 km	19 km	< 100 m	9.6 km
	Mean	1.8 km	42 km	< 100 m	14 km
4 pillars	Maximum	2.6 km	85 km	< 100 m	18 km

	Minimum	1.2 km	19 km	< 100 m	9.9 km
	Mean	1.8 km	48 km	< 100 m	14 km

Where,

SEL $_{cum}$ - Cumulative Noise Exposure Limit - Single value for the collected, combined total of sound exposure over a specified time or multiple instances of a noise source.

PTS (Permanent Threshold Shift-permanent hearing loss) - A permanent total or partial hearing loss caused by an acoustic trauma.

TTS (TemporaryThreshold Shift-temporary hearing loss)

HF (185dB) - high frequency cetaceans with a noise exposure limit of 185 dB

According to Southall et al. (2019), as sound pulses propagate through water, they dissipate and also lose their most damaging characteristics (e.g., fast pulse rise time and peak sound pressure) and become more like noise "non-impulse" at longer distances. Thus, the above tables also show the distances for exposure to continuous noise that can significantly affect marine mammals.

The data in Table 6.82 indicate that exposure to noise levels using the hammer at maximum energy, impulse type of 185 dB in HF cetaceans at a distance of less than 100 meters from the sound source, may pose a significant risk to marine mammals, including the risk of PTS.

Table 6.2 shows exposure to noise levels using the hammer at maximum energy, pulse type of 155 dB in the case of VHF cetaceans at an Medium distance of 12 km from the sound source, may pose a significant risk to marine mammals, including the risk of PTS.

Exposure to noise levels of 170 dB impulse type for HF cetaceans at an Medium distance of 1.8 km from the sound source can pose a significant risk to marine mammals, including the risk of TTS.

Exposure to noise levels of 140 dB impulse type in the case of VHF cetaceans at an Medium distance of 48 km from the sound source can pose a significant risk to marine mammals, including the risk of TTS.

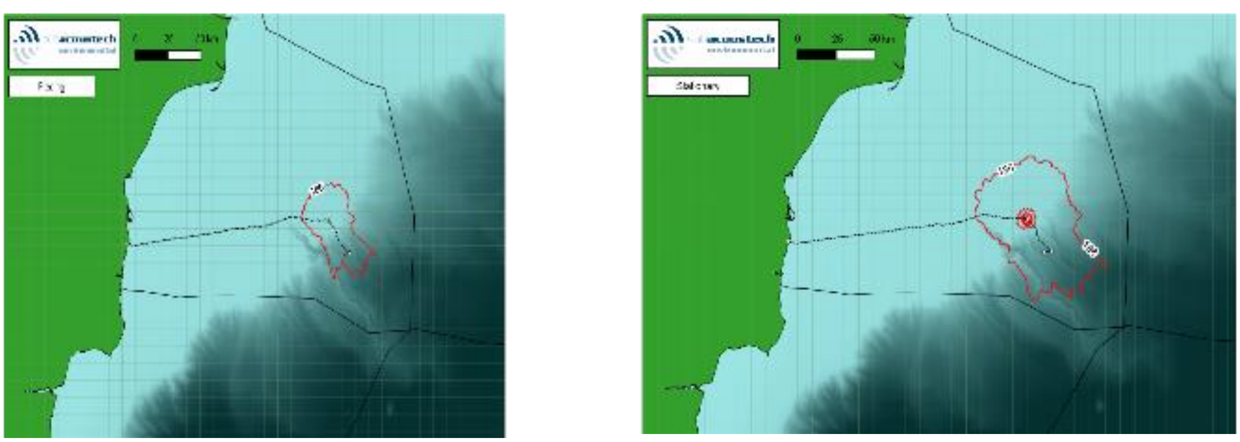


Figure 6.92 SELcum Cumulative Impulse Noise Exposure Level for Fish (Popper et al., 2014) with the hammer used at full power for a single pier installation, the outer isoline is the TTS limit and the inner isoline ≥ 203 dB

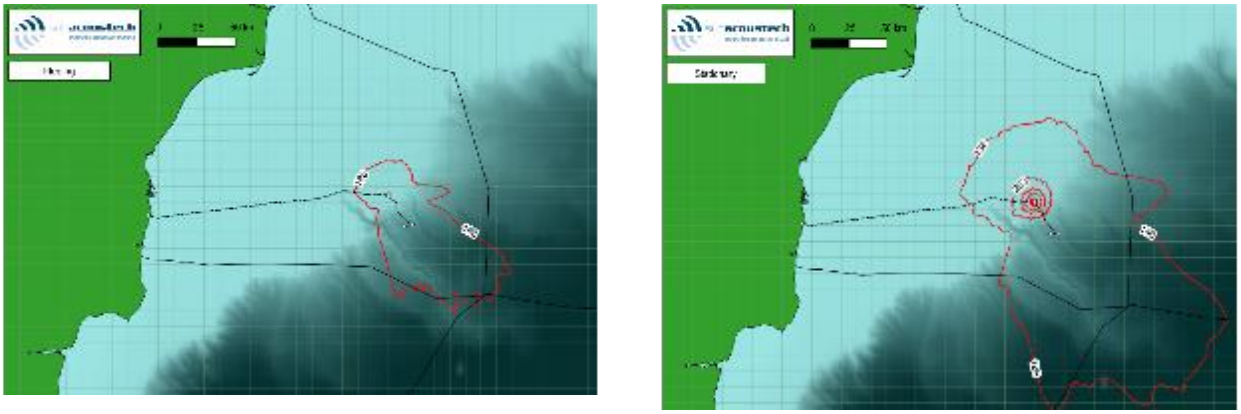


Figure 6.93 Cumulative impulse noise exposure level for fish (Popper et al., 2014) with the hammer used at maximum energy for the installation of four successive piers, the outer isoline is the TTS limit and the inner one ≥ 203 dB

Table 6.84 Synthesis of the model Popper et al. (2014) of the cumulative impact to fish associated with the noise generated during piling installation using a MENCK 3200 iS hammer at full power

Popper et al. (2014) (MENCK 3200 iS maximum energy)		**SEL $_{as}$ unweighted (receiver moves)**					
		219 dB	**216 dB**	**210 dB**	**207 dB**	**203 dB**	**186 dB**
A single pillar	Maximum	< 100 m	< 100 m	< 100 m	< 100 m	180 m	41 km
	Minimum	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	11 km
	Mean	< 100 m	< 100 m	< 100 m	< 100 m	120 m	21 km
4 pillars	Maximum	< 100 m	< 100 m	< 100 m	< 100 m	180 m	96 km
	Minimum	< 100 m	< 100 m	< 100 m	< 100 m	100 m	11 km
	Mean	< 100 m	< 100 m	< 100 m	< 100 m	130 m	32 km

Table 6.85 Synthesis of the model Popper et al. (2014) of the cumulative impact for stationary receivers associated with pile installation noise using a MENCK 3200 iS hammer at full energy

Popper et al. (2014) (MENCK 3200 iS maximum energy)		**SEL $_{as}$ unweighted (receiver moves)**					
		219 dB	**216 dB**	**210 dB**	**207 dB**	**203 dB**	**186 dB**
A single pillar	Maximum	960 m	1.4 km	3.1 km	4.2 km	7.2 km	58 km
	Minimum	820 m	1.2 km	2.2 km	2.8 km	4.9 km	20 km
	Mean	890 m	1.3 km	2.5 km	3.5 km	5.9 km	35 km
4 pillars	Maximum	2.0 km	3.1 km	6.3 km	9.6 km	16 km	>100 km
	Minimum	1.6 km	2.2 km	4.5 km	6.0 km	9.1 km	25 km
	Mean	1.8 km	2.5 km	5.1 km	7.6 km	13 km	67 km

In the case of fish and stationary species, exposure to noise levels between 219 dB and 186 dB at the indicated distances from the source may cause injury.

a) MENCK 3200iS best case scenario hammer

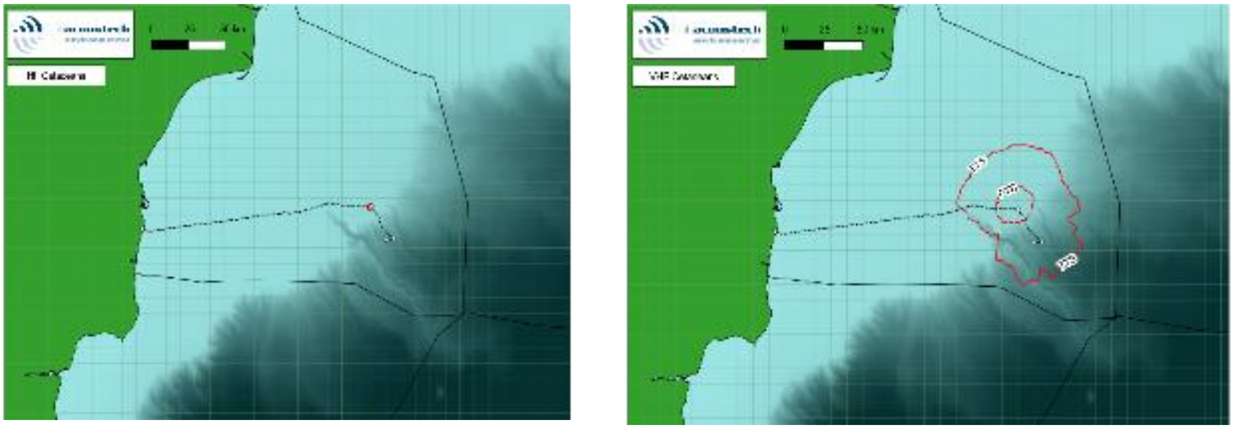


Figure 6.94 Cumulative impulse noise exposure level SELcum (Southall et al., 2019) with the hammer used in the best-case scenario for the installation of a single pier, the inner isoline is the PTS limit and the outer isoline the TTS limit

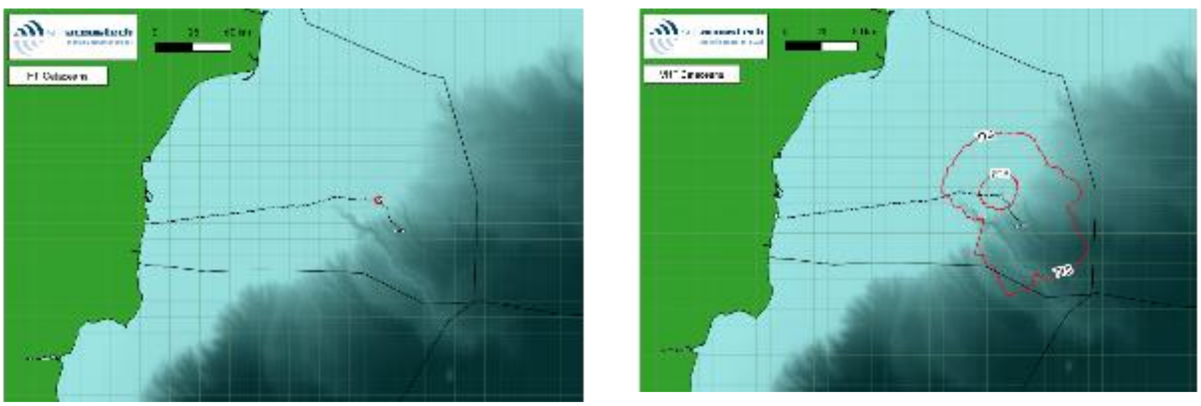


Figure 6.95 Cumulative impulse noise exposure level SEL $_{as}$ (Southall et al., 2019) with the hammer in the best-case scenario for the installation of four successive piers, the inner isoline is the PTS limit and the outer isoline the TTS limit

Table 6.86 Synthesis of the Southall et al. (2019) model of the cumulative PTS impact for marine mammals associated with the noise generated during the installation of piles using MENCK 3200iS hammers

Southall et al. (2019) (MENCK 3200iS best case scenario)		**SEL $_{as}$ weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)			
		Impulsive		**Non impulsive (continuous)**	
		HF (185dB)	**VHF (155 dB)**	**HF (198 dB)**	**VHF (173dB)**
A single pillar	Maximum	< 100 m	14 km	< 100 m	< 100 m
	Minimum	< 100 m	7.1 km	< 100 m	< 100 m
	Mean	< 100 m	11 km	< 100 m	< 100 m
4 pillars	Maximum	< 100 m	15 km	< 100 m	< 100 m
	Minimum	< 100 m	8.1 km	< 100 m	< 100 m
	Mean	< 100 m	12 km	< 100 m	< 100 m

Table 6.87 Synthesis of the Southall et al. (2019) model of TTS cumulative impact for marine mammals associated with the noise generated during the installation of piles using MENCK 3200iS hammers

Southall et al. (2019) (MENCK 3200iS best case scenario)		**SEL $_{as}$ weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)			
		Impulsive		**Non impulsive (continuous)**	
		HF (170 dB)	**VHF (140dB)**	**HF (178 dB)**	**VHF (153dB)**
A single pillar	Maximum	2.4 km	47 km	< 100 m	17 km
	Minimum	1.2 km	19 km	< 100 m	8.9 km
	Mean	1.8 km	36 km	< 100 m	13 km
4 pillars	Maximum	3.1 km	71 km	< 100 m	19 km
	Minimum	1.4 km	19 km	< 100 m	11 km
	Mean	2.2 km	45 km	< 100 m	15 km

Where,
SEL $_{cum}$ - Cumulative Noise Exposure Limit - Single value for the collected, combined total of sound exposure over a specified time or multiple instances of a noise source.
PTS (Permanent Threshold Shift-permanent hearing loss) - A permanent total or partial hearing loss caused by acoustic trauma.
TTS (Temporary Threshold Shift-temporary hearing loss)
HF (185dB) - high frequency cetaceans with a noise exposure limit of 185 dB.

The data in Table 6.86 indicate that exposure to noise levels using the hammer at full energy, impulse type of 185 dB for HF cetaceans at a distance of less than 100 meters from the sound source, may pose a significant risk to marine mammals, including the risk of PTS.

Table 6.86 shows exposure to noise levels using the hammer at maximum energy, pulse type of 155 dB in the case of VHF cetaceans at an Medium distance of 12 km from the sound source, may pose a significant risk to marine mammals, including the risk of PTS.

Exposure to noise levels of 170 dB impulse type in the case of HF cetaceans at an Medium distance of 2.2 km from the sound source can pose a significant risk to marine mammals, including the risk of TTS.

Exposure to noise levels, 140 dB impulse type in the case of VHF cetaceans at medium distance of 45 km from the sound source, can pose a significant risk to marine mammals, including the risk of TTS.

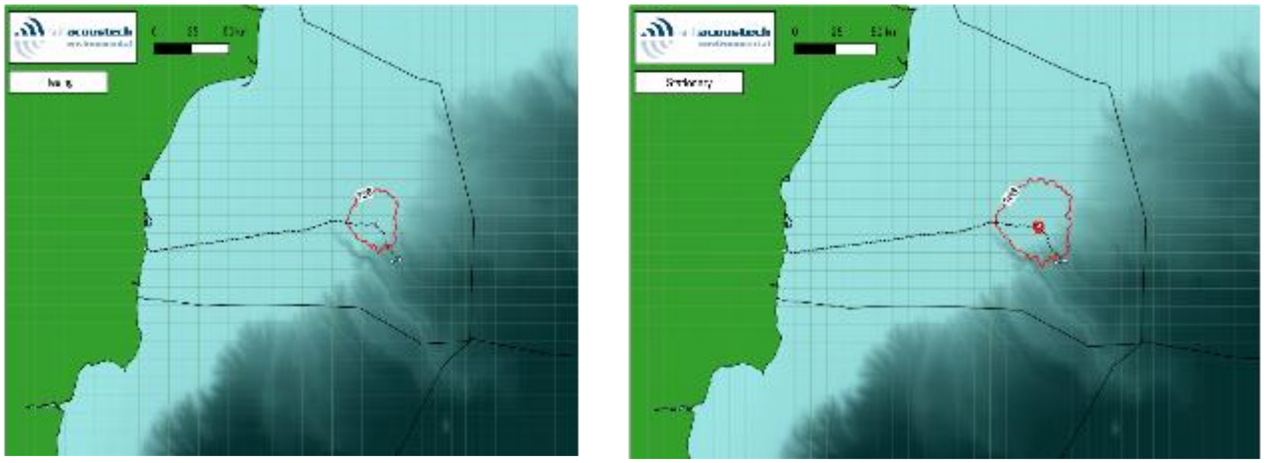


Figure 6.96 Cumulative impulse noise exposure level SELcum for fish (Popper et al., 2014) with the hammer in the best case scenario for a single pier installation, the outer isoline is the TTS limit and the inner isoline ≥ 203 dB

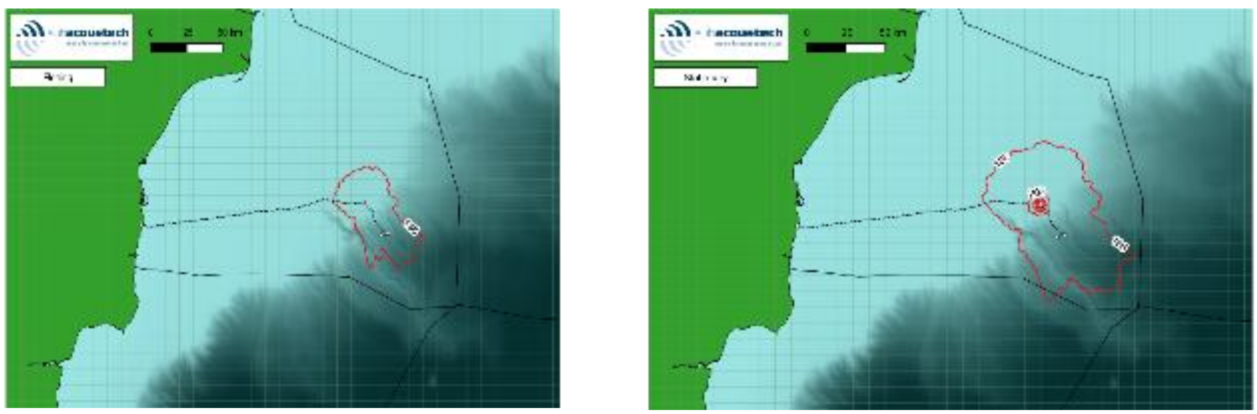


Figure 6.97 Cumulative impulse noise exposure level for fish (Popper et al., 2014) with the hammer in the best scenario for the installation of four successive piers, the outer isoline is the TTS limit and the inner one ≥ 203 dB

Table 6.88 Synthesis of the model Popper et al. (2014) of the cumulative impact to fish associated with pile installation noise using a MENCK 3200iS hammer in the best case scenario

Popper et al. (2014) (MENCK 3200iS best case scenario)		**SEL $_{as}$ unweighted (receiver moves)**					
		219 dB	**216 dB**	**210 dB**	**207 dB**	**203 dB**	**186 dB**
A single pillar	maximum	< 100 m	< 100 m	< 100 m	< 100 m	180 m	20 km
	minimum	< 100 m	< 100 m	< 100 m	< 100 m	< 100 m	11 km
	mean	< 100 m	< 100 m	< 100 m	< 100 m	120 m	16 km
4 pillars	maximum	< 100 m	< 100 m	< 100 m	< 100 m	210 m	49 km
	minimum	< 100 m	< 100 m	< 100 m	< 100 m	100 m	11 km
	mean	< 100 m	< 100 m	< 100 m	< 100 m	140 m	24 km

Table 6.89 Synthesis of the model Popper et al. (2014) of the cumulative impact to stationary receivers associated with pile installation noise using a MENCK 3200iS hammer in the best case scenario

Popper et al. (2014) (MENCK 3200iS best case scenario)		SEL $_{as}$ unweighted (receiver moves)					
		219 dB	**216 dB**	**210 dB**	**207 dB**	**203 dB**	**186 dB**
A single pillar	maximum	460 m	740 m	1.7 km	2.6 km	3.9 km	27 km
	minimum	390 m	620 m	1.3 km	1.8 km	2.6 km	16 km
	mean	420 m	670 m	1.5 km	2.0 km	3.1 km	22 km
4 pillars	maximum	1.1 km	1.7 km	3.6 km	4.6 km	8.3 km	71 km
	minimum	960 m	1.3 km	2.4 km	3.6 km	5.6 km	20 km
	mean	1.1 km	1.5 km	2.8 km	4.0 km	6.8 km	40 km

In the case of fish and stationary species, exposure to noise levels between 219 dB and 186 dB at the indicated distances from the source may cause injury.

Microtunneling

Figure 6.88 shows the estimated 1s unweighted SEL noise exposure levels from coastal microtunneling operations. Modeled impact ranges for marine mammals and fish are shown in Table 6.90 through Table 6.91. Due to the noise level as well as the water depth (10 m), the predicted impact ranges are low, TTS injury ranges for VHF cetaceans are estimated up to a maximum distance of 920 m from the noise source. The impact ranges from all other species groups are much smaller.

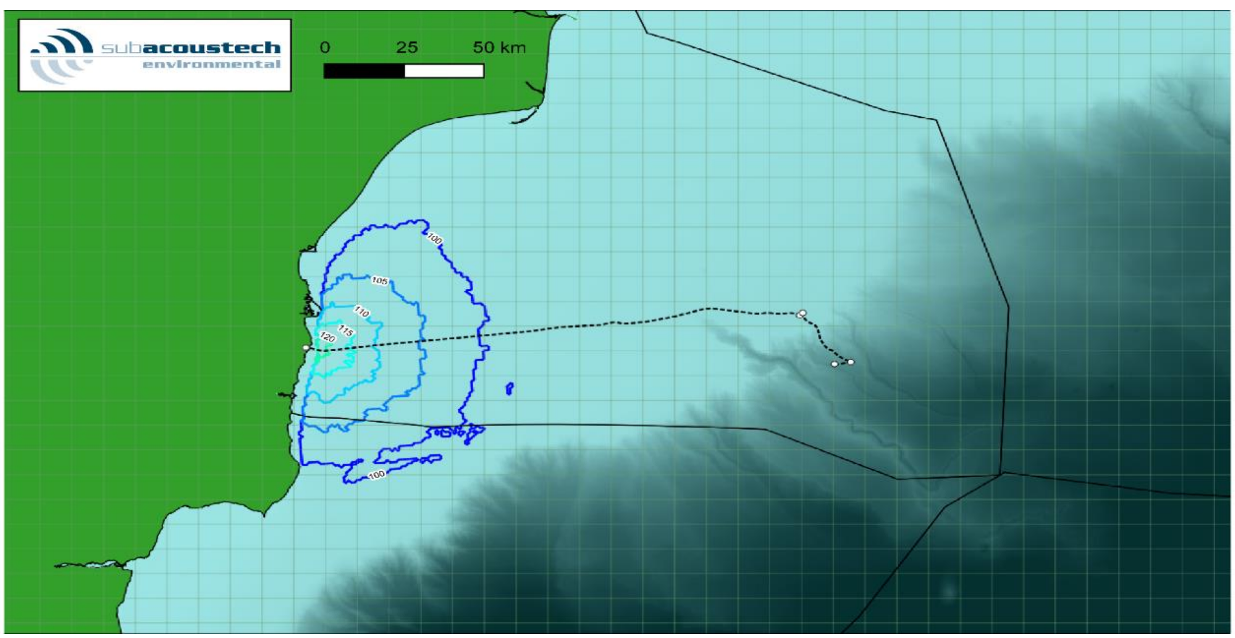


Figure 6.98 Estimated unweighted noise levels (only SEL per 1s) from the execution of the coastal microtunnel, isolines from 125 dB (green) to 100 dB (dark blue)

Table 6.90 Southall et al. (2019) Model Synthesis of Cumulative PTS Impact Range for Marine Mammals Associated with Microtunneling Noise

Southall et al. (2019) Execution of the microtunnel		SEL $_{as}$ weighted (the mammal moves away from the noise source at a speed of 1.5 m/s)	
		Continuous noise	
		HF (198 dB)	VHF (173dB)
PTS	Maximum	< 100 m	< 100 m
	Minimum	< 100 m	< 100 m
	Mean	< 100 m	< 100 m

where,

SEL $_{cum}$ - Cumulative Noise Exposure Limit - Single value for the collected, combined total of sound exposure over a specified time or multiple instances of a noise source.

PTS (Permanent Threshold Shift-permanent hearing loss) - A permanent total or partial hearing loss caused by acoustic trauma.

HF (198dB) - high frequency cetaceans with a noise exposure limit of 198 dB.

exposure levels greater than 198 dB for HF cetaceans and 173 dB for VHF cetaceans at a distance of less than 100 meters from the sound source may pose a significant risk to marine mammals, including the risk of PTS.

Table 6.91 Southall et al. (2019) Model Synthesis of Cumulative TTS Impact Range for Marine Mammals Associated with Microtunneling Noise

Southall et al. (2019) Execution of the microtunnel		SEL $_{as}$ weighted (the mammal moves away from the noise source at a speed of 1.5 m/s)	
		Continuous noise	
		HF (178 dB)	VHF (153dB)
TTS	Maximum	< 100 m	920 m
	Minimum	< 100 m	< 100 m
	Mean	< 100 m	120 m

TTS (TemporaryThreshold Shift-temporary hearing loss)

The noise exposure level of 178 dB for HF cetaceans at a distance of less than 100 meters from the sound source and 153 dB for VHF cetaceans at a maximum distance of 920 m may pose a significant risk to marine mammals, including the risk of TTS.

Table 6.92 Synthesis of the model Popper et al. (2014) of the impact range for fish associated with noise generated from microtunneling

Popper et al. (2014) Execution of the microtunnel		Unweighted $_{RMS}$ SPL	
		Continuous noise	
		170 dB	158 dB
TTS	Maximum	< 50 m	< 50 m
	Minimum	< 50 m	< 50 m
	Mean	< 50 m	< 50 m

In the case of fish, the noise exposure level of 170 dB and 158 dB, at a distance of less than 50 m from the source, can cause recoverable damage, respectively TTS.

Execution of the trench for placing the umbilical ducts

Figure 6.91 shows the estimated 1-second unweighted SEL noise levels from Trench Execution for offshore umbilical laying; the modeled impact ranges are shown in Table 6.93 to Table 6.95. Due to the low-frequency noise sources (< 50 Hz) in trenching, the sound pressure propagates to greater distances than some of the other sources and, as such, the maximum TTS impact ranges of marine mammals, according to Southall et al. (2019), are estimated at 5.2 km for LF cetaceans and 680 m for VHF cetaceans. Using Popper et al. (2014) criteria for fish, TTS ranges of up to 2.0 km from the ditch are estimated for fish with the swim bladder involved in hearing if the noise is present for a Duration of 12 h.

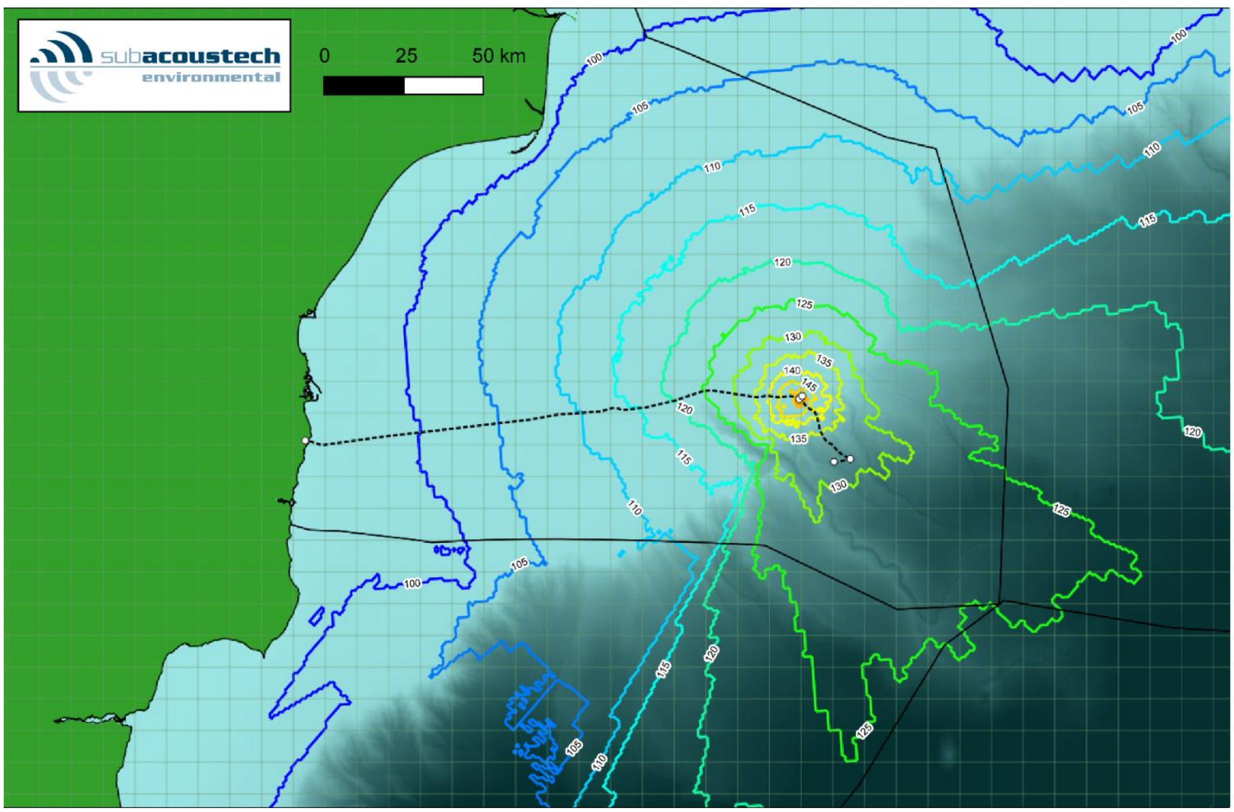


Figure 6.99 Estimated unweighted noise level (only SEL per 1s) from the execution of pipeline laying trenches in the sea, isolines from 150dB (orange) to 100dB (dark blue)

Table 6.93 Southall et al. (2019) Model Synthesis of Cumulative PTS Impact Range for Marine Mammals Associated with Dredging Noise

Southall et al. (2019) Execution of trenches laying pipes		**SEL $_{as}$ weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)	
		Continuous noise	
		HF (198 dB)	**VHF (173dB)**
PTS	Maximum	< 100 m	< 100 m
	Minimum	< 100 m	< 100 m
	Mean	< 100 m	< 100 m

Where, SEL $_{cum}$ - Cumulative Noise Exposure Limit - Single value for the collected, combined total of sound exposure over a specified time or multiple instances of a noise source.
PTS (Permanent Threshold Shift-permanent hearing loss) - A permanent total or partial hearing loss caused by acoustic trauma.
HF (198dB) - high frequency cetaceans with a noise exposure limit of 198 dB.

Underwater noise exposure levels above 198 dB for HF cetaceans and 173 dB for VHF cetaceans at a distance of less than 100 meters from the sound source may pose a significant risk to marine mammals, including the risk of PTS.

Table 6.94 Southall et al. (2019) Model Synthesis of Cumulative Marine Mammal TTS Impact Range Associated with Dredging Noise

Southall et al. (2019) Execution of trenches laying pipes		**SEL $_{as}$ weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)	
		Continuous noise	
		HF (178 dB)	**VHF (153dB)**
TTS	Maximum	< 100 m	680 m
	Minimum	< 100 m	170 m
	Mean	< 100 m	350 m

TTS (Temporary Threshold Shift-temporary hearing loss)

The underwater noise exposure level of more than 178 dB for HF cetaceans less than 100 meters from the sound source and 153 dB for VHF cetaceans at medium distance of 350 m from the noise source may represent a significant risk for marine mammals, including the risk of TTS.

Table 6.95 Synthesis of the model Popper et al. (2014) of the impact range for fish associated with the noise generated from the construction of ditches

Popper et al. (2014) Execution of trenches laying pipes		**Unweighted $_{RMS}$ SPL**	
		Continuous noise	
		170 dB	**158 dB**
TTS	Maximum	250 m	2.0 km
	Minimum	180 m	1.2 km
	Mean	200 m	1.4 km

In the case of fish, the sound pressure limit of 170 dB at a maximum distance of 250 m from the source and 158 dB at a maximum distance of 2.0 km from the source can cause injuries.

Noise generated by ships

The predicted noise levels from ship noise in the offshore area are shown in Figure 6.100, with the corresponding impact ranges given in Table 6.93 to Table 6.95. Maximum TTS impact ranges for marine mammals are estimated to be < 100 m for HF cetaceans and 700 m for VHF cetaceans. For swimbladder fish involved in hearing, TTS distances of up to 630 m from vessels are also predicted if noise is present for a Duration of 12 h.

We note that the vessel used for this modeling, a large container ship, is a worst-case assumption for vessels at the Neptune Deep site, and most of the impact ranges shown here will be lower for smaller vessels.

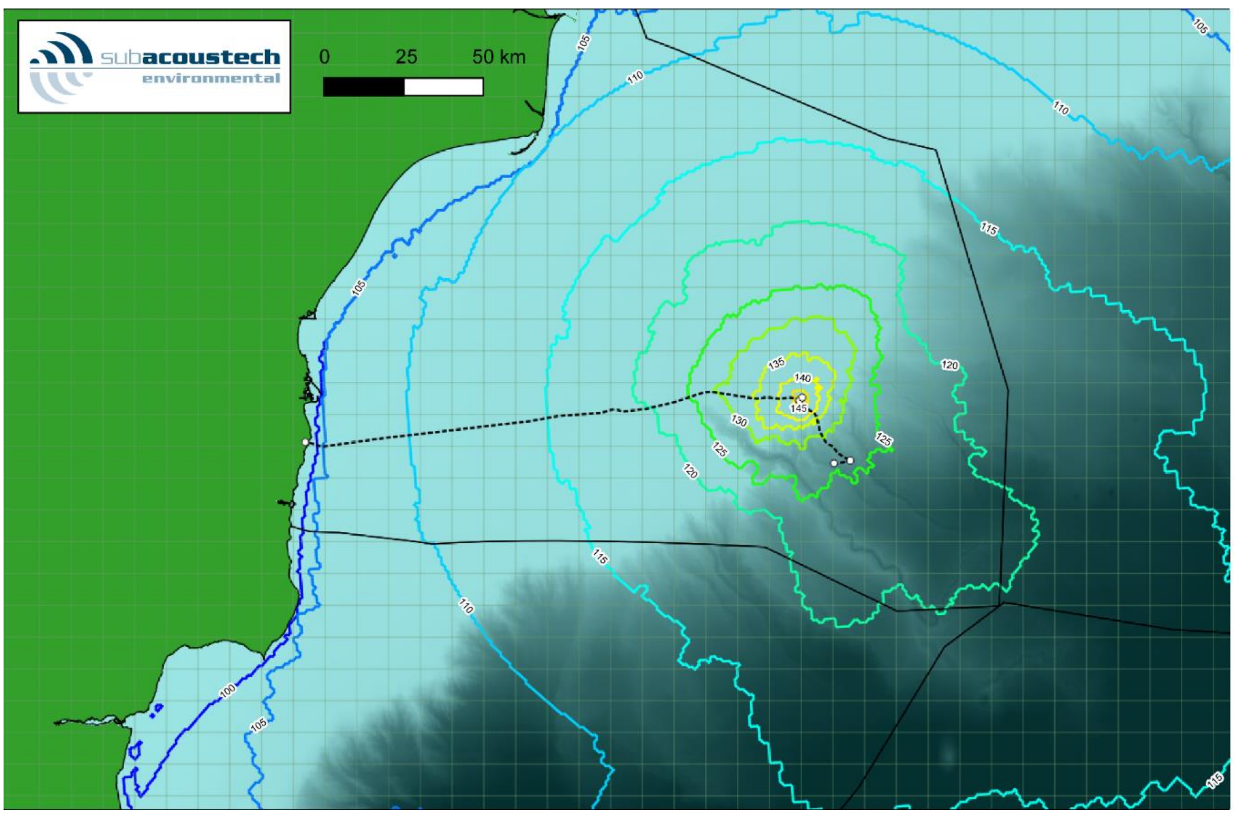


Figure 6.100 Estimated unweighted noise level (only SEL per 1s) from ships, isolines from 150dB (orange) to 100dB (dark blue)

Table 6.96 Synthesis of the Southall et al. (2019) model of the cumulative PTS impact range for marine mammals associated with ship noise

Southall et al. (2019) Noise from ships		SEL $_{as}$ **weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)	
		Continuous noise	
		HF (198 dB)	**VHF (173dB)**
PTS	Maximum	< 100 m	< 100 m
	Minimum	< 100 m	< 100 m
	Mean	< 100 m	< 100 m

Where, SEL $_{cum}$ - Cumulative Noise Exposure Limit - Single value for the collected, combined total of sound exposure over a specified time or multiple instances of a noise source.
PTS (Permanent Threshold Shift-permanent hearing loss) - A permanent total or partial hearing loss caused by an acoustic trauma.
HF (198dB) - high frequency cetaceans with a noise exposure limit of 198 dB

Underwater noise exposure levels above 198 dB for HF cetaceans and 173 dB for VHF cetaceans at a distance of less than 100 meters from the sound source may pose a significant risk to marine mammals, including the risk of PTS.

Table 6.97 Southall et al. (2019) model synthesis of cumulative TTS impact range for marine mammals associated with ship-generated noise

Southall et al. (2019) Noise from ships		SEL $_{as}$ **weighted** (the mammal moves away from the noise source at a speed of 1.5 m/s)	
		Continuous noise	
		HF (178 dB)	**VHF (153dB)**
TTS	Maximum	< 100 m	700 m
	Minimum	< 100 m	410 m
	Mean	< 100 m	540 m

TTS (TemporaryThreshold Shift-temporary hearing loss)

Underwater noise exposure levels of more than 178 dB for HF cetaceans less than 100 meters from the sound source and 153 dB for VHF cetaceans at a distance of 700 m from the noise source may pose a significant risk to marine mammals, including the risk of TTS.

Table 6.98 Synthesis of the model Popper et al. (2014) of the impact range for fish associated with ship noise

Popper et al. (2014) Noise from ships		**Unweighted $_{RMS}$ SPL**	
		Continuous noise	
		170 dB	**158 dB**
TTS	Maximum	90 m	630 m
	Minimum	80 m	490 m
	Mean	80 m	550 m

In the case of fish, the sound pressure limit of 170 dB at a maximum distance of 90 m from the source and 158 dB at a maximum distance of 630 m from the source can cause injury.

The magnitude of the impact of noise generated during the execution of dredging, drilling, microtunnels, ditches and ship noise was estimated to be minor, given the fact that they are negative, direct, manifest over a short period of time and have low intensity. As the identified receptors have medium sensitivity, a minor impact results.

In the case of impulse-type noise from the installation of the jacket by knocking the piles, the magnitude of the generated noise impact was estimated to be medium, given the fact that the noise is negative, direct, manifests itself over a short period of time and has medium intensity. As the identified receptors have medium sensitivity, a moderate impact results.

6.2.7 .2 Evaluation of the impact during the operation period

<u>6.2.7.2.1 Impact assessment during the period of operation in the terrestrial area</u>

6.2.7.2.1.1 Noise sources during the operation stage in the land area

The main sources of noise from NGMS and CCR are the following:

- Control valve and overhead pipes ~ 75 dB LpA at 1m;
- Flow conditioning devices and downstream overhead pipes~ 75 dB LpA at 1m;
- Other additional noise-generating/flow-restricting devices in the piping system and downstream overhead piping with estimated noise levels >75 dB LpA at 1 m;
- Relief valves, pressure relief valves and associated openings and downstream overhead piping up to and including the dispersion stack - 85 dB LpA at the nearest normally accessible location in an emergency, if practicable, but without exceed 110 dB LpA or a weighted sound power level of 120 dB LwA;
- External air conditioning unit from CCR building ~ 60 dB LpA at 1m;
- Diesel generator operation: estimated 1 hour/week ~ 75 dB LpA at 1m. The generator is equipped with an insulating case and vibration dampers;
- Outgassing during maintenance: It is estimated that maintenance will be performed once every 4 years for approximately 20 minutes.

The nearest dwellings are located to the east and south of the onshore facilities and the boundary of the pipeline site, shown as N2 and N6 in the image below.

Figure 6.101 Project location on land and nearby residential area

6.2.7.2.1.2 Noise modeling in daily operating conditions

In order to determine the attenuation of sound propagated in the associated ambient environment, the activities carried out during the operational phase of the Neptun Deep project, IO Consulting through Spectrum Acoustic Consultants, UK carried out [39]sound pressure level modeling using software. Noise modeling in detail is presented in Appendix M.

Modeling under normal operating conditions indicates that the weighted sound pressure level at the boundary of the NGMS site is 50 dB LpA and in the residential area it is between 30-35 dB LpA, which leads to a negligible impact.

[39]Spectrum Acoustic Consultants, UK - Natural Gas Metering Station and Onshore Facilities. Noise Assessment

Figure 6.102 The noise level generated in daily operating conditions

6.2.7.2.1.3 Noise modeling during the maintenance period and in abnormal operating situations

During the maintenance period as well as in emergency situations, the system is depressurized by releasing the natural gas through the vent stack, through purge (evacuation) valves, pressure safety valves and pressure reduction restriction holes, which will generate high noise levels. Pressure relief valves (PSVs), relief valves (BVs), restriction orifices (ROs) and downstream connected pipes will generate high noise levels, typically in the range of 120-140 dB LpA at 1 meter from the sura, due to the high flow and pressure drop across the valves and associated ports. However, it is estimated that due to acoustic insulation on the downstream pipelines and the installation of a noise attenuator at the gas dispersion stack, the noise level will be reduced by 20-30 dB (A). An emergency is a temporary, unexpected, infrequent situation in which the release of methane is unavoidable and necessary to prevent an immediate and substantial adverse impact on human safety, public health, or the environment.

The modeling results indicate that the weighted acoustic pressure level in the residential area, in emergency situations and during maintenance, is between 60-70 dB LpA. Modeling was carried out in the worst-case scenario for one hour with no mitigation measures applied.

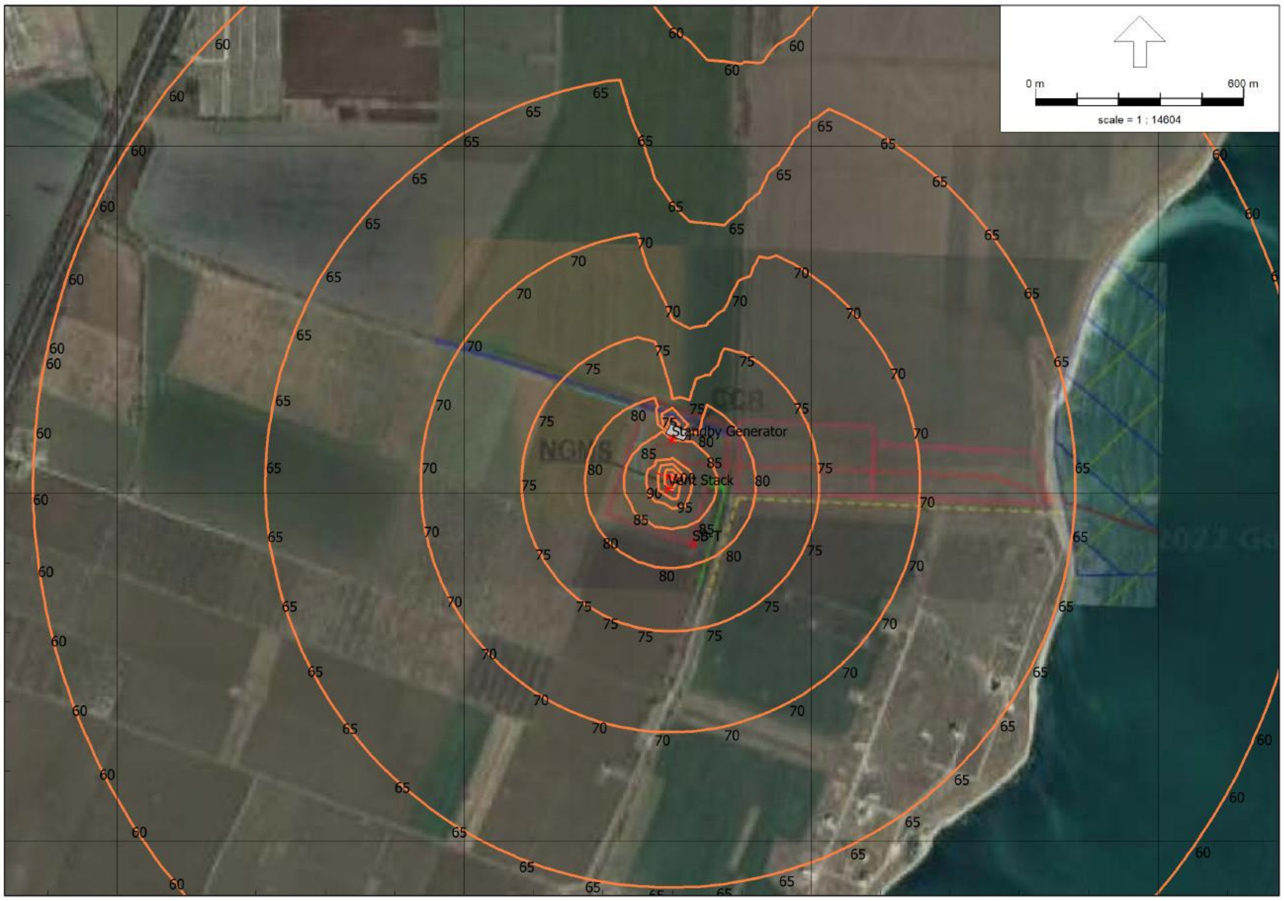


Figure 6.103 The noise level estimated to be generated during maintenance and in abnormal operating situations

In this context, the significance of the impact on the acoustic environment is insignificant, in the conditions of a medium sensitivity class, and of a negligible impact magnitude, with local extension, short-term and reversible, with a low intensity.

6.2.7.2.2 Impact assessment during the period of operation in the marine area

In the operating stage, under normal operating conditions, the generated noise does not represent a potential impact on the marine environment.

6.2.7.3 Evaluation of the impact on the acoustic environment during the decommissioning stage

6.2.7.3.1 Assessment of the impact on the acoustic environment in the land area

In the land area, it is estimated that the impact will be similar to that in the construction stage given the fact that the noise sources come from the operation of the machines used for decommissioning, the planned works as well as from the car traffic from the transport of equipment and waste. The decommissioning period in the land area is estimated at 12 months.

6.2.7.3.2 Assessment of the impact on the acoustic environment in the marine area

The decommissioning period at sea is estimated at 18 months.

In the decommissioning stage, underwater noise will be generated from the ships used for decommissioning from the works of cutting the installations, recovering the underwater infrastructure. Underwater noise has a potential impact on marine mammals and fish.

However, underwater noise from ships is not expected to exceed the hearing impairment threshold.

In addition to vessel noise, there will be potential underwater noise from utility cutting work. In the study, Pangerc et al. 2016, [40]it is noted that underwater noise from the decommissioning of a platform at 80 m depth increases the underwater background noise by 4-15 dB, which will not damage the hearing of marine mammals and fish.

The decommissioning activities are estimated to have a negative, direct, local effect in the short term, so the magnitude will be minor. The sensitivity of the receivers being estimated to be medium results in a minor impact.

6.2.7.4 Summary of noise impacts at all stages of the project

The table below shows the impact assessment by magnitude and receiver sensitivity without the application of impact mitigation measures. The impact significance matrix is presented in point 6.1.4.3.

Table 6.99 Assessment of the impact on the acoustic environment

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
Construction stage						
Increasing the noise level in the land area	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	term	Short term				
	The intensity	Low				
Increasing noise levels in the marine area	*Nature effect*	Negative	Medium	Medium	Moderate	Yes
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				

[40]Pangerc et al.2016, Underwater sound measurement data during diamond wire cutting: First description of radiated noise, https://marine.gov.scot/sites/default/files/underwater_sound_measurement_data.pdf

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
	Term	Short term				
	The intensity	Medium				
Operation stage						
Increasing the noise level in the land area	*Nature effect*	Negative	Negligible		No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Temporary				
	The intensity	Low				
Increasing noise levels in the marine area	*Nature effect*	Negative	Negligible	Medium	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Temporary				
	The intensity	Low				
Decommissioning stage						
Increasing the noise level in the land area	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	Term	Short term				
	The intensity	Low				
Increasing noise levels in the marine area	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
GENERAL ASSESSMENT of the impact on NOISE			**Minor** – onshore activities; **Moderate** – offshore (underwater noise during construction phase).			

6.2.7.5 Measures to prevent/avoid/reduce the impact on the acoustic environment

Given that from the assessment of the impact on the acoustic environment, the expected impact is mostly minor, no mitigation measures are necessary, except for the moderate impact during the construction stage in the marine area.

However, to mitigate the level of noise produced by machinery, equipment and vehicles during construction, operation and decommissioning, the following is recommended:

- Carrying out the work is staged in time and space, according to the work schedule.
- The installation of mobile panels to reduce the noise level during the execution of the microtunnel for the activities which will generate noise above the admissible limits in order to protect the inhabited areas.
- Carrying out work execution activities during the day, when possible, in the established schedule.
- Carrying out maintenance work on the equipment according to the maintenance schedule, so that the level of noise produced is below the maximum permissible limits.
- Perimeter planting of trees for sound attenuation when propagating through vegetation.

No measures are proposed for normal operating conditions in the operating stage, but additional installations/equipment will be included for the acoustic insulation of the GPP pipe, and for mitigating the noise level produced by the valves, up to 20-30 dB(A) in the scenario situation emergency.

The measures to reduce the level of noise produced in the underwater environment are the following:

- Use of marine mammal observers (MMO) accredited by JNCC to allow the commencement of operations with the application of soft start techniques during piling;
- Redo of observation and soft start techniques in after any break longer than 60 minutes, which might allow marine mammals to return to the work area;
- The construction works will be carried out in stages. During the installation works of the jacket pillars, no activities which would generate an increase in the cumulative impact of the noise will be performed.
- All vessels used in the project must comply with MARPOL 73/78 regulations.

6.2.8 Radiation

The effects of thermal radiation, natural radioactivity in the construction, operation and decommissioning stages of the project are presented in table 6.100 below.

Table 6.100 Effects of radiation

Effect	Construction stage	Operation stage	Decommissioning stage
Thermal radiation emissions	-	x	-
Light radiation emissions	-	x	-
Natural radionuclide emissions	-	x	-

The evaluation criteria for assessing sensitivity and magnitude are as follows:

Evaluation criteria

Magnitude criteria

Magnitude	Description
Negligible	The impact does not generate quantifiable (visible or measurable) effects in the natural state of the environment.
Low	Localizable and detectable temporary or short-term impacts on physical receptors (resources) that cause changes beyond natural variability without altering the functionality or quality of the receptor (resource). The environment returns to the state before the impact after the cessation of the activity that causes the impact.
Medium	Temporary or short-term impact on physical receptors (resources) that may extend beyond the local scale and produce changes in receptor (resource) quality or functionality. However, the long-term integrity of the receiver (resource) or any dependent receiver is not affected. If the extent of the impact is large, then the magnitude can also be large.
High	Impact on receptors (resources) that can cause irreversible changes and beyond the permissible limits, at the local or larger scale. Changes may alter the long-term character of the receptor (resource) and other dependent receptors. An impact that persists after the cessation of the activity producing it has a high magnitude.

Sensitivity criteria

Sensitivity	Description
Low	A receptor that is not important to the operation of the services, or that is important but resistant to change (in the context of the proposed activities) and will quickly naturally recover to its pre-impact state once the impacting activity stops.
Medium	A receiver/resource that is important for the services to function. It may be less resistant to change but can be returned to its original state through specific actions, or it can regenerate naturally over time.
High	A receptor/resource that is critical to ecosystems/services, is not resistant to change and cannot be restored to its original state.

Radiation sensitivity

Based on the information regarding the current state presented in Chapter 4, radiation has been assessed as having low sensitivity.

6.2.8.1 Impact assessment in the construction phase

6.2.8.1.1 Light radiation emissions

In the marine area, light emissions from ships or drilling platform can affect the local distribution of seabirds, thus becoming an attraction, some species of birds can be disoriented by these light emissions, hitting ships or platforms and so failing on these.

6.2.8.2 Impact assessment in the operating stage

6.2.8.2.1 Thermal radiation emissions

Thermal radiation emissions are generated by flare systems. The flare systems and their support arm have been designed so that the thermal radiation has no effect on the workers on the platform (when they are present for maintenance work) as well as on the equipment on the upper deck of the Neptun Alpha platform.

6.2.8.2.2 Light radiation emissions

The sources of light radiation emissions are lighting systems from the production platform and from the NGMS and CCR. The LED light sources in the NGMS and CCR area will be mounted on metal poles 8 m high, and the light will be directed downwards. The population in the area is potentially affected by light radiation.

Light emissions from ships or oil rigs can affect the local distribution of seabirds, thus becoming an attraction, some bird species can be disoriented by these light emissions, hitting ships or platforms and thus stranding them.

Studies and observations on the effects of artificial light on birds have shown that light from ships or marine oil structures usually attract nocturnal birds both as an activity and as a migration period, sometimes in large numbers [41]. This can lead to bird mortality, occasionally due to collision with non-illuminated structures near the light source that the birds cannot see, or more rarely, the lighted structures themselves.

Many of the cases of mortality have been reported in the situation of those birds that, flying past the lights, landed on the deck, after which they were no longer able to take flight again, which subsequently led to death, due to either dehydration, starvation, exhaustion, hypothermia.

It has also been proven that birds can be attracted to artificial light from a distance of up to 5km in the case of offshore installations with a brightness of 30 kW.

However, the analyzed area is located at a great distance from the shore and under these conditions, extremely few bird species reach this area. This is especially true of seabirds such as gulls, which can use the ship's superstructure as a resting place and feed on the fish in the area.

Migratory birds arrive in the area by accident, with migration routes following the shoreline even for marine species. Accidentally, different species can arrive in the analyzed area diverted by air currents or storms, but an actual avifauna is missing.

---

[41] Telfer, TC, JL Sincock, GV Byrd, and JR Reed. 1987. *Attraction of Hawaiian seabirds to lights: conservation efforts and effects of moon phase* . Wildlife Society Bulletin 15; Russell, RW 2005. *Interactions between migrating birds and offshore oil and gas platforms in the northern Gulf of Mexico: Final Report* . US Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-009 .

6.2.8.2.3 Natural radionuclide emissions

The activity concentration of natural radionuclides is estimated to be below the detection limit. The accumulation of deposits on the inside of pipes and installations can lead to a higher activity concentration if measures to eliminate this risk are not taken. To prevent the occurrence of these deposits in the technological process, a deposition inhibitor is injected at the wellheads. After testing the efficiency of several products of this kind, the operator opted for the use of the product SCAL13370A from the manufacturer Champion X, which indicated the best results.

During the operation phase, both the produced water, sea water, and sediments in the platform area will be monitored to determine if it is necessary to optimize the injection rates.

It is considered that there is no potential risk of increasing natural radionuclides in the Black Sea that would affect the waters on the territory of the Republic of Bulgaria.

All natural water sources contain natural radionuclides (natural radioactivity), including spring water, rainwater, and even tap water, but the concentrations are generally orders of magnitude below harmful levels to health.

Similarly, reservoir waters may contain low concentrations of natural radionuclides, which are not harmful in the concentrations found in the reservoir water itself, these being concentrations that are below the detection limits. However, if they accumulate in deposits inside the pipes or equipment, they could become a problem.

The risk of NORM accumulations depends on the geological formation, reservoir, well, and processing conditions (pressure and temperature), which influence the tendencies of sulfate and carbonate deposition.

From the tests carried out, the risk of barium sulfate and calcium carbonate deposits is low; however, for even greater safety, it has been decided to inject a deposition inhibitor at the wellhead level to eliminate the appearance of any potential deposits inside the system.

Based on the information provided, it is concluded that there is no potential risk of increasing the concentration of natural radionuclides in the Black Sea. As such, there will not be associated risks of technogenic increase of ionizing radiation that could lead to the contamination of marine waters, coastal waters and implicitly of surface and/or subsurface waters from the terrestrial area, both on Romanian and Bulgarian territory.

6.2.8.3 Impact assessment in the decommissioning stage

Decommissioning works onshore area are estimated to last 12 months and 18 months in the marine area.

No impact is estimated due to radiation during the decommissioning stage.

6.2.8.4 Summary of radiation impacts at all stages of the project

Table 6.101 Radiation impact assessment

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
Construction stage						
Light radiation emissions	*Nature effect*	Negative	Negligible	Low	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
Operation stage						
Light radiation emissions	*Nature effect*	Negative	Negligible	Low	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Long term				
	The intensity	Low				
Natural radionuclide emissions	*Nature effect*	Negative	Low	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Irreversible				
	Extension	Local				
	Term	Long term				
	The intensity	Low				
Thermal radiation emissions	*Nature effect*	Negative	Negligible	Low	No impact	
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Long term				
	The intensity	Low				
GENERAL ASSESSMENT of the Radiation			**Insignificant impact**			

6.2.8.5 Measures to prevent/avoid/reduce impact on material assets and natural resources

Given that from the radiation impact assessment, the expected impact is mostly minor, no impact mitigation measures are necessary.

6.2.9 Material goods and natural resources

The effects on material assets and natural resources during the construction, operation and decommissioning stages of the project are presented in table 6.102.

Table 6.102 Effects on material goods and natural resources

Effect	Construction stage	Operation stage	Decommissioning stage
Damage to material assets	x		-
Producing major accidents accompanied by explosions and/or fires that would spread and affect the material assets of the local community	-	x	-
Use of natural resources	x	x	-

The evaluation criteria for assessing sensitivity and magnitude are as follows:

Evaluation criteria

Magnitude criteria

Magnitude	Description
Negligible	Barely visible temporary impact on material assets as well as natural resources that does not lead to perceptible changes.
Low	Impact on material assets and natural resources over a short period of time, but which does not extend and does not generate disruptions to the population or resources.
Medium	Impact on material assets and natural resources that may generate long-term changes but does not affect the overall stability of material assets. If the extent of the impact is large, then the magnitude can also be large.
High	Impact on one or more material assets and natural resources that causes long-term or permanent changes and affects their overall stability and condition.

Sensitivity criteria

Sensitivity	Description
Low	The affected material assets and natural resources are not considered significant from a resource point of view, and do not have high economic, cultural or social value.
Medium	The material goods and natural resources affected are not significant in the general context of the analyzed area, but they have great local significance.
High	The material goods and natural resources affected are specifically protected by national or international legislation and are significant for the communities in the project area or at the regional/national level.

The sensitivity of material goods and natural resources

Based on the information regarding the current state, presented in Chapter 4, the material goods, was evaluated as having low sensitivity due to the fact that it does not involve damage to material goods, nor the irreparable loss of some material goods on which local communities depend.

The sensitivity in the case of non-renewable natural resources was assessed to be high given the fact that natural gas deposits are important at the national level.

However, natural gas is an important source of fuel for the national economy, and Romania will thus become the largest gas producer in the European Union.

6.2.9.1 Impact assessment in the construction stage

6.2.9.1.1 Affecting material assets

The accidental damage to the material assets of other local distributors in the project area during the construction phases (for example: water supply pipes, irrigation systems, communication cables, etc.) will have a potential impact on the population.

The installation of the gas production pipeline in the marine area will cross cables.

Accidentally during the construction of the temporary railway level crossing, potential damage may occur that will lead to the stoppage of railway traffic.

6.2.9.1.2 Use of Natural Resources

Regarding the natural resources used by the project in its implementation and operation (e.g., natural mineral aggregates, fresh water, and sea water), the quantities utilized are not capable of leading to the depletion of reserves.

6.2.9.2 Impact assessment in the operating stage

6.2.9.2.1 Producing major accidents accompanied by explosions and/or fires that would spread and affect the material assets of the local community

In accidental situations, with a low probability of occurrence, the occurrence of major accidents accompanied by explosions and/or fires at the NGMS and at the underground production pipeline leads to air emissions, discomfort for the population due to the damage to material assets.

6.2.9.2.2 Use of the natural resource

Regarding natural resources, production of natural gas is the main objective of the project. The activity will be planned to ensure that production is limited to economically recoverable reserves, having available the best available technologies.

From a socio-economic point of view, the exploitation of the resource represents a positive aspect, without leading to the depletion of this type of natural resource.

Therefore, considering the impact in a national context, with permanent, irreversible effects, the magnitude of the impact is medium. Given the low sensitivity, the significance of the impact is minor.

6.2.9.3 Impact assessment in the decommissioning stage

6.2.9.3.1 Affecting material assets

The damage to existing material assets in the project area during the decommissioning stage is identical to that during the construction stage.

Thus, it's concluded that the impact on material goods and natural resources will be negative, minor, with an impact significance of insignificant.

6.2.9 .4 Summary of impacts on material assets and natural resources in all stages of the project

Table 6.103 Impact assessment on material goods and natural resources

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
Construction stage						
Damage to material goods	*Nature effect*	Negative	Low	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	Term	Temporary				
	The intensity	Low				
Use of the natural resources	*Nature effect*	Negative	Low	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Irreversible				
	Extension	local				
	Term	Temporary				
	The intensity	low				
Operation stage						
Producing major accidents accompanied by explosions and/or fires that would spread and affect the material assets of the local community	*Nature effect*	Negative	Medium	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	Term	Short term				
	The intensity	Low				
Use of the natural resources	*Nature effect*	Negative	Medium	Low	Minor	No
	Effect type	Direct				

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
	Reversibility of the effect	Irreversible				
	Extension	Regional				
	Term	Permanent				
	The intensity	High				
Decommissioning stage						
Damage to material goods	*Nature effect*	Negative	Low	Low	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	Term	Long term				
	The intensity	Low				
Overall impact on material assets and natural resources			The impact is minor			

6.2.9.5 Measures to prevent/avoid/reduce the impact on material goods and natural resources.

Given that from the assessment of the impact on material goods and natural resources, the expected impact is mostly minor, no mitigation measures are required.

However, to prevent any impact on material assets, the following is recommended:

- Marking of areas where planned works overlap with pipelines;
- Work in areas of overlap with public utility pipes will be done manually where possible.

To prevent inefficient use of resources for sustainable exploitation, the following is recommended:

- The use of natural resources in the quantities allocated by the technical design, in order to avoid the depletion of resources;
- Compliance with the natural gas exploitation program agreed with the regulatory authorities;
- Implementation of emergency preparedness and response plans in order to avoid major accidents.

6.2.10 Cultural heritage

The effects on cultural heritage during the construction, operation and decommissioning stages of the project are presented in table 6.104.

Table 6.104 Effects on cultural heritage

Effect	Construction stage	Operation stage	Decommissioning stage
Cultural heritage impact in the onshore and offshore areas	x	-	x

The evaluation criteria for assessing sensitivity and magnitude are as follows:

Evaluation criteria

Magnitude criteria

Magnitude	Description
Negligible	Barely visible temporary impact on cultural heritage.
Low	Impact on the cultural heritage for a short period of time, which does not extend and does not generate changes.
Medium	Impact on cultural heritage that can generate long-term changes and generate partial changes to cultural heritage elements.
High	Impact on one or more elements of the cultural heritage causing long-term or permanent changes to the elements.

Sensitivity criteria

Sensitivity	Description
Low	The affected cultural heritage elements are not considered significant in terms of resources, and do not have a high cultural value.
Medium	The cultural heritage elements affected are not significant in the general context of the analyzed area, but they have great local significance.
High	The affected cultural heritage elements are specifically protected by national or international legislation and are significant for the communities in the project area or at the regional/national level.

The sensitivity of cultural heritage

Based on the information regarding the current state presented in Chapter 4, the cultural heritage has been assessed as having medium sensitivity due to the fact that the identified elements are representative of the local cultural heritage in the land area and national cultural heritage in the marine area.

6.2.10.1 Impact assessment during the construction stage

6.2.10.1.1 Cultural heritage impact in the onshore and offshore areas during construction

In the area established for the execution of construction works, both on land and at sea, there are no archaeological sites or historical monuments from the cultural heritage, but it represents an area with archaeological potential.

The identification and positioning of cultural heritage elements located in the vicinity in relation to the project elements were the subject of archaeological field research studies. Through the opinions obtained from the competent authorities (Ministry of Culture, Constanța County Directorate of Culture), the maintenance of some safety zones was established.

The location in the offshore area of the project is partially located in the archaeological protection zone of the Romanian continental platform on the Black Sea coast LMI Code **Underwater archaeological site "Continental Platform of the Romanian Black Sea Coast" CT-lsA-02561.**

Based on the current conditions of the evaluated component, the characteristics and works of the project, an insignificant impact on the cultural heritage during the construction phase is expected.

6.2.10.2 Impact assessment in the operating stage

Based on the current conditions of the evaluated component, the characteristics and works of the project, an insignificant impact on the cultural heritage is expected during the operation stage.

6.2.1 0.3 Impact assessment in the decommissioning stage

<u>6.2.10.3.1 Cultural heritage impact during decommissioning in the onshore and offshore areas</u>

The elements of cultural heritage located in the vicinity in relation to the elements of the project were the subject of archaeological field research studies before the start of construction works. Through the opinions obtained from the competent authorities (Ministry of Culture, Constanța County Directorate of Culture), the maintenance of some safety zones was established.

Based on the current conditions of the evaluated component, the characteristics and works of the project, an insignificant impact on cultural heritage is expected during the decommissioning stage.

6.2.10.4 Summary of impacts on cultural heritage in all stages of the project

Table 6.105 Evaluation of the impact on cultural heritage

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
Construction stage						
Affecting the cultural heritage	*Nature effect*	Negative	Negligible	Medium	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	term	Short term				
	The intensity	Low				
Decommissioning stage						
	Nature effect	Negative	Negligible	Medium	No impact	No
	Effect type	Direct				

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
Affecting the cultural heritage	*Reversibility of the effect*	Reversible				
	Extension	local				
	term	Short term				
	The intensity	Low				
General impact on cultural heritage			**Insignificant impact**			

6.2. 10.5 Measures to prevent/avoid/reduce the impact on cultural heritage

Given that from the assessment of the impact on the cultural heritage the impact is insignificant, no mitigation measures are necessary.

For the protection of the objectives of interest for the national cultural heritage identified in the marine area in the vicinity of the project site, the following are recommended:

- Maintaining the safety zone of the cultural heritage objectives identified in the marine area of the project;
- In the case of chance finds, the relevant onshore or offshore legal provisions will be applied.;
- In the event of the discovery of archaeological complexes that require "in situ" conservation, the project will adapt to the realities revealed by archaeological research, as per legal provisions.

6.2.11 The landscape

The effects on the landscape during the construction, operation and decommissioning stages of the project are presented in table 6.106.

Table 6.106 Effects on the landscape

Effect	Construction stage	Operation stage	Decommissioning stage
Change of land use	x	-	x
The presence of the drilling rig in the marine area	x	-	-
Presence of NGMS and CCR in the land area	-	x	-
The presence of the production platform	-	x	-

The evaluation criteria for assessing sensitivity and magnitude are as follows:

Evaluation criteria

Magnitude criteria

Magnitude	Description
Negligible	Barely visible temporary impact on the landscape.
Low	Impact on extinction for a short period of time, but which does not extend and does not generate disruptions to the population or resources.
Medium	Impact on the landscape that may generate long-term changes but will not result in visible changes to the landscape.
High	Impact on the landscape that causes long-term or permanent changes and will result in obvious changes to the landscape.

Sensitivity criteria

Sensitivity	Description
Low	The affected landscape is not considered significant in terms of natural features.
Medium	The affected landscape is not significant from the point of view of natural characteristics in the general context of the analyzed area, but they have great local significance.
High	The affected landscape has landscape importance at national or international level and are significant for communities in the project area or at regional/national level.

The sensitivity of the landscape

Based on the information regarding the current state presented in Chapter 4, the landscape was assessed as having **low sensitivity** because it does not present special natural characteristics.

6.2.11.1 Impact assessment during the construction stage

6.2.11.1.1 Change of land use

The land affected by the construction works was removed from the agricultural circuit. The presence of the machines will create a visual impact on the receivers in the project area.

Landscaping elements are provided by the technical construction project, in order to reduce the visual impact, namely: planting a perimeter curtain of trees and shrubs on the NGMS and CCR land plot, covering the land surfaces under which the gas production pipeline passes.

6.2.11.1.2 The presence of the drilling platform in the marine area

The MODU drilling platform will be present for approximately 2 years at the project site in the marine area. The structure of the drilling platform will not be visible from the shore given the distance of 160 km.

Distances are 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 the viewer's height and decreases at lower elevations and with decreasing atmospheric clarity. On a clear day viewed from the beach, the horizon will be about 6 km away. 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, its horizon is always perceived as very distant.

The visual impact due to the presence of the drilling platform will be limited to maritime traffic in the vicinity of the drilling platform. The visual influence area of the drilling rig with an estimated height of 68m is estimated to be approximately 36 km.

In Romania, sea fishing, carried out along the Romanian coastal river, is limited to marine areas up to 60-meter isobaths, due to the characteristics of the vessels and their limited autonomy.

Given the large distance from the shore, the presence of the drilling platform will have an insignificant impact on the landscape.

6.2.11.2 Impact assessment in the operating stage

6.2.11.2.1 Presence of NGMS and CCR in the land area

In the operation stage, the impact on the visual aesthetics will be generated by the new onshore infrastructures, respectively NGMS and CCR.

The NGMS will include only the infrastructure required for essential operation with a limited number of buildings such as the local equipment room (LER) and gas/moisture analyzer housing. No office, storage or workshop spaces are provided in the fenced area related to NGMS.

For most of the NGMS related equipment and buildings, off-site prefabricated skids and subassemblies will be used, including the pigging station, metering equipment and valves.

The area occupied by the NGMS will be 23,183 m^2, with the dispersion stack having the highest height of 12 m.

The Centralized Control Room - CCR is an independent building located near the NGMS and has a height of approximately 7 m. The occupied area will be 3,459 m^2.

A perimeter vegetal curtain composed of woody vegetation will be installed around the entire plot of land comprising NGMS and CCR (surface S1 with cadastral number 109216, owned by OMV Petrom except for the gas pipeline protection zone, as national regulations do not allow the planting of trees or any other plants with roots deeper than 50 cm in these areas.

A suggestive 3D image of NGMS and CCR is shown in figure no. 104 for the visual appearance of the onshore facilities is provided in the renderings shown below.

Figure 6.104 Image with NGMS and CCR in operation stage

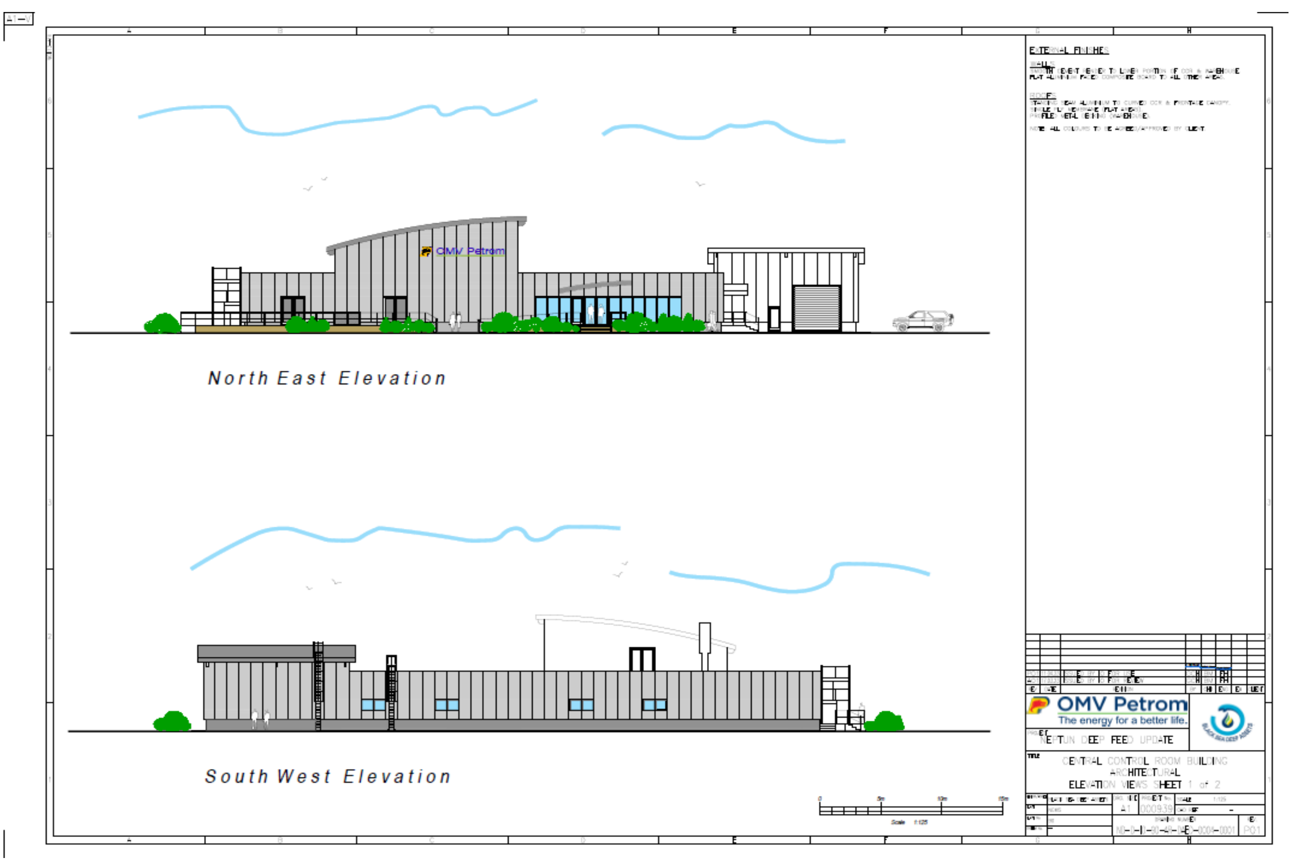


Figure 6.105 Command and Control Room (CCR)

The lands on which the gas production pipeline is installed underground will be grassed, the visual image will be of a grassed area. According to safety regulations, no trees or shrubs are planted over the gas production pipeline.

6.2.11.2.2 Presence of production platform

The production platform will be present for a long period of a maximum of 20 years at the project site in the marine area. The structure of the production platform will not be visible from the shore given the distance of 160 km.

The visual impact due to the presence of the production platform will be limited to maritime traffic in the vicinity of the drilling platform. The area of visual influence of the drilling platform with an estimated height of 68m is estimated to be approximately 36 km.

Given the large distance from the shore, the presence of the production platform will have an insignificant impact on the landscape.

6.2.11.3 Impact assessment in the decommissioning stage

6.2.11.3.1 Change of land use

After the NGMS and CCR decommission, the land owner will decide what use the land will have. The presence of the machines will create a visual impact on the receivers in the project area.

In the land area, after the demolition and evacuation of the materials, waste, installations on the land, landscaping works will be carried out in order to restore the environment.

Decommissioning works in the land area are estimated to last 12 months.

6.2.11.4 Summary of impacts on the landscape at all stages of the project

The summary of impacts on the landscape it is presented in the table below.

Table 6.107 Assessment of the impact on the landscape

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
Construction stage						
Change of land use	*Nature effect*	Negative	Negligible	Low	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
The drilling platform	*Nature effect*	Negative	Negligible	Low	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
Operation stage						
Presence of NGMS and CCR	*Nature effect*	Negative	Negligible	Low	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	Term	Short term				
	The intensity	Low				
The presence of the production platform	*Nature effect*	Negative	Negligible	Low	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
Decommissioning stage						
Change of land use	*Nature effect*	Negative	Negligible	Low	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
Overall impact on the landscape			Insignificant impact			

6.2.11.5 Measures to prevent/avoid/reduce the impact on cultural heritage

Given that from the landscape impact assessment the impact is insignificant, no mitigation measures are required.

Though, to decrease any potential visual discomfort of the local population due to the presence of machinery, equipment and onshore installations (NGMS), recommendations are as follows:

- The occupation of additional land areas compared to those provided for in the project will be avoided;
- Construction works will take place only in the areas demarcated for the works;
- Only the indicated access roads will be used for the transport of materials;
- A curtain of vegetation is installed and maintained to reduce the visibility of the NGMS.

6.2.12 Human settlements

The location on land provided for the implementation of the analyzed project is located to the south of the administrative territory of Tuzla commune, and at the northern limit of the administrative territory of Costineşti commune.

Currently, the buildings built within the territorial administrative radius of Tuzla and Costinești communes are used by the population for residential purposes (housing). Tourist guesthouse buildings are mainly occupied in the summer season (June to August) by tourists.

The nearest houses are located approximately 100 m south of the site boundary proposed for the installation of the production pipeline and the onshore entry point of the microtunnel underpass, respectively approximately 350 m southeast of the site boundary proposed for the installation of the NGMS.

The effects on human settlements during the construction, operation and decommissioning stages of the project are presented in table 6.108.

Table 6.108 Effects on human settlements

Effect	Construction stage	Operation stage	Decommissioning stage
Change of land use	x	-	x
Presence of NGMS and CCR	x	x	x

The evaluation criteria for assessing sensitivity and magnitude are as follows:

<u>Evaluation criterias</u>

Magnitude criteria

Magnitude	Description
Negligible	Barely visible temporary impact on human settlements.
Low	Impact on human settlements for a short period of time, but which does not extend and does not generate disruptions to the population or resources.
Medium	Impact on human settlements that may generate long-term changes but does not affect the overall stability of material assets. If the extent of the impact is large, then the magnitude can also be large.
High	Impacts on human settlements that cause long-term or permanent changes and affect their overall stability and condition.

Sensitivity criteria

Sensitivity	Description
Low	Human settlements are not considered significant in terms of resources, and are not of high economic, cultural or social value.
Medium	The affected human settlements are not significant in the general context of the analyzed area, but they have great local significance.
High	Affected human settlements are specifically protected by national or international legislation and are significant for communities in the project area or at regional/national level.

<u>The sensitivity of human settlements</u>

Based on the information regarding the current state presented in Chapter 4, the human settlements were assessed as having **medium sensitivity** due to the houses present near the proposed site as well as the fact that through the General Urbanism Plan of the Costinești commune, the administrative territory of the Costinești commune is proposed for development tourist a construction area (''intravilan'') located adjacent to the southern limit of the project site.

6.2.12.1 Impact assessment during the construction stage

<u>6.2.12.1.1 Change of land use</u>

The implementation of the project will involve changes regarding the final use of some land areas owned by OMV Petrom SA. This aspect will not affect, however, the use of the lands in the vicinity of the project's onshore location, which will have the same destination as at present.

The lands with a total area of 138184 square meters, having the cadastral codes 109659, 109729 100819 corresponding to the S3 and S4 lands mentioned in this document, according to the decision of the Constanța County Agriculture Directorate no. 10385/3.10.2022, were permanently removed from the agricultural circuit.

The implementation of the Neptun Deep project is to take place on land privately owned by OMV Petrom SA, and as regards the natural gas exploitation and production facilities, they are located in the Romanian sector of the EEZ, the Black Sea, the area where the state, through the authorities manage natural resources, namely the Romanian Waters National Administration, the National Mineral Resources Agency.

During construction, the temporarily occupied surfaces in the land area are only on the site owned as property by OMV Petrom, the existing exploitation roads in the area will be used and the lands in the vicinity of the site will not be affected.

The total area estimated to be temporarily occupied during construction in the land area is 52,451 sq m.

The construction work in the land area is estimated to last 8 months, and the installation of the facilities in the NGMS and the construction of the CCR will take approximately 12 months.

The presence of the machines will create a visual impact on the receivers in the project area.

Landscaping elements are provided by the technical construction project, to reduce the visual impact, namely: planting a perimeter curtain of trees and shrubs on the NGMS and CCR land plot, covering the land surfaces under which the gas production pipeline passes.

6.2.12.2 Impact assessment in the operating stage

6.2.12.2.1 Presence of NGMS and CCR

In the operating stage, the impact on human settlements is under the aspect of visual aesthetics generated by the new onshore infrastructures, respectively, NGMS and CCR.

The NGMS will include only the infrastructure required for essential operation with a limited number of buildings such as the local equipment room (LER) and gas/moisture analyzer housing. No office, storage or workshop spaces are provided in the fenced area related to NGMS.

For most of the NGMS related equipment and buildings, off-site prefabricated skids and subassemblies will be used, including the pigging station, metering equipment and valves.

The area occupied by the NGMS will be 23183 m^2, with the dispersion bin having the highest height of 12 m.

The Centralized Control Room - CCR is an independent building located near the NGMS and has a height of approximately 7 m. The occupied area will be 3459 m^2.

A perimeter vegetal curtain composed of woody vegetation will be installed around the entire plot of land comprising NGMS and CCR (surface S1 with cadastral number 109216, owned by OMV Petrom except for the gas pipeline protection zone, as national regulations do not allow the planting of trees or any other plants with roots deeper than 50 cm in these areas.

Another impact on human settlements is the establishment of the 200 m wide safety zone on each side of the pipeline measured from the axis of the pipeline. Thus, according to the regulations in force, if it is desired to build in the safety zone, it will be necessary to obtain an approval from the owner of the underground production pipeline. This aspect can lead to discomfort of the population. It is important to note that construction restrictions for residential or tourist constructions are only applicable to land surfaces owned by the beneficiaries. Such restrictions do not produce effects on adjacent lands.

6.2.12.3 Impact assessment in the decommissioning stage

6.2.12.3.1 Change of land use

After the NGMS and CCR decommission, the landowner will decide what use the land will have.

In the land area, after the demolition and evacuation of the materials, waste, installations from the land, landscaping works will be carried out to restore the environment.

Decommissioning work in the land area is estimated to take 12 months.

6.2.12 .4 Summary of impacts on human settlements in all stages of the project

Table 6.109 Assessment of the impact on human settlements

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
Construction stage						
Change of land use	*Nature effect*	Negative	Negligible	Medium	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	term	Short term				
	The intensity	Low				
Operation stage						
Presence of NGMS and CCR	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	term	Long term				
	The intensity	Low				
Decommissioning stage						
Change of land use	*Nature effect*	Positive	Positive	Low	Positive	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	local				
	term	Short term				
	The intensity	Low				
GENERAL IMPACT on human settlements			**Insignificant impact**			

6.2.12.5 Measures to prevent/avoid/reduce the impact on human settlements

Given that from the impact assessment on human settlements, the impact is insignificant, no mitigation measures are required.

6.2.13 Demography and the economic and social environment

The effects on demography and the economic and social environment during the construction, operation and decommissioning stages of the project are presented in table 6.110.

Table 6.110 Effects on demographics and the economic and social environment

Effect	Construction stage	Operation stage	Decommissioning stage
Demographic changes due to project works	x	-	x
Changes at the economy level	x	x	-
The presence of vessels used in construction	x	-	x
The presence of the production platform	-	x	-

The evaluation criteria for assessing sensitivity and magnitude are as follows:

Evaluation criteria

Magnitude criteria

Magnitude	Description
Negligible	Barely visible temporary impact on demography and socio-economic conditions.
Low	Impact on a specific group/community or on material assets (cultural, tourism, etc.) over a short period of time, but which does not extend and does not generate disruptions to the population or resources.
Medium	Impact on a specific group/community or on material assets that may generate long-term changes but does not affect the overall stability of material assets.
High	Impact on a specific group/community or one or more material assets that causes long-term or permanent changes and affects their overall stability and condition.

Sensitivity criteria

Sensitivity	Description
Low	The affected socio-economic elements are not considered significant in terms of resources, and do not have a high economic, cultural or social value.
Medium	The affected socio-economic elements are not significant in the general context of the analyzed area, but they have a great local significance.
High	Socio-economic elements are specifically protected by national or international legislation and are significant for communities in the project area or at regional/national level.

Sensitivity of demography, economic and social environment

Based on the information regarding the current state presented in Chapter 4, demography has been assessed as having **low sensitivity** since it does not imply demographic changes within the local community as a result of project implementation or damage or the occurrence of risks aggravated by project implementation (eg: significant change of air quality, risk of explosions, soil contamination, water contamination, etc.)

Regarding the economic and social environment, they were assessed as having medium sensitivity.

6.2.13.1 Impact assessment in the construction stage

6.2.13.1.1 Demographic changes due to project works

The activities of execution of works in the land area will be executed by several contractors who will provide the personnel necessary for the execution of the works. Given the fact that the construction period is estimated at 10 months, a migration of people to the area is expected.

The project can generate local and regional opportunities for the creation of new jobs and the purchase of products and services at all stages of the project (construction, operation, decommissioning).

6.2.13.1.2 Changes at the economy level

The project would generate a positive impact on the local and national economy and on the neighboring local communities.

The procurement of goods and services during the life cycle of the project will be ensured through local or regional suppliers. Thus, it can also contribute to the economic development of the area and represents an opportunity for the development of other investments and socio-economic activities within the project area.

6.2.13.1.3 Presence of vessels used in construction

The presence of construction vessels can affect both marine traffic and commercial fishing through the establishment of the 500m safety zone.

Certain vessels used during construction will be limited in their maneuverability (especially those involved in pipeline installation activities), so a safety zone must be imposed. During the construction phase, the contractor will establish a safety zone around each work vessel. The imposition of safety zones will be temporary and dependent on the work being carried out.

The safety zones are necessary for the execution of the maneuvers of the vessels used in the construction and to avoid potential collisions with other vessels in traffic that would result in oil pollution in the marine area.

In Romania, sea fishing, carried out along the Romanian coastal river, is limited to marine areas up to 60-meter isobaths, due to the characteristics of the vessels and their limited autonomy.

In the coastal area, the presence of ships could have a visual impact on tourism in the area and an effect on recreational fishing. To limit the effects, work in the coastal area was planned to start at the end of the summer season.

The estimated Duration for the execution of all works in the marine area is planned at 24 months and the works will be executed successively.

6.2.1 3.2 Impact assessment in the operating stage

6.2.13.2.1 Changes at the economy level

In the next two decades, the Neptun Deep project, the largest offshore project in Romania, is expected to bring ~EUR 20 billion as contributions to the state budget. It will make the country the EU's largest gas producer. The development of these resources would bring consistent economic value to the country, with estimated investments of up to EUR 4 billion, made by the two partners. According to data from an impact study[42] ordered by OMV Petrom, the project will generate and maintain at the country level ~ 9,000 jobs (direct, indirect & induced jobs).

6.2.13.2.2 Presence of production platform

A 500 m safety zone will be established around the Neptun Alpha production platform.

Along the offshore gas production pipeline, the safety zone is 200 m wide on each side of the pipeline measured from the axis of the pipeline.

In Romania, sea fishing, carried out along the Romanian coast, is limited to marine areas up to 50-meter isobaths, due to the characteristics of the vessels and their limited autonomy.

6.2.13.3 Impact assessment in the decommissioning stage

6.2.13.3.1 Demographic changes due to project works

The activities for the execution of decommissioning works in the land area will be executed by the contractors who will provide the personnel necessary for the execution of the works. Given the fact that the construction period is estimated at 12 months, a migration of people is expected in the area.

The project can generate local and regional opportunities for the creation of new jobs and the purchase of products and services at all stages of the project (construction, operation, decommissioning).

[42] The study has been prepared by Concilium Policy Advisors Group (CPAG), a company that is specialized in macroeconomic analysis. The study is based on "Leontief" input output methodology that is internationally best practice.

6.2.13.3.2 Presence of vessels used in decommissioning

The presence of vessels used for decommissioning can affect both naval traffic and commercial fishing through the establishment of the 500 m safety zone.

Certain vessels used during decommissioning will be limited in their maneuverability, so a safety zone must be imposed. During the decommissioning phase, the contractor will establish a safety zone around each work vessel. The imposition of safety zones will be temporary and dependent on the work being carried out.

The safety zones are necessary for the execution of the maneuvers of the ships used in decommissioning and to avoid potential collisions with other ships in traffic that would result in oil pollution in the marine area.

The estimated Duration for the execution of all works in the marine area is planned at 19 months and the works will be executed successively.

6.2.13 .4 Summary of impacts on demography, economic and social environment in all stages of the project

Table 6.111 Assessment of the impact on demography, the economic and social environment

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
Construction stage						
Demographic changes due to project works	*Nature effect*	Positive	Positive	Low	Positive	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
Changes at the economy level	*Nature effect*	Positive	Positive	Medium	Positive	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
The presence of vessels used in construction	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
	The intensity	Low				
Operation stage						
Changes at the economy level	*Nature effect*	Positive	Positive	High	Positive	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Long term				
	The intensity	Low				
The presence of the production platform	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Long term				
	The intensity	High				
Decommissioning stage						
Demographic changes due to project works	*Nature effect*	Positive	Positive	Low	Positive	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
The presence of vessels used for decommissioning	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
GENERAL IMPACT on demographics, economic and social environment			**Insignificant impact and positive impact for the economy during operation**			

6.2.13.5 Measures to prevent/avoid/reduce the impact on demography, the economic and social environment.

Given that from the assessment of the impact on the demography, economic and social environment, the impact is insignificant, no mitigation measures are required.

For the actual development of the Neptun Deep project (change in the use of the land owned by OMVP, the presence of NGMS and CCR, Neptun Alpha) it is proposed to implement a communication plan with the local population to provide information regarding the evolution of the project, and the achievement of the environmental performances established by regulatory acts, while also providing the opportunity to respond to community concerns about the project.

In order to prevent the risk of major accidents as a result of collision with ships within or outside the project, a safety zone of 500m will be ensured around the drilling platform/production platform, to avoid collision with ships.

In order to prevent affecting the naval traffic of other ships (commercial, fishing), it is recommended to coordinate the schedules regarding the loading/unloading and movements of the ships in the project with the economic activities in the port area, as well as informing the port authorities about the traffic schedule of the ships in the project.

Compliance with the planning of the construction works of the microtunnel will prevent as much as possible the damage to recreational and/or tourist activities in the coastal area of Tuzla and Costinești communes.

6.2.14 Population health

The effects on the health of the population during the construction, operation and decommissioning stages of the project are presented in table 6.112.

Table 6.112 Effects on population health

Effect	Construction stage	Operation stage	Decommissioning stage
Increase in dust and gas emissions in the air from car traffic, unloading of construction materials, etc.)	x	-	x
Increased noise and vibration level	x	x	x
Artificial lighting	-	x	-

The evaluation criteria for assessing sensitivity and magnitude are as follows:

Evaluation criteria

Magnitude criteria

Magnitude	Description
Negligible	Barely noticeable temporary impact on human health
Low	Impact on a specific group/community for a short period of time, but which does not spread and does not generate disturbances among the population.

Magnitude	Description
Medium	Impact on a specific group/community that can generate long-term changes but does not affect the health status of the population.
High	Impact on a specific group/community that causes long-term or permanent changes and affects the health status of the population.

Sensitivity criteria

Sensitivity	Description
Low	Mixed rural and industrial area with existing sources of air emissions and noise
Medium	Rural residential area
High	Rural residential area where there are no emission sources

Human health sensitivity

Based on the information regarding the current state presented in Chapter 4, human health was assessed as having **medium sensitivity** due to the fact that the dwellings are located in the rural area and in addition there are dwellings near the site.

6.2.14.1 Assessment of the impact on the health of the population during the construction stage

6.2.14.1.1 Increase in dust and gas emissions in the air

Construction work in the land area will lead to emissions of dust and gases that have potential effects on human health.

Dust emissions are generated by soil excavation, unloading of materials from dump trucks, car traffic on the temporary unpaved access road.

Gas emissions come from the operation of equipment and vehicles. Pollutants emitted nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOC), dust (PM), sulfur dioxide (SO_2) and carbon dioxide (CO_2)

The calculation of air pollutant emissions is presented in Chapter 2, point 2.5.3.1.

Particulate matter in suspension

The assessment of the toxic potential of suspended particles depends primarily on their chemical and physical characteristics. The size of the particles, their composition, the distribution of the chemical constituents inside the particles are also of major importance in their action on the health of the exposed population. The aggressiveness of particles depends not only on their concentration, but also

on their size. Thus, the most aggressive of the respirable particles (below 10 µm) are those with a diameter of approximately 2.5 µm and with a certain toxic specificity, which is given by the chemical composition.
The level of suspended particles can be influenced by meteorological factors such as wind speed, wind direction, temperature, and precipitation. This variation can be substantial even during a single day, or from one day to another, causing short-term fluctuations in the level of suspended particles.

Health effects depend on the size of the particles and their concentration and can fluctuate with daily variations in the levels of the PM10 and PM2.5 fraction (PM-Particulate Matter).
According to Law 104/2011, *the limit value* for PM10 is 50 µg/m^3 (24-hour Medium), with the following values to protect health: Upper evaluation threshold 70% of the limit value (35 µg/m^3, not is exceeded more than 35 times in a calendar year), Lower evaluation threshold 50% of the limit value (25 µg/m^3, not to be exceeded more than 35 times in a calendar year). The annual medium is 40 µg/m^3, with evaluation thresholds of 20-28 µg/m^3.

Nitrogen oxides, sulfur oxides, belong to the group of irritant pollutants. The predominant action on the respiratory system translates into functional and/or morphological changes in the airways or pulmonary alveoli. They vary depending on the exposure time and the concentration of irritants in the inhaled air. Exposure to this category of pollutants is clinically translated by the appearance of various pathological changes: immediate effects - conjunctival and corneal lesions, characteristic tracheo-bronchial syndrome, increased mortality and morbidity of the population through respiratory and cardiovascular diseases, aggravation of chronic bronchitis and the appearance of acute periods; and chronic effects – increasing the frequency and severity of acute respiratory infections and aggravating chronic non-specific broncho-pneumopathy.
According to Law 104/2011, the limit value for *nitrogen oxides* (one hour) is 200 µg/m^3 (not to be exceeded more than 18 times in a calendar year) with the evaluation thresholds (lower and upper) of 100-140 µg/m^3, and the Medium per calendar year 40 µg/m^3, with evaluation thresholds of 26-32 µg/m3. For *sulfur dioxide*, the limit value for 24 hours is 125 µg/m^3 (not to be exceeded more than 3 times in a calendar year), and the evaluation thresholds 50-75 µg/m^3.

Carbon monoxide is an asphyxiating gas that results as a result of burning fuel in a limited - insufficient - amount of air. Exhaust gases contain medium 4% carbon monoxide in the case of petrol engines and only 0.1% in the case of Diesel engines. When the concentration of carbon monoxide in the ambient air is lower than the equilibrium value in the blood, CO passes from the blood into the air, the degree of elimination being increased by effort and by increasing the partial pressure of oxygen in the inhaled air. By blocking an amount of hemoglobin, carbon monoxide produces hypoxia, causing immediate (acute) and long-lasting (chronic) effects.

Acute effects are usually encountered in the case of continuous CO removal in enclosed spaces that are not provided with windows or that are closed. Through long-term exposures to lower concentrations of CO, secondary or so-called chronic effects may occur. These refer in particular to the exposures of the population in the case of environmental pollution and are characterized, in adults, by favoring the formation of atheromatous plaques on the vascular walls and increasing the frequency of atherosclerosis, as well as by the occurrence with increased frequency of congenital malformations and hypotrophic children, with great social and economic implications.
According to Law 104/2011, the limit value (8-hour Medium) is 10 mg/m^3, the upper evaluation threshold - 70% of the limit value (7 mg/m^3), the lower evaluation threshold - 50% of the limit value (5 mg/m^3).

Volatile organic compounds are chemical compounds that have increased vapor pressure, which results in their high volatility. They are any organic compound that has an initial boiling point less than or equal to 250 degrees C at a standard pressure of 101.3 Kpa. In the presence of light, VOCs react with other pollutants (NO_X) being the primary precursors of the formation of tropospheric ozone and suspended particles, which are the main components of smog. The VOC category includes: Methane, Formaldehyde, Acetaldehyde, Benzene, Toluene, Xylene, Isoprene. The effects on health translate into irritating effects on the eyes, nose and throat, causing headaches, loss of coordination and movements, nausea. Pathologies of the liver, kidneys and central nervous system. Certain VOCs cause cancer and reproductive disorders. Key signs and symptoms associated with VOC exposure include conjunctivitis, nasal and pharyngeal discomfort, headache and skin allergy, nausea, vomiting, epistaxis, dizziness. According to Law 104/2011, the limit value for benzene is (annual Medium) 5 $\mu g/m^3$, with evaluation thresholds of 2-3.5 $\mu g/m^3$.

Given the presented, direct, negative effects are estimated, with local manifestation and low intensity, resulting in a low magnitude. The sensitivity is assessed to be medium resulting in a minor impact.

Taking into account the estimated pollutant emissions, as resulting from the calculations presented in Chapter 2, relative to the distance from sensitive receptors (population) and considering the conclusions of the Study on the Impact Assessment on Public Health and Population Comfort developed for the Neptun Deep project, direct, negative effects are estimated, with local manifestation and low intensity, resulting in a low magnitude. Given the medium sensitivity of the receptor and the low magnitude, the estimated impact is minor.

6.2.14.1.2 Increased of noise and vibration level

Construction activities will generate noise and vibration due to the use of machinery, diesel generators and heavy vehicles that will be used to transport materials and workers.

Both noise and vibration have potential effects on the health of the population. As I mentioned, there are houses in the area and background noise generated by the passing of the train.

In the study for the assessment of the impact on the health of the population, developed by Vest Medical Impact SRL, in order to estimate the noise level during the construction stage at the homes in the study area, a noise modeling was carried out with the dBmap program, with the scenario in which the machines work in different work areas. Modeling results indicate a noise level of 50 dB near the nearest dwellings, as presented in section 6.2.9.1.1.

Potential health effects of noise include psychosocial effects (discomfort and other subjective assessments of general well-being and quality of life), psychological effects, effects on sleep, decreased hearing acuity, and stress-related health effects that may be psychological, behavioral or somatic.

Individual sensitivity varies extremely widely from one person to another. In people affected by noise, the phenomenon of deafness does not set in suddenly.
As it results from the noise level modeling conducted for the construction phase (the onshore site) in relation to the distance from sensitive receptors, it is concluded that the rate of attenuation of the generated noise level leads to values below the threshold of impact on human health.

From this perspective, the significance of the impact on human health is insignificant, under the conditions of a medium sensitivity class, and of a Low impact magnitude, with local extension, temporary and reversible, with a low intensity.

6.2.14.2 Evaluation of the impact on the health of the population during the operation stage

6.2.14.2.1 Increase in noise level

In the operation stage, the modeling carried out to determine the attenuation of the sound propagated in the surrounding environment associated with the activities carried out in the operation stage of the Neptun Deep project indicates that the weighted acoustic pressure level at the boundary of the NGMS site is 50 dB LpA and in the residential area it is between 30-35 dB LpA, which leads to a negligible impact. The modeling in detail is presented in appendix M.

During the maintenance period and, in emergency situations, depressurization of the system is carried out by releasing the natural gas within the NGMS pipes through the vent stack, through purge (evacuation) valves, pressure safety valves and pressure reduction restriction holes, which will generate high noise levels.

The modeling results indicate that the weighted acoustic pressure level in the residential area, in emergency situations and during maintenance, is between 60-70 dB LpA. The modeling was carried out in the worst-case scenario, for one hour, without the application of mitigation measures.

Thus, the significance of the impact on human health is insignificant, under the conditions of a medium sensitivity class, and of a Low impact magnitude, with local extension, temporary and reversible, with a low intensity.

6.2.14.3 Evaluation of the impact on health during the decommissioning stage

In the decommissioning stage, it is estimated that the impact will be similar to that in the construction stage given the fact that the noise sources come from the operation of the machines used for decommissioning, the planned works as well as from the car traffic from the transport of equipment and waste.

Pollutants emitted into the air during the decommissioning phase will be similar to those during the construction phase.

The decommissioning period in the land area is estimated at 12 months.

Thus, the significance of the impact on human health is insignificant, under the conditions of a medium sensitivity class, and of a Low impact magnitude, with local extension, temporary and reversible, with a low intensity.

6.2.14.4 Conclusions of the impact assessment report on population health

The project has been analyzed from the point of view of its impact on human health and the environment, considering specific risk factors and social and health impacts of the objective. Below are the general conclusions:

1. Effects on Human Health in Construction, Operation, and Decommissioning Phases:

- In the construction phase, the project can generate impacts related to emissions of dust and gases into the air, noise level, and vibrations. These impacts are evaluated as having a magnitude varying from low to high, but with a medium sensitivity of human health to these impacts over a short period of time in the off-tourist season. The results of the air environmental factor evaluation indicate that the impact on air quality in the area proposed for the location of the evaluated objective is minimal. The concentrations of hazardous substances estimated according to simulations were below the permissible limit, suggesting that there is no probability of potential toxicity on the health of the nearby population.
- In the operation phase, the increase in noise and vibration levels can have a medium magnitude impact on human health in the short term in the off-tourist season. Also, the results of the air environmental factor evaluation indicate that the impact on air quality in the area proposed for the studied objective is minimal. The concentrations of hazardous substances estimated according to simulations were below the permissible limit, suggesting that there is no probability of potential toxicity on the health of the nearby population.
- In the decommissioning phase, temporary emissions of dust and gases into the air have a low magnitude impact on human health also in the off-tourist season.

2. Checklist and Total Score: Using the checklist for specific social and health impact factors of the objective, a total score of +6 was obtained, indicating that the operation of the project does not generate significant risks or major negative impacts on human health and the environment.
3. Responsible Implementation: It is essential that the developer and local authorities collaborate to implement the mandatory conditions as well as the recommendations mentioned in this study, and to regularly monitor compliance with them throughout the project's implementation. This will ensure responsible and sustainable development.
4. Favorable Impact: The project can be developed in accordance with current laws and regulations, having a favorable impact on the environment and the health of the local population, without generating significant risks or major negative impacts.

   Overall, the "NEPTUN DEEP" project can be successfully implemented and can contribute to economic and energy development, while ensuring the protection of health and the environment.

Provided that all required approvals are fully complied with and the recommendations of this study are followed, the existing distances represent the sanitary protection perimeter, and the objective can operate in the proposed location. Therefore, it is considered that the activity of the objective analyzed in this study is insignificant from the point of view of impact on health and comfort of the population.

6.2.14.4 Summary of impacts on human health at all stages of the project

Table 6.113 Human health impact assessment

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
Construction stage						
Increase in air pollutant emissions	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Short term				
	The intensity	Low				
Increasing noise level	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				

Effect	Magnitude components		Magnitude	Sensitivity	Impact	Potential cross-border impact
	Term	Short term				
	The intensity	Low				
Operation stage						
Increasing noise level	*Nature effect*	Positive	Negligible	Medium	No impact	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Duration	Temporary				
	The intensity	Low				
Decommissioning stage						
Increase in air pollutant emissions	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Duration	Short term				
	The intensity	Low				
Increasing noise level	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Duration	Short term				
	The intensity	Low				
GENERAL IMPACT on human health			**Insignificant impact**			

6.2.14.5 Measures to prevent/avoid/reduce the impact on human health

To prevent any negative impact on the environment and public health, the "NEPTUN DEEP" project intends to implement the best available techniques. Here are some of the proposed measures:

- Installation of mobile panels to attenuate the noise level for activities exceeding the permissible noise level, at the execution of the microtunnel entrance manhole in order to protect the inhabited areas.
- All mechanical equipment must comply with standards regarding environmental noise emissions according to GD 1756/2006 on limiting the level of noise emissions in the environment produced by equipment intended for use outside buildings.
- Complete avoidance or reduction of oversized transport during the night.
- All vehicles will turn off their engines - no vehicle will have its engine running at standstill.

- Adopting a flexible work schedule, so as to ensure the comfort of residents during the quiet period during the day and at night.
- Perimeter tree planting for sound attenuation when propagated by vegetation.
- During periods without precipitation, it will be ensured the wetting of access roads and areas with active works to reduce particulate emissions and to comply with concentrations (PM10 / PM2.5) in the limit values provided by the legislation in force.
- Avoiding the execution of works that involve the handling of soil quantities (scrapings / fillings) during periods of strong winds.
- Setting a maximum speed limit on temporary access roads.

The implementation of these measures will contribute to minimizing any potential negative impact on the environment and human health, while ensuring optimal conditions for the project's activities.

6.2.15 Biodiversity

The effects on biodiversity during the construction, operation and decommissioning stages of the project are presented in table 6.114.

Table 6.114 Effects on biodiversity

Effect	Construction stage	Operation stage	Decommissioning stage
Noise emissions onshore	x	x	x
Topsoil removal	x	-	-
Roadkill	x	-	x
Relocation of the substrate with living organisms	x	-	-
Turbidity increase	x	-	x
Temporary and local increase in nutrients and possibly some pollutants present in sediments due to sediment resuspension	x	-	-
Underwater noise emissions	x	-	-
Crushing and/or denudation of the hard substrate populated by marine organisms as a result of the placement of the ship's anchors	x	-	-
Emissions in offshore marine waters of some chemical compounds that have the potential to affect the aquatic environment	-	x	-

The evaluation criteria for assessing sensitivity and magnitude are as follows:

Evaluation criteria

Magnitude criteria

Magnitude	Description
Negligible	Barely visible temporary impact on biodiversity
Low	Impact on a species that manifests itself only at the level of a group of individuals for a short period of time (one generation or less) but does not affect other trophic levels or the population of that species.
Medium	Impact on a species that manifests itself at the level of part of the population and may cause changes in abundance and/or a reduction in distribution over one or more generations but does not affect the long-term population integrity of the species or other species dependencies. The cumulative nature and magnitude of the consequences are important.
High	Impact on a species that affects the entire population and causes declines in abundance and/or changes in distribution beyond the limit of natural variation, with no possibility of recovery or return, or that occurs over several generations.

Sensitivity criteria

Sensitivity	Description
Low	A species or habitat that is not protected or listed. It is common or abundant; is not critical for ecosystem functions or other ecosystems do not represent key elements for ecosystem stability.
Medium	A species or habitat that is not protected or listed; it is spread globally but is rare in the plan/project area. It is important for the functioning and stability of the ecosystem and is threatened or the population is in decline.
High	A species or habitat that is protected by relevant directives or international conventions. It is listed as rare, threatened, or vulnerable (IUCN); it is critical for ecosystem stability and functionality.

Biodiversity sensitivity

Based on the information presented in Chapter 4 – on the current state of biodiversity present on the project site, this component was assessed as having a **medium overall sensitivity**, as species/habitats are present that represent a sensitive link for the functioning and stability of the marine ecosystem, but are widely distributed, not being a species found only in the project site area.

Regarding **marine mammals,** given the high degree of protection of these species of conservative interest, **the sensitivity class is assessed as high**.

6.2.15.1 Impact assessment at the construction phase

Table 6.115 Correlating the effects and impacts generated and the possibility of affecting biodiversity in the Neptune Deep project area during the construction phase

Type of intervention	Potential effects	Potential impacts	The possibility of significantly affecting biodiversity in the area of influence of the project Yes/No	Observations
Construction works onshore	Topsoil layer removal	Loss of habitat surface	**No**	Arable land subject to periodic agricultural interventions on soil and vegetation is concerned. The land in the land area of the project is not of particular importance as feeding and resting habitat for ROSPA0076 bird species. It does not intersect with protected natural areas.
		Habitat alteration	**No**	No habitats of community interest are present in the terrestrial area of the project. Bird feeding habitats represented by cultivated land will continue to be available in the project area. It does not intersect with protected natural areas.
		Habitat fragmentation	**No**	Habitat fragmentation during the construction period is a temporary impact, linked to interventions on topsoil and carpet. The impact will manifest itself during the intervention and will cease after the completion of the construction phase, implicitly of the greening works.
		Disturbance of species' activity	**No**	The disturbance of bird and land mammal species is local, at the level of the working point and within a radius of 50-100 m, but also limited in time to the Duration of the intervention.
		Population reduction	**No**	No plant or animal species of conservative interest are present on the stripped-covered areas, as the land is anthropogenic.
	Accidental mortality due to road traffic and machine operation	Loss of habitat surface	**No**	**-**
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	The roads arranged will not cross important habitats of species of community interest. Carnivorous mammals have a predominantly

Type of intervention	Potential effects	Potential impacts	The possibility of significantly affecting biodiversity in the area of influence of the project Yes/No	Observations
				nocturnal activity and will cross roads when there is no road traffic.
		Disturbance of species activity	**No**	-
		Reduction of population size	**No**	The vehicles and machinery will travel at low speeds and will not generate a significant risk of roadkil for individuals of *Spermophillus citellus* observed in the cliff area and collision for birds feeding on adjacent land (mostly gulls) or those in the passage. The roads do not cross the habitat of *Spermophillus citellus* and, consequently, road traffic will not take place near it. In the case of *Bufo viridis* some individuals may arrive at the project site at night, but road traffic will be carried out during the day.
	Increased noise level	Loss of habitat surface	**No**	-
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	-
		Disturbance of species' activity	**Yes**	Disturbance of bird species representing conservation objectives for the Black Sea ROSPA0076 using neighboring habitats as feeding and/or resting place.
		Population reduction	**No**	There will be no accidental injuries or killings as a result of the noise level at the construction stage at the level of the driveways.
Shore undercrossing (microtunnel construction	Relocation of substrate with living organisms	Loss of habitat surface	**Yes**	Activities that may have the potential for fragmentation of habitats of Community interest outside protected natural areas
		Habitat alteration	**Yes**	Activities that may have the potential for fragmentation of habitats of Community interest outside protected natural areas
		Habitat fragmentation	**Yes**	Activities that may have the potential for fragmentation of habitats of Community interest outside protected natural areas
		Disturbance of species' activity	**Yes**	Activities that may potentially disturb fish and marine mammals

Type of intervention	Potential effects	Potential impacts	The possibility of significantly affecting biodiversity in the area of influence of the project Yes/No	Observations
		Reduction of population size	**Yes**	Activities that may have the potential to reduce the number of benthic organisms, but also plankton in the area of the trench and the outlet of the microtunnel.
	Increased turbidity	Loss of habitat surface	**Yes**	Activities that can produce changes in the habitat surface as a result of the clogging process, if the distance to the works is very small.
		Habitat alteration	**Yes**	Activities that may produce potential disturbances in water quality and indirectly on habitats
		Habitat fragmentation	**No**	-
		Disturbance of species' activity	**Yes**	Activities that may potentially disturb fish and marine mammals
		Reduction of population size	**Yes**	Activities that may have the potential to reduce the number of benthic organisms, but also plankton in the area of the trench and the outlet of the microtunnel.
	Temporary and local increase in nutrients and possibly pollutants present in sediments due to sediment resuspension	Loss of habitat surface	**No**	It is only possible at high concentrations of pollutants. Valid in areas with major historical pollution
		Habitat alteration	**Yes**	Only if there are already pollutants in high concentrations in the sediment
		Habitat fragmentation	**No**	-
		Disturbance of species' activity	**Yes**	Only if there are already pollutants in high concentrations in the sediment
		Reduction of population size	**No**	It is only possible at high concentrations of pollutants. Valid in areas with major historical pollution
	Increase in underwater noise level	Loss of habitat surface	**No**	Temporary effect, which will not produce changes in distribution pattern in the long term
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	-
		Disturbance of species' activity	**Yes**	Mammals and marine fish will move away from the source of noise

Type of intervention	Potential effects	Potential impacts	The possibility of significantly affecting biodiversity in the area of influence of the project Yes/No	Observations
		Population size reduction	**Yes**	High noise levels can result in injuries or even accidental killings of fish and marine mammal species
	Crushing and/or denudation of hard substrate populated with marine organisms as a result of the placement of barge anchors used for installation	Loss of habitat surface	**Yes**	If habitat 8330 is present in the area
		Habitat alteration	**Yes**	Macrozoobentic organisms may be affected
		Habitat fragmentation	**No**	-
		Disturbance of species activity	**No**	-
		Reduction of population size	**Yes**	Damage to epibiont organisms in the overlapping zone
Production well drilling	Relocation of substrate and benthic organisms	Loss of habitat surface	**No**	Small areas outside protected natural areas are affected. At a depth of 120 m, where the benthic fauna is represented mainly by opportunistic oligochaetes (60.13%) and tolerant nematodes (29.68%).
		Habitat alteration	**No**	
		Habitat fragmentation	**No**	-
		Disturbance of species' activity	**No**	-
		Reduction of population size	**No**	-
	Increased turbidity	Loss of habitat surface	**No**	No significant damage to plankton and zoobenthos
		Habitat alteration	**No**	No significant damage to plankton and zoobenthos
		Habitat fragmentation	**No**	No significant damage to plankton and zoobenthos
		Disturbance of species' activity	**No**	No significant damage to plankton and zoobenthos
		Reduction of population size	**No**	No significant damage to plankton and zoobenthos

Type of intervention	Potential effects	Potential impacts	The possibility of significantly affecting biodiversity in the area of influence of the project Yes/No	Observations
	Increase in underwater noise level	Loss of habitat surface	**No**	-
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	-
		Disturbance of species' activity	**Yes**	The noise generated can drive marine mammals away from a radius of 100 m without posing a risk of injury or accidental killing.
		Reduction of population size	**No**	There is no risk of injury or accidental killing of dolphins.
	Artificial lighting	Loss of habitat surface	**No**	-
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	-
		Disturbance of species' activity	**No**	Fish can gather in illuminated areas, but nevertheless at a depth of 120 m their number is very small (eg. *Merlangius merlangus*)
		Reduction of population size	**No**	-
	Crushing of sedimentary substrate populated with marine organisms as a result of placement of drilling platform anchors	Loss of habitat surface	**No**	No habitats of conservative interest are present
		Habitat alteration	**No**	No species of conservative interest are present
		Habitat fragmentation	**No**	-
		Disturbance of species activity	**No**	No species of conservative interest are present
		Reduction of population size	**No**	A reduction in the number of oligochaetes and nematodes is not foreseen
Installation of fiber optic pipe and cable from platform to shore	Change substrate type	Loss of habitat surface	**No**	No species or habitats of conservative interest are present
		Habitat alteration	**No**	No species or habitats of conservative interest are present
		Habitat fragmentation	**No**	No species or habitats of conservative interest are present

Type of intervention	Potential effects	Potential impacts	The possibility of significantly affecting biodiversity in the area of influence of the project Yes/No	Observations
		Disturbance of species' activity	**No**	No species or habitats of conservative interest are present
		Reduction of population size	**No**	No species or habitats of conservative interest are present
	Increase in underwater noise level	Loss of habitat surface	**No**	-
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	-
		Disturbance of species' activity	**Yes**	Disturbance of fish and marine mammals
		Reduction of population size	**No**	Noise does not reach a very high level
	Increased turbidity as a result of fiber optic cable installation	Loss of habitat surface	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas.
		Habitat alteration	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Habitat fragmentation	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Disturbance of species' activity	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Reduction of population size	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
	Relocation of substrate and benthic organisms	Loss of habitat surface	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Habitat alteration	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Habitat fragmentation	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Disturbance of species activity	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas

Type of intervention	Potential effects	Potential impacts	The possibility of significantly affecting biodiversity in the area of influence of the project Yes/No	Observations
		Reduction of population size	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
Neptun Alpha platform installation	Increase in underwater noise level	Loss of habitat surface	**No**	-
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	-
		Disturbance of species' activity	**Yes**	Removal of dolphins from the area of platform installation works
		Reduction of population size	**Yes**	Potential harm to dolphins near the platform installation area
	Crushing of sedimentary substrate populated with marine organisms as a result of jacket placement	Loss of habitat surface	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Habitat alteration	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Habitat fragmentation	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Disturbance of species' activity	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Reduction of population size	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
	Increased turbidity	Loss of habitat surface	**No**	No significant damage to plankton and zoobenthos
		Habitat alteration	**No**	No significant damage to plankton and zoobenthos
		Habitat fragmentation	**No**	No significant damage to plankton and zoobenthos
		Disturbance of species' activity	**No**	No significant damage to plankton and zoobenthos
		Reduction of population size	**No**	No significant damage to plankton and zoobenthos
	Increase noise level	Loss of habitat surface	**No**	-
		Habitat alteration	**No**	-

Type of intervention	Potential effects	Potential impacts	The possibility of significantly affecting biodiversity in the area of influence of the project Yes/No	Observations
		Habitat fragmentation	**No**	-
		Disturbance of species' activity	**No**	Low level noise
		Reduction of population size	**No**	Low level noise
Installation of underwater systems including production pipelines and umbilical systems from drilling centers to platform	Increase in underwater noise level	Loss of habitat surface	**No**	-
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	-
		Disturbance of species activity	**Yes**	Disturbance of fish and marine mammals
		Reduction of population size	**No**	Noise does not reach a level that causes mortality among fish and cetaceans
	Relocation of substrate and benthic organisms as a result of placement of piles with suction from manifolds	Loss of habitat surface	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Habitat alteration	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Habitat fragmentation	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Disturbance of species' activity	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Reduction of population size	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
	Increased turbidity	Loss of habitat surface	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas.
		Habitat alteration	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas.
		Habitat fragmentation	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas.
		Disturbance of species' activity	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas.

Type of intervention	Potential effects	Potential impacts	The possibility of significantly affecting biodiversity in the area of influence of the project Yes/No	Observations
		Reduction of population size	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas.
Checks from commissioning of equipment on the platform	Increasing noise levels and igniting the flare	Loss of habitat surface	**No**	-
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	-
		Disturbance of species' activity	**No**	Short-term impact in an area without bird agglomeration
		Reduction of population size	**No**	Low risk of accidentally injured or killed birds due to short Duration and long distance from shore

6.2.15.1.1. Earth noise emission

Noise and vibration emissions are expected to increase in the ground area of the project, due to construction activities such as: vegetation stripping activities, soil excavation, surface leveling, mobilization of vehicles, workers and equipment, transportation of materials, construction/installation of equipment and installations.

On land, the construction works will be carried out at 161 m from the Special Protection Area ROSPA0076 Marea Neagra..

Increasing the noise level will lead to temporary disturbance of identified birds and mammals in the vicinity of the site in the terrestrial area. In the area were identified mammalian species: *Spermophilus citellus, Lutra lutra,* rodent species, and on irrigation canals and in the orchard in the area were observed individuals of *Meles meles, Vulpes vulpes* and *Canis aureus.*

In the coastal zone, the project site overlaps with the Special Protection Area ROSPA0076 Marea Neagra and the Special Area of Conservation ROSAC0273 Zona marina de la Capul Tuzla.

The sources of noise in the coastal zone are the vessels used for the execution of the microtunnel exit manhole, the execution of the transition trench as well as for the installation of the gas production pipeline through the microtunnel.

Increasing the noise level in the coastal zone will lead to disruption of bird activity.

Noise and vibration emissions are expected to be of low intensity during construction activities, with local, reversible, short-term expansion of a low magnitude. The sensitivity is assessed as low, resulting in a minor impact.

6.2.15.1.2 Topsoil removal

The land in the land area of the project is not of particular importance as feeding and resting habitat for ROSPA0076 bird species. It does not intersect with protected natural areas. The feeding habitats of birds, represented by cultivated land, will continue to be available in the project area.

The disturbance of bird and land mammal species is local, at the level of the working point and within a radius of 50-100 m, but also limited in time to the Duration of the intervention.

No plant or animal species of conservative interest are present in the removal-covered areas, as the land is anthropogenic.

Impact of topsoil removal are low intensity during construction activities, with local, reversible, short-term expansion of negligible magnitude. The sensitivity is estimated to be low, resulting in an insignificant impact.

6.2.15.1.3 Accidental mortality due to road traffic and operation of machinery

The roads arranged will not cross important habitats of species of community interest. Carnivorous mammals have a predominantly nocturnal activity and will crossroads when there is no road traffic. The vehicles and machinery will travel at low speeds and will not generate a significant risk of roadkil for individuals of *Spermophillus citellus* observed in the cliff area and collision for birds feeding on adjacent land (mostly gulls) or those in the passage. The roads do not cross the habitat of *Spermophillus citellus* and, consequently, road traffic will not take place near it.

In the case of *Bufo viridis* some individuals may arrive at the project site at night, but road traffic will be carried out during the day.

Impact generated by car traffic are of low intensity during construction activities, with a local, reversible, short-term expansion of low magnitude. The sensitivity is estimated to be low, resulting in an insignificant impact.

6.2.15.1.4 Increased turbidity

The increase in turbidity in the water column is generated by dredging works in the coastal area (approximately 600 m from the shoreline), to achieve the exit manhole of the microtunnel and the trench for laying the gas production pipeline with a length of 3,375 km.

Also, the turbidity in the water column will increase from the installation works of the gas production pipeline and fiber optic cable, of the Subacvatic components, the anchoring of the ships used in the project, as well as the installation of the jacket of the Neptun Alpha platform, but it is expected that it will be lower compared to that generated by the dredging works in the coastal area.

Plankton

Planktonic organisms cannot swim against water currents and depend entirely on them for movement. They cannot leave the places of operation of the machines, nor the much wider area affected by sediment resuspensions. Therefore, we consider that an indirect negative impact generated by the interventions carried out at substrate level on phytoplankton and zooplankton will be generated, but it will be reversible, will cease after completion of the works.

Phytoplankton populations have the ability to reproduce between two generations / day to two generations at 7-10 days, while zooplankton populations have the capacity to reproduce continuously, depending on the species, seasonally or only one generation per year, a determining factor being the presence of phytoplankton, but also environmental conditions.

As a result, it can be considered that after completion of the works, the biocenoses and communities in the pelagic field of water will recover in a very short time.

In conclusion, the impact on plankton from concentration increase of suspended sediment growth in the water column is assessed to be local, temporary, of low intensity. Therefore, the magnitude of the impact is assessed to be low.

Bentos

The resettlement of suspended material in the water mass and the occurrence of hypoxic episodes may contribute to the mortality of immobile or reduced mobility of bental organisms, but in the marine environment through currents a continuous supply of oxygen is ensured, thus avoiding the possibility of extended or long-lasting hypoxic episodes.

If there are phytobental specimens (macroalgal and angiosperms) or macrozoobital organisms in the area, there is a risk of their mechanical removal following excavation activities in the coastal zone. From the area of influence of the project, no phytobenthic species of conservative interest were reported (e.g. *Cystoseira barbata, Zostera noltii*). Plant biomass is provided in marine habitats in the project area by various algae, such as red algae – *Ceramium elegans, Ceramium virgatum, Callithamnion corymbosum, Porphyra leucosticta etc.* – and green algae – *Ulva intestinalis, Ulva lactuca, Cladophora sp.*

Since only opportunistic annual algae are present in the area of influence, the impact caused by the attenuation of light intensity on the benthic flora is assessed to be negligible, the impact will be local, temporary and minor.

It should be noted that dredging/excavation of the trench will be carried out outside protected natural areas of community interest. Most suspended sediment particles will resettle near the trench (500-700 m). A large part of the area where the concentration of suspended solids in the protected area will increase is represented by denuded rock (without organism's characteristic of habitat 1170), and low concentrations of suspended particles (1-5 mg/l) are not able to affect biofilter organisms because they fall within the normal limits of water turbidity in coastal areas. During storms on the Romanian coast, TSS values of 75 mg/l can also be recorded (Pantea, 2020), while the occurrence of negative effects due to the high concentration of suspended particles can be anticipated, for example, in the case of the characteristic species *Mytilus galloprovincialis*, from TSS values higher than 80 mg/l (Buhbe, 2005). The concentration of solid particles in the water mass generated by the works within the project will not exceed values of 1-5 mg/l inside the protected natural area ROSAC0273Zona marina de la Capul Tuzla, while values of 0.1-1 mg/l are anticipated inside the ROSCI0293 Costinesti – August 23, which does not represent an exceedance of normal turbidity values in coastal waters.

In the case of habitat subtype 1170-2 Biogenic reefs of *Mytilus galloprovincialis*, with an insular presence, north and south of the gas pipeline route (points: P7, P9, P10, P23) which presents a high vulnerability to trench digging/dredging activities, due to the short distances (160 m – 550 m) to the works area. Given the crucial ecological role in the marine ecosystem of habitat subtype 1170-2, specific avoidance measures have been proposed to avoid potential significant impacts due to the high level of turbidity in the vicinity of the transition ditch (e.g. use of turbidity curtains at work points). This measure to avoid the impact of high turbidity was also foreseen for habitat 8330 located outside sites of Community importance and special areas of conservation.

Fish

The increase in turbidity will have as an indirect consequence the removal of fish from the works area. The removal will be temporary during the works and does not cause ichthyofauna mortalities, the fish being organisms with high mobility.

Marine mammals

The increase in turbidity will have as an indirect and secondary consequence the removal of marine mammals from the works area. The removal will be temporary during the works and does not cause mortality among cetacean species, which are organisms with high mobility that have the possibility to move quickly away from work areas.

In conclusion, the impact on biodiversity by increasing turbidity in the water column is assessed to be local, temporary, of low intensity.

Based on the medium sensitivity and low magnitude, the impact is assessed to be negative and minor.

6.2.15.1.5 Relocation of substrate with living organisms

During excavations in the trench area, the substrate with macrozoobental organisms will be relocated, but these works will not take place inside the protected natural area and will not directly affect habitats of community interest. The field study conducted in 2021 did not reveal the presence of habitats and species of conservative interest on the route of the gas pipeline.

In summary, the impact on biodiversity through substrate relocation with living organisms is assessed to be local, temporary, or of low intensity.

Based on the medium sensitivity and a low magnitude, the impact is assessed to be minor negative.

6.2.15.1.6 Temporary and local increase in nutrients and possibly pollutants present in sediment due to sediment resuspension

Following excavations, sediments will be resuspended in water, which will also contribute to the temporary and local increase of nutrients and possibly pollutants present in sediments, but unable to produce significant changes in chemical status and physicochemical elements defining the ecological status of water bodies.

From the laboratory analysis performed, no exceedances of the values of pollutant concentrations in water and sediments in the project area were revealed, according to Order no. 161/2006. Possible temporary changes in the composition of phytoplankton and zoobenthos in the area of excavation/dredging works will not contribute to altering the quality of biological elements characterizing the ecological status of the water body within protected natural areas.

In summary, the impact on biodiversity through temporary and local increases in nutrients and possibly some pollutants present in sediments due to sediment resuspension is assessed to be local, temporary, or of low intensity.

Based on the medium sensitivity and a low magnitude, the impact is assessed to be minor negative.

6.2.15.1.7 Crushing and/or denudation of hard substrate populated with marine organisms as a result of anchorage placement of ships

During excavation activities in the shore area, a barge will be used, which will have anchors placed on the seabed to maintain the working position. In the working areas for the microtunnel exit pit, which are located at a distance of less than 100 m from the ROSAC0273 Cape Tuzla Marine Area, part of the anchors (4 anchors - 7 anchor points/anchor positions) will be left on the bottom of the water, inside the site. Anchors on the bottom will locally disturb sediment as well as sessile and reduced mobility organisms. The repositioning of the barge will be achieved gradually by lifting and then changing the position of the anchors while the chains will be constantly tensioned. The anchors will cause crushing and/or denudation of the hard substrate populated with marine organisms. Of the 7 anchor points inside the ROSAC0273, 5 points intersect with the analyzed habitat: T1.1, T2.1, T2.5, T3.1 and T8.4

Stony substrate in anchorages have Low or almost no algae or edifying mollusks of habitat subtypes 1170-8 Infralittoral rock with photophilic algae and 1170-9: Infralittoral rock with *Mytilus galloprovincialis*. Where existing physical and chemical conditions of the marine environment are favorable for the fixation and development of marine benthic organisms, they shall recolonize, within a short period of time after completion of works (1 to 2 years), surfaces on which mechanical actions have been exerted by manipulating anchors.

Habitat 8330 is mentioned in the standard form of the site as having an area of 0.7 ha and is located in the northern part of the protected natural area (> 2km from the project site in the marine area). To date, no mapping of the distribution of this habitat within the site has been carried out. The nearest habitat area (Blumenfield® observations in 2023), not previously mentioned, was located at ca. 500 m south of the pipe, outside the ROSAC0273 boundaries and overlaps with anchor position T6.3. Permanent damage to *habitat 8330* overlapping anchorage points T6.3 can be expected due to the fragility of the characteristic cavernous submarine structure. In this case, in order to avoid affecting this type of habitat, it was proposed to relocate the anchor position.

In summary, the impact on biodiversity through crushing and/or denudation of hard substrate populated with marine organisms as a result of the placement of ship anchors used in production pipeline installation, well drilling and platform installation is assessed to be local, temporary, reversible and of low intensity.

Based on high sensitivity and low magnitude, the impact is assessed to be moderately negative.

6.2.15.1.6 Increased underwater noise

In shore construction activities, the main vibration and noise generating activities are tunnel drilling activities undercrossing the cliff and shallow area and pipeline trench excavation activities. During the period of these activities, specimens of *Tursiops truncatus ponticus*, *Phocoena phocoena relicta* and fish will move away from the area where works are carried out. During the period of these activities, specimens of *Tursiops trucatus ponticus* and *Phocoena phocoena relicta* will move away from the area where works are carried out. Marine mammals will not be affected by noise and vibration and will return to the area after construction activities have ceased. The distribution pattern will not be affected in the medium or long term.

The works carried out will also result in the removal of pelagic fish populations from the works area, which constitute a trophic resource for cetaceans. The removal will be temporary during the works and does not cause mortalities among fish or cetacean species, which are organisms with high mobility.

From the beginning of the work of unloading and positioning the jacket, marine mammals will quickly leave the working area, and will not approach the sources generating noise and strong vibrations until after the cessation of disturbing activities. The works are estimated to last 2-3 days, and the specimens will return to the waters near the platform after the completion of the underwater works.

Due to the noise generated by the jacket fixing activity of the Neptun Alpha platform, individuals of *Tursiops truncatus, Phocoena phocoena* and *Delphinus delphis* in the immediate vicinity of the work area may be affected. Very high noise levels (185 dB) can injure or even cause death in marine mammals.

Even if a potential impact has been identified, as a result of noise modeling scenarios in the aquatic environment, that may affect the population size of dolphin species resulting from the high noise level generated by the jacket fixing activity of the Neptun Alpha platform, this potential impact will not materialize. Before the pile beating activities, other interventions will be carried out such as operating the platform transport vessel in the fixing area, operating the support vessel, packing the jacket and masts with the use of the crane, all of which have the effect of removing cetaceans within a radius of at least 400 m, beyond the area of significant damage (100 m) of individuals of *Tursiops truncatus* and *Delphinus delphis*.

It should be emphasized that a species particularly sensitive to noise and vibration is present on the offshore site of the project, namely *Phocoena phocoena* (porpoise). In the case of this species, pile tapping activities can affect porpoises on an area with a much larger radius (about 12 km) than in the case of the other two dolphin species (*T. truncatus, D. delphis*). In the case of the species of Community interest *Phocoena phocoena, the* impact without the application of reduction/prevention/avoidance measures is considered to be significant.

Because of its high sensitivity and magnitude, the impact is assessed to be negatively high (significant).

6.2.15.1.7 Artificial lighting

Sources of light radiation emission are lighting systems on the drilling platform and at site organizations in the land area.

Light emissions from ships or drilling rigs can affect the local distribution of seabirds, thus becoming an attraction, with some bird species being disoriented by these light emissions, hitting ships or platforms, and thus running aground on them.

Studies and observations on the effects of artificial light on birds have shown that light from ships or offshore oil structures usually attracts nocturnal birds both in activity and migration period, sometimes in large numbers[43]. This can lead to bird mortality, occasionally due to collision with unlit structures near the light source that birds cannot see, or less commonly, even by lighted structures.

Many of the mortality cases were reported in the case of those birds that flew past the lights landed on deck, after which, they could not take flight again, which subsequently led to death, due to dehydration, starvation, exhaustion, hypothermia.

It has also been proven that birds can be attracted to artificial light from a distance of up to 5km in offshore installations with a brightness of 30 kW.

However, the analyzed area is located at a great distance from the shore and under these conditions, extremely few species of birds reach this area. These are mainly seabirds such as gulls, which can use the vessel's superstructure as a resting place and feed on fish in the area.

[43] Telfer, T. C., J. L. Sincock, G. V. Byrd, and J. R. Reed. 1987. *Attraction of Hawaiian seabirds to lights: conservation efforts and effects of moon phase*. Wildlife Society Bulletin 15; Russell, R. W. 2005. *Interactions between migrating birds and offshore oil and gas platforms in the northern Gulf of Mexico: Final Report*. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-009.

Migratory birds accidentally arrive in the area, with migration routes following the shoreline even for marine species. Accidentally, different species may arrive in the analyzed area deflected by air currents or storms, but one avifauna itself is missing.

In summary, the impact on biodiversity through the effect of artificial lighting is assessed to be local, temporary, reversible and of low intensity.

Based on the medium sensitivity and negligible magnitude, the impact assessed is minor.

6.2.15.2 Impact assessment at the operational phase

Table 6.116 Correlating the effects and impacts generated and the possibility of affecting biodiversity in the Neptun Deep project area during the operation phase

Type of intervention	Potential effects	Potential impacts	The possibility of significant damage to biodiversity in the area of influence of PP Yes/No	Observations
Neptune Alpha Platform	Artificial lighting and flare lighting	Loss of habitat surface	**No**	-
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	-
		Disturbance of species activity	**No**	The platform will serve as a resting place and landmark in the orientation of birds in the passage
		Population size reduction	**No**	The platform will serve as a resting place and landmark in the orientation of birds in the passage
	Emissions to offshore marine waters of chemical compounds that have the potential to harm the aquatic environment	Loss of habitat surface	**No**	-
		Habitat alteration	**Yes**	Possible changes in zoobenthos and zooplankton
		Habitat fragmentation	**No**	-
		Disturbance of species activity	**Yes**	Disturbance of pelagic fish and marine mammals
		Population size reduction	**Yes**	Possible changes in zoobenthos and zooplankton
SRM and CCR	Artificial lighting	Loss of habitat surface	**No**	-
		Habitat alteration	**No**	-

Type of intervention	Potential effects	Potential impacts	The possibility of significant damage to biodiversity in the area of influence of PP Yes/No	Observations
		Habitat fragmentation	**No**	-
		Disturbance of species activity	**No**	No significant behavioral changes. Arable land contains species adapted to light pollution
		Population size reduction	**No**	No significant behavioral changes. Arable land contains species adapted to light pollution
	Sudden increase in noise level during depressurization	Loss of habitat surface	**No**	-
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	-
		Disturbance of species activity	**Yes**	Short-term impact that cannot affect the pattern of distribution of species in the project area.
		Population size reduction	**No**	The noise does not reach values that may cause injury or accidental killing to local fauna

***6.2.15.2.1*. Increased noise level during depressurization**

It is estimated that maintenance by controlled gas discharge will be carried out every 4 years, approximately 20 minutes. A noise will be generated that can disturb birds within a radius of 2 km at the time of production, but the higher intensity will be felt in the immediate vicinity of the SRM station. Avifauna in this area of influence is represented by species adapted to anthropogenic impact – different species of gulls, crows, magpies, sparrows, domestic pigeons and will not move away for a long time from arable land around the station.

The impact can be considered direct negative, short-lived and reversible.

6.2.15.2.2 Emissions to offshore marine waters of chemical compounds that have the potential to affect the aquatic environment.

The discharge into the sea of the water produced leads to emissions into offshore marine waters of chemical compounds that have the potential to harm the aquatic environment. The chemical compounds contained in the effluent have the potential to affect zooplankton and zoobenthic organisms (nematodes and oligochaetes) in the water column between 40 m and 120 m deep, over a distance of approx. 7 km from chesson.

From the modeling carried out, it results that the effluent wedge with potential damage (EIF >5%) of macrozoobenthos and zooplankton will extend over a distance of approx. 7 km in the south-west direction and 2 km around the platform in the other directions. Given the distance of approx. 13.2 km from the Neptun Alpha platform to the protected natural area ROSCI0311 Canionul Viteaz, we consider that the risk of affecting this habitat is very low. At the same time, following observations made on the pipeline route and in the area of the Neptun Alpha platform, the presence of habitat 1180 was not reported.

Taking into account information on toxicity of chemicals contained in process water and models of effluent dispersion in the water mass, a potential indirect adverse impact on zooplankton in the effluent affected area is estimated.

The impact is considered long-term, but temporary, limited to the service life (20 years) of the Neptune Alpha platform. The extent of the impact is local.

Given the high probability of the toxic effect on zooplankton organisms occurring in the discharge area (90 m depth) and the extent of this effect both vertically and horizontally, while taking into account the high rate of natural regeneration of zooplankton populations and in the absence of protected species in their composition, we estimate a moderate significance of the impact.

In the case of phytoplankton, a minor negative impact will be generated because the effluent wedge will affect only phytoplankton at the base of the photic zone and will not extend to the surface horizon (10-30 m) where the diversity and abundance of organisms register the highest values.

If the effluent wedge exceeds a depth of 100m, zoobenthos may also be affected in the platform area. In the absence of a large faunal diversity due to the natural conditions recorded at these depths but considering the sensitivity of the receptor to the toxicity of chemicals, we consider that the impact will be of moderate significance.

Based on high sensitivity and low magnitude, the impact is assessed to be moderately negative.

In conclusion, the potential impact on marine biodiversity generated by the effluent produced by the exploitation platform can be considered negative, indirect, and insignificant due to the reversible damage, at local level and within permissible limits, of this environmental factor.

6.2.15.2.3 Artificial lighting

Sources of light radiation emission are lighting systems from the production platform and from SRM and CCR.

Light emissions from ships or the drilling rig can affect the local distribution of seabirds, thus becoming an attraction, with some bird species being disoriented by these light emissions, hitting the platform and thus stranding on them.

In summary, the impact on biodiversity through the effect of artificial lighting is assessed to be local, temporary, reversible and of low intensity.

Based on the medium sensitivity and low magnitude, the impact assessed is minor.

6.2.15.3 Impact assessment during the decommissioning period

Table 6.117 Correlating the effects and impacts generated and the possibility of affecting biodiversity in the Neptun Deep project area during the decommissioning phase

Type of intervention	Potential effects	Potential impacts	The possibility of significant damage to biodiversity in the area of influence of PP Yes/No	Observations
SRM and CCR	Increased noise level during decommissioning	Loss of habitat surface	**No**	Arable land subject to periodic agricultural interventions on soil and vegetation is concerned. The land in the land area of the project is not of particular importance as feeding and resting habitat for ROSPA0076 bird species. It does not intersect with protected natural areas.
		Habitat alteration	**No**	Arable land subject to periodic agricultural interventions on soil and vegetation is concerned. The land in the land area of the project is not of particular importance as feeding and resting habitat for ROSPA0076 bird species. It does not intersect with protected natural areas.
		Habitat fragmentation	**No**	The disturbance of bird and land mammal species is local, at the level of the working point and within a radius of 50-100 m, but also limited in time to the Duration of the intervention.
		Disturbance of species activity	**No**	No plant or animal species of conservative interest are present on the stripped-covered areas, as the land is anthropogenic.
		Population size reduction	**No**	The disturbance of bird and land mammal species is local, at the level of the working point and within a radius of 50-100 m, but also limited in time to the Duration of the intervention.

Type of intervention	Potential effects	Potential impacts	The possibility of significant damage to biodiversity in the area of influence of PP Yes/No	Observations
	Accidental mortality due to the operation of vehicles and machinery	Loss of habitat surface	**No**	**-**
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	-
		Disturbance of species activity	**No**	**-**
		Population size reduction	**No**	The works involving heavy machinery will be carried out at approx. 140 m from the habitat of the species *Spermophillus citellus*. In the case of *Bufo viridis* some individuals may arrive at the project site during the night, but work will be carried out during the day.
Neptun Alpha platform and underwater installations	Increase in underwater noise level	Loss of habitat surface	**No**	-
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	-
		Disturbance of species activity	**Yes**	Marine mammals will avoid the work area
		Population size reduction	**No**	-
	Disturbance of sedimentary substrate populated with marine	Loss of habitat surface	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Habitat alteration	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas

Type of intervention	Potential effects	Potential impacts	The possibility of significant damage to biodiversity in the area of influence of PP Yes/No	Observations
	organisms upon decommissioning	Habitat fragmentation	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Disturbance of species activity	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Population size reduction	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
	Increased turbidity	Loss of habitat surface	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Habitat alteration	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Habitat fragmentation	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Disturbance of species activity	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
		Population size reduction	**No**	No species and/or habitats of Community interest are present. Outside protected natural areas
	Increase underwater noise level	Loss of habitat surface	**No**	-
		Habitat alteration	**No**	-
		Habitat fragmentation	**No**	-
		Disturbance of species activity	**Yes**	The noise shall not reach a level liable to disturb the activity of marine mammals
		Population size reduction	**No**	-

6.2.15.3.1 Increased noise level

Noise and vibration emissions during the decommissioning phase are expected to increase, due to construction works such as cutting installations, dismantling equipment, excavating soil, levelling surfaces, mobilizing vehicles, workers, and equipment, transporting materials and waste.

On land, the decommissioning works will be carried out at a distance of 161 m from the Special Protection Area ROSPA0076 the Black Sea.

The increase in noise levels will lead to temporary disruption of the activities of identified birds and mammals in the vicinity of the site in the terrestrial area. In the area, *Spermophilus citellus,* Lutra lutra*,* rodents have been identified, and on irrigation canals and in the orchard in the area *Meles meles*, *Vulpes vulpes* and *Canis aureus*.

Increasing the noise level in the coastal zone will lead to temporary disruption of bird activity.

Noise and vibration emissions are expected to be of low intensity during decommissioning activities, with local, reversible, short-term expansion of a low magnitude. The sensitivity is assessed as low, resulting in a minor impact.

6.2.15.3.2 Road traffic mortality and machine operation

. Carnivorous mammals have a predominantly nocturnal activity and will crossroads when there is no road traffic. The vehicles and machinery will travel at low speeds and will not generate a significant risk of roadkil for individuals of *Spermophillus citellus* observed in the cliff area and collision for birds feeding on adjacent land (mostly gulls) or those in the passage. The roads do not cross the habitat of *Spermophillus citellus* and, consequently, road traffic will not take place near it.

In the case of *Bufo viridis* some individuals may arrive at the project site at night, but road traffic will be carried out during the day.

The effects generated by car traffic are of low intensity during decommissioning activities, with a local, irreversible, short-term expansion of negligible magnitude. The sensitivity is estimated to be low, resulting in an insignificant impact.

6.2.15.3.3 Temporary and local increase in nutrients and possibly pollutants present in sediments due to sediment resuspension.

Following the decommissioning of the underwater infrastructure, sediments will be resuspended in the water, which will also contribute to the temporary and local increase of nutrients and possibly some pollutants present in the sediments, but unable to produce significant changes in the chemical status and physicochemical elements defining the ecological status of water bodies.

The insignificant increase in the concentration of suspended solids and nutrients over a short period of time will not affect planktonic and benthic communities and consequently will not affect the upper links in the food chain such as ichthyofauna, avifauna and marine mammals.

In conclusion, the impact on biodiversity through temporary and local increases in nutrients and possibly some pollutants present in sediments due to sediment resuspension is assessed to be local, temporary, of low intensity.

Based on the medium sensitivity and a low magnitude, the impact is assessed to be minor negative.

6.2.15.3.4 Increased underwater noise

The underwater noise generated by the decommissioning works of the components at sea, namely: cutting the legs of the platform support structure, closing, and abandoning the production wells, decommissioning of the underwater infrastructure, naval traffic is estimated to have a lower level than its level during the construction period. With all these activities, marine mammals and fish will move away from the area where work is being carried out and return to the area after construction activities have ceased.

In conclusion, the impact on biodiversity due to underwater noise is assessed to be local, short-term, low-intensity.

Based on the average sensitivity and average magnitude, the impact is assessed to be moderately negative.

6.2.15.4 Summary of impacts on biodiversity at all stages of the project

The table below presents the impact assessment by magnitude and sensitivity of the receiver without applying impact mitigation measures.

The significance matrix of the impact is presented in Section 6.1.4.3.

Table 6.118 Environmental impact assessment biodiversity at all stages of the project

Effect	Magnitude components		Magnitude	Sensibility	Meaning Impact	Potential cross-border impact
Construction stage						
Earth-based noise emissions	*Nature effect*	Negative	Low	Low	Minor	No
	Effect Type	Directly				
	Reversibility of effect	Reversible				
	Extension	Local				
	Duration	Short term				
	Intensity	Low				
Stripping topsoil layer	*Nature effect*	Negative	Negligible	Low	Insignificant	No
	Effect Type	Directly				

Effect	**Magnitude components**		**Magnitude**	**Sensibility**	**Meaning Impact**	**Potential cross-border impact**
	Reversibility of effect	Reversible				
	Extension	Local				
	Duration	Short term				
	Intensity	Low				
Accidental mortality due to road traffic and machine operation	*Nature effect*	Negative	Low	Low	Minor	No
	Effect Type	Directly				
	Reversibility of effect	Reversible				
	Extension	Local				
	Duration	Short term				
	Intensity	Low				
Increased turbidity	*Nature effect*	Negative	Medium	Medium	Moderate	No
	Effect Type	Indirect secondary				
	Reversibility of effect	Reversible				
	Extension	Local				
	Duration	Short term				
	Intensity	Low				
Relocation of substrate with living organisms	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect Type	Directly				
	Reversibility of effect	Reversible				
	Extension	Local				
	Duration	Short term				
	Intensity	Low				
Temporary and local increase in nutrients and possibly pollutants	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect Type	Indirect				

Effect	Magnitude components		Magnitude	Sensibility	Meaning Impact	Potential cross-border impact
present in sediments due to sediment resuspension	*Reversibility of effect*	Reversible				
	Extension	Local				
	Duration	Short term				
	Intensity	Low				
Crushing and/or denudation of hard substrate populated with marine organisms as a result of the placement of ship anchors used for installation of the production pipeline	*Nature effect*	Negative	Low	High	Moderate	No
	Effect Type	Directly				
	Reversibility of effect	Reversible				
	Extension	Local				
	Duration	Short term				
	Intensity	Low				
Increased underwater noise	*Nature effect*	Negative	High	High	Major	Yes
	Effect Type	Directly				
	Reversibility of effect	Reversible				
	Extension	regional				
	Duration	Short term				
	Intensity	Low				
Artificial lighting	*Nature effect*	Negative	Negligible	Low	Insignificant	
	Effect Type	Directly				
	Reversibility of effect	Reversible				
	Extension	Local				
	Duration	Short term				
	Intensity	Low				
Stage of operation						
Emissions to offshore marine waters of	*Nature effect*	Negative	Low	High	Moderate	No
	Effect Type	Directly				

Effect	Magnitude components		Magnitude	Sensibility	Meaning Impact	Potential cross-border impact
chemical compounds that have the potential to affect the aquatic environment	*Reversibility of effect*	Reversible				
	Extension	local				
	Duration	Long term				
	Intensity	Low				
Increased noise level during depressurization	*Nature effect*	Negative	Low	Low	Minor	
	Effect Type	Directly				
	Reversibility of effect	Reversible				
	Extension	Local				
	Duration	Temporary				
	Intensity	Low				
Artificial lighting	*Nature effect*	Negative	Low	Low	Minor	
	Effect Type	Directly				
	Reversibility of effect	Reversible				
	Extension	Local				
	Duration	Long term				
	Intensity	Low				
Decommissioning phase						
Increased noise levels in the terrestrial area	*Nature effect*	Negative	Low	Low	Minor	No
	Effect Type	Directly				
	Reversibility of effect	Reversible				
	Extension	Local				
	Duration	Short term				
	Intensity	Low				
Artificial lighting	*Nature effect*	Negative	Negligible	Low	Insignificant	No
	Effect Type	Directly				
	Reversibility of effect	Reversible				

Effect	Magnitude components		Magnitude	Sensibility	Meaning Impact	Potential cross-border impact
	Extension	Local				
	Duration	Short term				
	Intensity	Low				
Temporary and local increase in nutrients and possibly pollutants present in sediments due to sediment resuspension	*Nature effect*	Negative	Low	Medium	Minor	No
	Effect Type	Directly				
	Reversibility of effect	Reversible				
	Extension	Local				
	Duration	Short term				
	Intensity	Low				
Increased underwater noise	*Nature effect*	Negative	Medium	Medium	Moderate	No
	Effect Type	Directly				
	Reversibility of effect	Reversible				
	Extension	local				
	Duration	Short term				
	Intensity	Low				
OVERALL ASSESSMENT OF THE BIODIVERSITY FACTOR			**Insignificant impact (moderate negative).** **Except for the impact of underwater noise on marine mammals during the construction period (pile hammering), the significance of which is Significantly negative.**			

6.2.15.5 Measures to prevent/avoid/reduce impacts on biodiversity.

MS 1. The anchoring plan shall be respected which reduces to a minimum (7 positions) the use of anchors in ROSAC0273. Any change in the anchorage plan in ROSAC0273 will be made only after being informed and with the consent of the environmental protection authorities (EPA and ANANP).

MS 2. For the anchor that overlaps with the mapped area of habitat 8330 (outside ANPIC), a new position will be identified in the vicinity that will not intersect habitats on hard substrate.

MS 3. The anchor launching works will be assisted by biodiversity conservation specialists, and the anchor placement areas will be inspected before starting the works with the help of ROV equipment.

MS 4. In order to limit the spread of sediment wedges inside and outside ANPIC, turbidity curtains will be installed around the working areas that will retain most of the suspended sediments.

MS 5. Carrying out excavation works in the shore area only in periods of calm sea.

MS 6. Implementation of accidental pollution response plans. The presence on board barges and vessels of emergency pollution response equipment.

MS 7. Imposition of a marine mammal exclusion zone. Work on fixing the platform shall only commence if no dolphins are present in the exclusion zone of 500 m around the works after a 30-minute observation period.

MS 8. In order to avoid potential injuries or accidental killings in cetaceans, as a result of noise and vibration emissions, at the beginning of the works of fixing the pillars to the jacket of the platform, only 20% of the power of the installation for beating these pillars will be used for 120 minutes (soft start procedure), so that the individuals in the area of damage (3.5 km in the case of T. truncatus and D. delphis; 19-20 km in the case of P. phocoena) can safely leave the area affected by the project. The soft start procedure will be applied whenever the pile fastening works will be interrupted for more than 60 minutes.

MS 9. Conduct the eco-toxicity study by conducting chronic toxicity tests for all chemicals that will be discharged into the sea, including biocide and methanol, by means of which to validate/demonstrate that the maximum allowable limit values set for discharge into the marine environment, at the level of each chemical substance ensure the protection of the marine environment, have a low impact on the marine aquatic ecosystem and do not lead to failure to achieve the environmental objectives set through the Marine Strategy Framework Directive (2008/56/EC). (Measure in correlation with the requirements of the Water Management Notice).

6.2.15.6 Conclusions of the appropriate assessment study

Given that no components of the PP have been identified in the impact assessment process within ANPIC that generate significant impacts, the following table will include species and habitats affected insignificantly negatively.

Table 6.119 Conclusions of the appropriate assessment

PP component description	ANPIC affected	Species/habitats affected	Conservation objectives/parameters affected	Types of impact, including cumulative	Reduction measures	Residual impact	Alternative solution	Overriding reasons of overriding public interest	Compensatory measures	Other issues
Barge anchorage Digging trench for gas pipeline	ROSAC0273 Cape Tuzla marine area	1110 Shallow submerged sandbanks	Habitat area	Direct and indirect short-term impact. Insignificant	MS 4	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Digging trench for gas pipeline			Characteristic invertebrate species	Indirect short-term impact Insignificant	MS 4	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Digging trench for gas pipeline			Ecological status of water based on physicochemical indicators	Indirect short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Barge anchorage Digging trench for gas pipeline	ROSAC0273 Cape Tuzla marine area	1170 Reefs	Habitat area	Direct and indirect short-term impact. Insignificant	MS 1, MS 4	Insignificant	This is not the case	This is not the case	This is not the case	The habitat is also present outside ANPIC
Barge anchorage Digging trench for gas pipeline			Area of habitat subtypes	Direct and indirect short-term impact. Insignificant	MS 1, MS 4	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Digging trench for gas pipeline			Ecological status of water based on physicochemical indicators	Indirect short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case

PP component description	ANPIC affected	Species/habitats affected	Conservation objectives/parameters affected	Types of impact, including cumulative	Reduction measures	Residual impact	Alternative solution	Overriding reasons of overriding public interest	Compensatory measures	Other issues
Digging trench for gas pipeline	ROSAC0273 Cape Tuzla marine area	8330 Caves fully or partially submerged	Ecological status of water based on physicochemical indicators	Indirect short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	The habitat is also present outside ANPIC
Digging trench for gas pipeline	ROSAC0273 Cape Tuzla marine area	*Alosa tanaica*	Ecological status of water based on physicochemical indicators	Indirect and secondary short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Ditch digging/dredging for gas pipeline	ROSAC0273 Cape Tuzla marine area	*Alosa immaculata*	Ecological status of water based on physicochemical indicators	Indirect and secondary short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Operation of vessels	ROSAC0273 Cape Tuzla marine area	*Tursiops truncatus*	Spatial and temporal pattern, intensity of habitat use	Direct short-term impact Insignificant	This is not the case	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Ditch digging/dredging for gas pipeline			Size and species diversity of prey	Short-term secondary impact Insignificant	This is not the case	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Ditch digging/dredging for gas pipeline			Ecological status of water based on physicochemical indicators	Indirect and secondary short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case

PP component description	ANPIC affected	Species/habitats affected	Conservation objectives/parameters affected	Types of impact, including cumulative	Reduction measures	Residual impact	Alternative solution	Overriding reasons of overriding public interest	Compensatory measures	Other issues
Operation of vessels	ROSAC0273 Cape Tuzla marine area	*Phocoena phocoena*	Spatial and temporal pattern, intensity of habitat use	Direct short-term impact Insignificant	This is not the case	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Ditch digging/dredging for gas pipeline			Size and species diversity of prey	Short-term secondary impact Insignificant	This is not the case	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Ditch digging/dredging for gas pipeline			Ecological status of water based on physicochemical indicators	Indirect and secondary short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Ditch digging/dredging for gas pipeline	ROSCI0293 Costinesti - August 23	1110 Shallow submerged sandbanks	Ecological status of water based on physicochemical indicators	Indirect and cumulative short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Ditch digging/dredging for gas pipeline	ROSCI0293 Costinesti - August 23	1170 Reefs	Ecological status of water based on physicochemical indicators	Indirect and cumulative short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Ditch digging/dredging for gas pipeline	ROSCI0293 Costinesti - August 23	1140 Surfaces of sand and silt discovered at low tide	Ecological status of water based on physicochemical indicators	Indirect and cumulative short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case

PP component description	ANPIC affected	Species/habitats affected	Conservation objectives/parameters affected	Types of impact, including cumulative	Reduction measures	Residual impact	Alternative solution	Overriding reasons of overriding public interest	Compensatory measures	Other issues
Ditch digging/dredging for gas pipeline	ROSCI0293 Costinesti - August 23	8330 Caves fully or partially submerged	Ecological status of water based on physicochemical indicators	Indirect and cumulative short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Ditch digging/dredging for gas pipeline	ROSCI0293 Costinesti - August 23	*Alosa tanaica*	Ecological status of water based on physicochemical indicators	Indirect and cumulative short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Ditch digging/dredging for gas pipeline	ROSCI0293 Costinesti - August 23	*Alosa immaculata*	Ecological status of water based on physicochemical indicators	Indirect and cumulative short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Ditch digging/dredging for gas pipeline	ROSCI0293 Costinesti - August 23	*Tursiops truncatus*	Ecological status of water based on physicochemical indicators	Indirect and cumulative short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Ditch digging/dredging for gas pipeline	ROSCI0293 Costinesti - August 23	*Phocoena phocoena*	Ecological status of water based on physicochemical indicators	Indirect and cumulative short-term impact Insignificant	MS 5, MS 6	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Neptun Alpha platform installation	ROSCI0311 Canionul Viteaz	*Tursiops truncatus*	Population size	Direct short-term impact Insignificant	MS 7, MS 8	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case

PP component description	ANPIC affected	Species/habitats affected	Conservation objectives/parameters affected	Types of impact, including cumulative	Reduction measures	Residual impact	Alternative solution	Overriding reasons of overriding public interest	Compensatory measures	Other issues
Neptun Alpha platform installation Operation of vessels			Distribution pattern	Direct short-term impact Insignificant	This is not the case	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Technological water from the Neptun Alpha platform			Ecological status of water based on ecological indicators	Long-term indirect and secondary impact Insignificant	MS 6, MS 9	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Technological water from the Neptun Alpha platform	ROSCI0311 Canionul Viteaz	1170	Ecological status of water based on ecological indicators	Long-term indirect impact Insignificant	MS 6, MS 9	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case
Technological water from the Neptun Alpha platform		1180	Ecological status of water based on ecological indicators	Long-term indirect impact Insignificant	MS 6, MS 9	Insignificant	This is not the case	This is not the case	This is not the case	This is not the case

6. 3 ENVIRONMENTAL IMPACT ASSESSMENT IN A CROSS-BORDER CONTEXT

6.3.1 General information on the project

Environmental impact assessment in a cross-border context from this chapter, developed for the Project " **NEPTUN DEEP"** closely follows the requirements of Annex 4 of Law no. 292/2018, *regarding the assessment of the impact of certain public and private projects on the environment* that transposes the requirements Directive 2014/52/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment, the Espoo Convention as and, of the Guidance on environmental issues that must be analyzed in the Environmental Impact Assessment Report, communicated to the project owner via the address of APM Constanta, no. 1632/11.08.2023.

In addition, according to the address of the Ministry of Environment, Water and Forests no. DGEICPSC/R/17868/08.08.2023, the Bulgarian side communicated its interest in participating in the environmental impact assessment procedure and submitted a number of relevant issues to be included in the content of the RIM.

Furthermore, as the project is located in Romania's Exclusive Economic Zone in the Black Sea, the requirements of Directive 2013/30/EU of the European Parliament and of the Council of June 12, 2013, regarding the safety of offshore oil and gas operations and its amendment will be respected of Directive 2004/35/EC.

The activity proposed by the project falls under Annex I of the Espoo Convention, point 15, *Offshore hydrocarbon production. Extraction of petroleum and natural gas for commercial purposes where the amount extracted exceeds 500 metric tons/day in the case of petroleum and 500 000 cubic meters/day in the case of gas (Offshore fuel production. Extraction of petroleum and natural gas for purposes commercial if the quantity extracted exceeds 500 metric tons/day in the case of oil and 500,000 cubic meters/day in the case of gas)".*

The "Neptun Deep" project includes the following facilities:

- **Onshore:** Pipeline and Communications Cable Installation, Beach Undercrossing, Seawall, Roads, and Railways; Realization of Temporary Railway Level Crossing; Construction of Regulation and Measurement Station - NGMS, Control Centre - CCR, Fencing, Lighting, Parking, Green Spaces, Platforms and Internal Roads; Site Organization, Insurance and Connection to Utilities.
- **Offshore:** Domino and Pelican South Infrastructure (Drilling Centers, Wells, Manifolds, Umbilical Systems, Risers, Supply/Induction Pipes, Auxiliary Equipment); Production Platform located in shallow waters; Natural Gas Production Pipeline; Fiber optic cable; Undercrossing the Shore; Utilities. **"**

The project holders are **OMV Petrom SA** and **Romgaz Black Sea Limited Nassau (Bahamas) Bucharest Branch.**

6.3.2. Location of the project site in the marine area

The offshore facilities of Neptun Deep are in the Romanian EEZ.

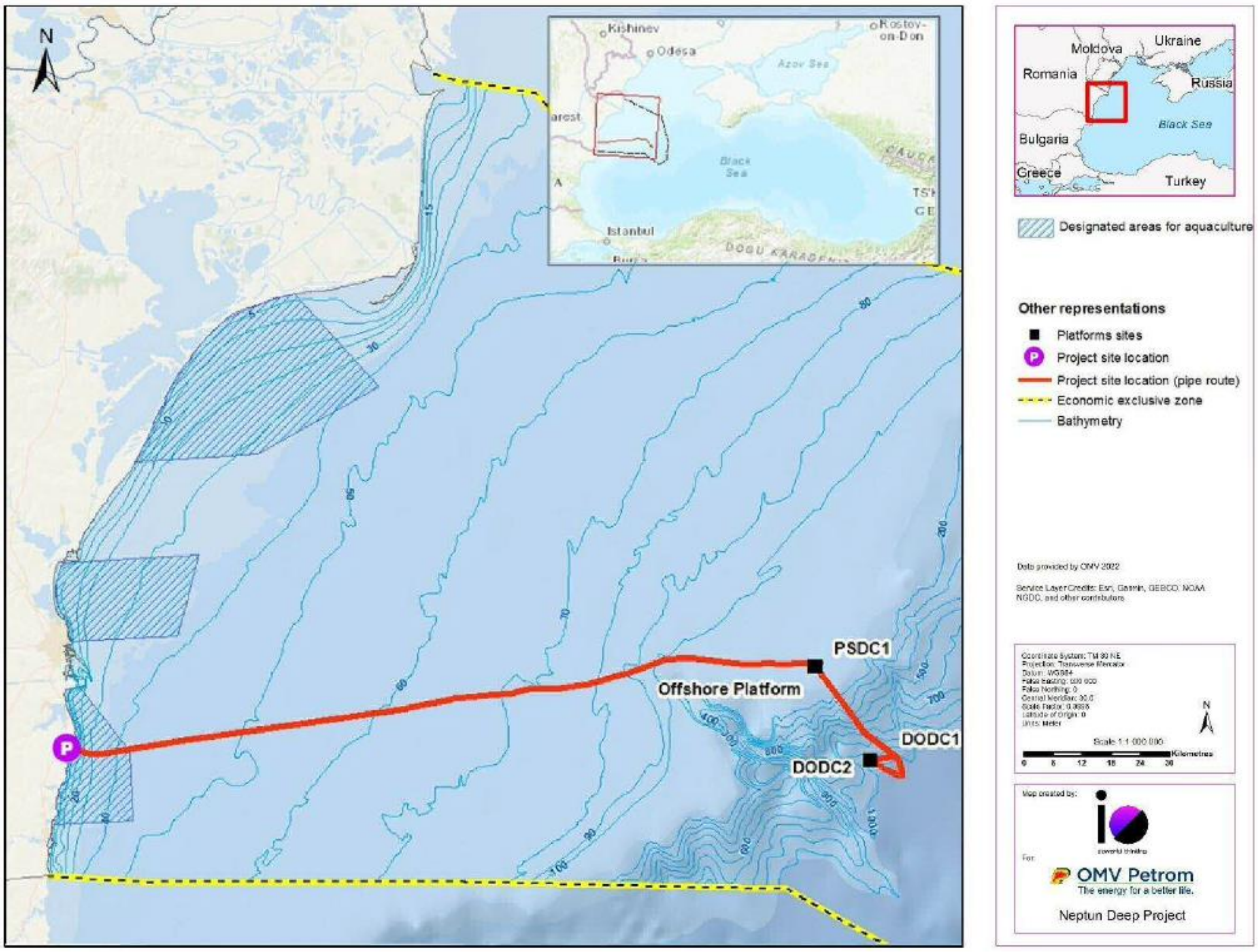


Figure 6.106 Location of the project in relation to the Exclusive Economic Zone of the neighboring States[44]

6.3.2.1 Marine production platform Neptun Alpha

The marine production platform, hereinafter referred to as the Neptun Alpha Platform, to which the Domino and Pelican South infrastructures will be connected, is located on the continental platform of the Black Sea in the Exclusive Economic Zone of Romania and approximately 160 km west of the town of Tuzla, Constanța county.

[44]Source: Environmental and Social Impact Assessment Report, Neptun Deep Project

The coordinates in the Stereo 70 and WGS84 system of the location of the production platform are presented in table no. 6.120, below:

Table 6.120 The coordinates of the Neptun Alpha Platform

Location	Stereo 70 coordinates		WGS84/TM30NE coordinates	
	North (m)	East (m)	North (m)	East (m)
Marine production platform	298,534.29	947,751.25	4,877,318.00	547,062.00

6.3.2.2 Drilling Centers

In the Neptun perimeter, for the 2 fields Domino and Pelican South, 3 drilling centers are proposed, one drilling Centre in Pelican South and 2 drilling centers in Domino.

The South Pelican Drilling Centre (PSDC1) is located on the Black Sea continental shelf approximately 160 km east of Tuzla and approximately 2 km northeast of the production platform.

The Domino drilling centers (DODC1 and DODC2) are located on the continental slope of the Black Sea, approximately 175 km east of Tuzla and approximately 24 km southeast of the production platform.

A selection of coordinates in the Stereo 70 and WGS84 system for drilling centers is shown in table no. 6.121, below:

Table 6.121 Drilling Centre coordinates

Location	Stereo 70 coordinates		WGS84/TM30NE coordinates	
	North (m)	East (m)	North (m)	East (m)
PSDC1	299,471.11	948,682.68	4,878,194.00	548,048.00
DODC1	280,058.98	964,335.02	4,857,884.92	562,445.99
DODC2	279,072.99	959,245.90	4,857,216.52	557,314.55

6.3.2.3 Gas production wells

The project includes drilling 10 subsea gas production wells, namely:

- 6 wells will be drilled to a vertical depth of 3,000 m from drill centers DODC1 and DODC2 (3 wells/drill Centre) in the Domino field at a water depth of 800 – 1,100 m;
- 4 wells will be drilled to a vertical depth of 3,400 m from a single drilling Centre (PSDC1) in the South Pelican field, at a water depth of 120 - 130 m;

Table 6.122 Domino and Pelican South production well coordinates

The drilling Centre	Well ID	Stereo 70 coordinates		WGS84 TM30NE coordinates	
		North (m)	East (m)	North (m)	East (m)
DODC1	VXT581006	280086.50	964329.44	4857912.23	562441.87
DODC1	VXT581007	280032.87	964341.32	4857858.06	562450.40
DODC1	VXT581008	280050.92	964309.35	4857878.02	562419.66

The drilling Centre	Well ID	Stereo 70 coordinates		WGS84 TM30NE coordinates	
		North (m)	East (m)	North (m)	East (m)
DODC2	VXT581010	279046.42	959252.03	4857189.21	557318.67
DODC2	VXT581011	279100.05	959240.15	4857243.38	557310.14
DODC2	VXT581012	279082.00	959272.12	4857223.42	557340.88
PSDC1	VXT581001	299445.21	948674.49	4878168.27	548037.99
PSDC1	VXT581002	299460.49	948708.22	4878181.41	548072.55
PSDC1	VXT581003	299482.62	948657.58	4878206.59	548023.45
PSDC1	VXT581004	299497.90	948691.31	4878219.73	548058.01

6.3.2.4 Flowlines and umbilical's from Domino, Pelican South to Neptun Alpha Platform

The supply/adduction pipes have the role of ensuring the active management of hydrates with the help of electric heating.

The supply/ adduction pipeline from the DODC2 to DODC1 drilling Centre and from DODC1 to the Neptun Alpha platform is 36.5 km long.

The route of the supply / adduction pipeline from the Neptun Alpha Platform to the DODC1 Drilling Centre and from the DODC1 Drilling Centre to the DODC2 Drilling Centre is shown in Appendix B.

The feed/supply pipeline from the PSDC1 drilling Centre to the Neptun Alpha platform is 1.5 km long.

The route of the Pelican South flexible supply/ adduction pipeline is shown in Appendix B.

A selection of Domino direct heating supply/ adduction pipe route coordinates is shown in Table 6.123 below:

Table 6.123 Selection of coordinates from the route of the Domino supply/supply pipeline

No.	Stereo 70 coordinates		WGS84 TM30NE coordinates	
	North (m)	East (m)	North (m)	East (m)
1	279025.23	959218.53	4857170.63	557284.24
2	276777.67	963127.25	4854690.05	561040.14
3	279825.01	964862.25	4857619.27	562956.87
4	281781.66	961391.27	4859783.03	559619.21
5	282876.55	960055.45	4860956.40	558355.79
6	285033.30	957585.58	4863044.50	556407.62
7	298468.42	947769.66	4877251.22	547076.27

A selection of coordinates along the route of the Pelican South flexible supply/supply pipeline is shown in table 6.124, below.

Table 6.124 Selection of coordinates from the route of the Pelican South supply/intake pipeline

No.	Stereo 70 coordinates		WGS84 TM30NE coordinates	
	North (m)	East (m)	North (m)	East (m)
1	298,529.48	947,778.10	4,877,311.55	547,088.43

No.	Stereo 70 coordinates		WGS84 TM30NE coordinates	
	North (m)	East (m)	North (m)	East (m)
2	298,571.46	948,025.82	4,877,338.14	547,337.97
3	299,330.15	948,715.31	4,878,051.53	548,071.82
4	299,467.24	948,686.46	4,878,189.91	548,051.54

The Domino and Pelican South subsea systems will be monitored and controlled using electrical and hydraulic control systems connected to the Neptun Alpha Platform via dedicated umbilical control connections. The Domino subsea system will include two electrical and hydraulic control umbilical segments: one between the offshore production platform and the DODC1 drilling center and one between the DODC1 drilling center and the DODC2 drilling center. The Pelican South subsea system will include an electrical and hydraulic control umbilical system between the Neptun Alpha Platform and the PSDC1 drilling center.

A selection of coordinates along the tracks of the Domino and Pelican South umbilical systems are shown in Tables 6.125 and 6.126, below:

Table 6.125 Selection of coordinates from the route of the Domino umbilical systems

No.	Stereo 70 coordinates		WGS84/TM30NE coordinates	
	North (m)	East (m)	North (m)	East (m)
1	279,121.45	959,273.77	4,857,263.07	557,345.25
2	278,877.80	963,092.03	4,856,784.79	561,134.75
3	280,010.52	964,307.35	4,857,838.13	562,415.66
4	286,370.59	955,974.01	4,864,690.13	554,504.48
5	279,121.45	959,273.77	4,857,263.07	557,345.25
6	278,877.80	963,092.03	4,856,784.79	561,134.75
7	280,010.52	964,307.35	4,857,838.13	562,415.66

Table 6.126 Selection of coordinates from the route of the Pelican South umbilical system

No.	Stereo 70 coordinates		WGS84/TM30NE coordinates	
	North (m)	East (m)	North (m)	East (m)
1	298,546.51	947,776.63	4,877,328.61	547,088.04
2	298,616.90	947,858.51	4,877,393.70	547,173.99
3	298,600.03	948,011.18	4,877,367.45	547,325.08
4	299,466.47	948,684.77	4,878,189.25	548,049.81

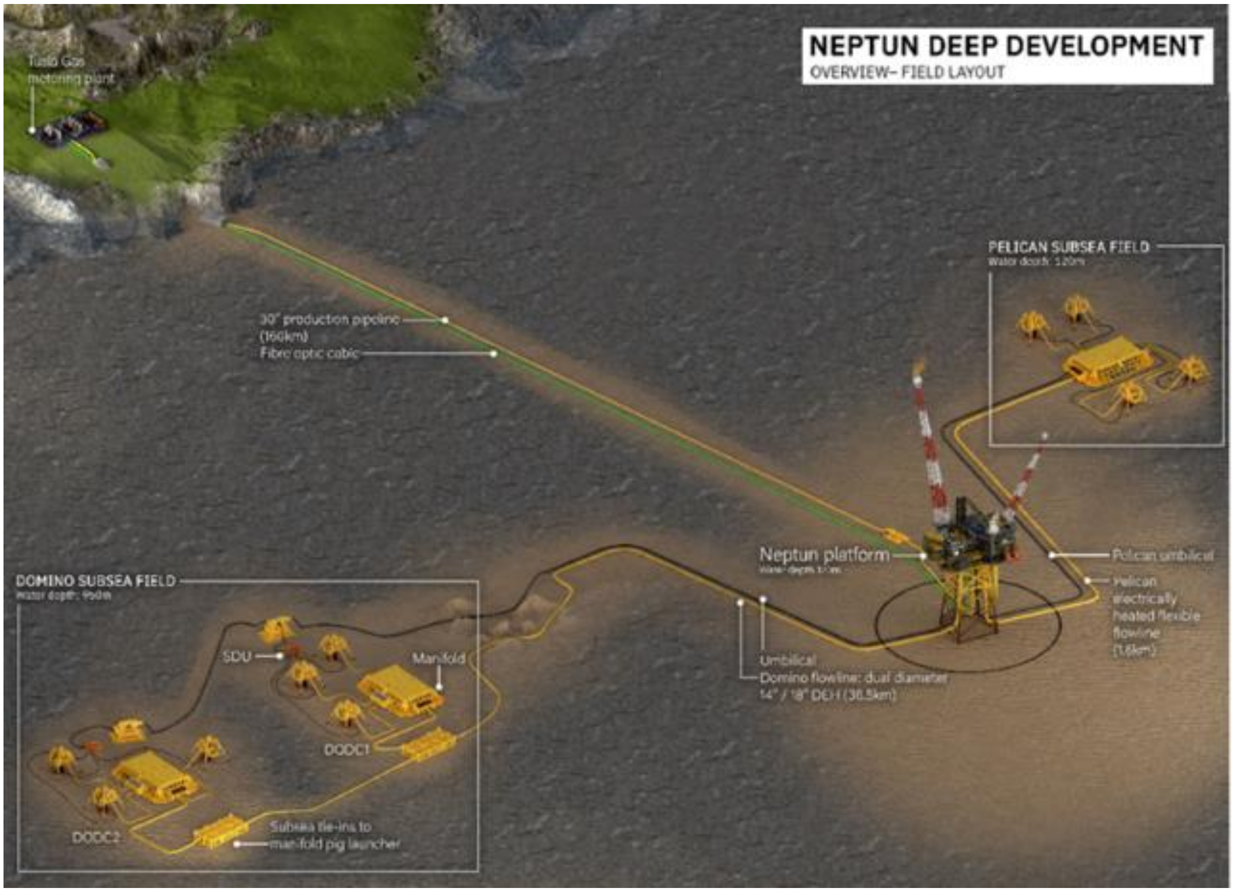


Figure 6.107 Neptun Deep Project

6.3.2.5 Gas production pipeline and fiber optic cable route

The gas production pipeline route has a total length of 160 km of which approximately 1,772 km is installed in the onshore and microtunnel area of the project.

The offshore section of the 762 mm (30 inch) production pipeline and fiber optic cable will occupy an underwater area of approximately 638,080 m^2.

The fiber optic cable will be installed parallel to the gas production pipeline at a distance of 30 m near the shore where it will be installed alongside the production pipeline.

A selection of offshore route coordinates of the production pipeline in Stereo 70 and WGS84/TM30NE are shown in Table 6.127 below.

Table 6.127 Selection of coordinates of the offshore route of the production pipeline

No.	Stereo 70 coordinates		WGS84 TM30NE coordinates	
	North (m)	East (m)	North (m)	East (m)
1	281,233.00	794,081.70	4,869,527.71	392,810.30
2	280,514.69	796,410.36	4,868,668.52	395,088.50
3	291,750.12	871,995.75	4,875,227.04	471,141.24

No.	Stereo 70 coordinates		WGS84 TM30NE coordinates	
	North (m)	East (m)	North (m)	East (m)
4	292,997.32	884,786.55	4,875,682.74	483,968.06
5	293,912.28	888,135.82	4,876,388.46	487,362.89
6	294,566.70	899,038.30	4,876,369.01	498,270.08
7	299,913.63	916,468.31	4,880,623.45	515,971.83
8	298,791.36	933,715.27	4,878,440.74	533,090.74
9	299,142.90	936,628.57	4,878,611.23	536,015.69
10	298,950.56	940,460.87	4,878,182.97	539,822.79
11	299,299.92	944,046.66	4,878,309.71	543,417.67
12	298,595.21	947,777.93	4,877,377.05	547,092.35

A selection of coordinates of the sea route of the optical fiber cable, in Stereo 70 and WGS84/TM30NE system are shown in table 6.128, below:

Table 6.128 Selection of coordinates from the sea route of the fiber optic cable

No.	Stereo 70 coordinates		WGS84 TM30NE coordinates	
	North (m)	East (m)	North (m)	East (m)
1	281,233.00	794,081.70	4,869,527.71	392,810.30
2	280,514.69	796,410.36	4,868,668.52	395,088.50
3	291,750.12	871,995.75	4,875,227.04	471,141.24
4	292,997.32	884,786.55	4,875,682.74	483,968.06
5	293,912.28	888,135.82	4,876,388.46	487,362.89
6	294,566.70	899,038.30	4,876,369.01	498,270.08
7	299,913.63	916,468.31	4,880,623.45	515,971.83
8	298,791.36	933,715.27	4,878,440.74	533,090.74
9	299,142.90	936,628.57	4,878,611.23	536,015.69
10	298,950.56	940,460.87	4,878,182.97	539,822.79
11	299,299.92	944,046.66	4,878,309.71	543,417.67

6.3.2.6 The coordinates of the entry and exit point of the microtunnel

The coordinates in the Stereo 70 system of the land entry point and the sea exit point of the microtunnel are shown in table no. 6.129 below:

Table 6.129 Coordinates of the entry and exit points of the microtunnel

Location	Stereo 70 coordinates		WGS84/TM30NE coordinates	
	North (m)	East (m)	North (m)	East (m)
Land entry point	281,495.40	793,230.70	4,869,841.70	391,977.73
Exit point from the sea	281,233.00	794,081.70	4,869,527.71	392,810.30

6.3.2.7 Coordinates of the underground gas production pipeline route and microtunnel

The production pipeline and fiber optic cable will have a total length of approximately 1,772 km in the land area of the project, of which 890 m in the microtunnel. The production pipeline and the onshore fiber optic cable will be installed side by side in the onshore microtunnel and trench.

Table 6.130 Inventory of coordinates in the STEREO 70 system of the onshore production pipeline route

Construction name	Coordinates in Stereo 70			WGS84/TM30NE coordinates	
	Item no.	North (X) m	East (Y) m	North (m)	East (m)
Onshore production pipeline and fiber optic cable route (section between undercrossing and NGMS) KP 156.965÷157.847	1	281,507.90	792,349.10	4,869,907.77	391,098.85
	2	281,507.70	792,374.70	4,869,905.99	391,124.37
	3	281,506.60	792,519.60	4,869,896.01	391,268.81
	4	281,506.20	792,566.60	4,869,892.73	391,315.66
	5	281,503.70	792,880.40	4,869,871.00	391,628.45
	6	281,503.00	792,973.70	4,869,864.58	391,721.46
	7	281,502.30	793,067.10	4,869,858.15	391,814.56
	8	281,501.70	793,136.40	4,869,853.30	391,883.64
	9	281,501.10	793,212.30	4,869,848.05	391,959.30
	10	281,500.00	793,215.70	4,869,846.75	391,962.62
Microtunnel KP 156.075÷156.965	1	281,493.00	793,234.30	4,869,838.50	391,980.75
	2	281,495.30	793,235.00	4,869,841.00	391,981.59
	3	281,234.20	794,081.40	4,869,528.50	392,809.69
	4	281,231.90	794,080.70	4,869,526.50	392,808.84

6.3.2.8 Locating the location of the Regulation and Measurement Station (NGMS), Command and Control Room (CCR) and Shut-off Valve Station

They will be built/installed on the S1 land Regulation and Measurement Station (NGMS) and Control Centre/Centralized Control Room (CCR) and other related facilities included in the NGMS and CCR sites.

NGMS will be an automatic, unmanned natural gas metering and custody transfer facility to NTS operated by Transgaz . The total area occupied by the NGMS site will be approximately 23,183 m^2.

The CCR site will be fenced with an estimated area of approximately 3,459 m^2.

The distance from NGMS to the border with the Republic of Bulgaria in the land zone is about 25 km.

A shut-off valve station will be located east of the railway level crossing, located in a buried reinforced concrete manhole, provided with a perimeter protective fence.

The coordinates in the Stereo 70 and WGS84 TM30NE systems of the fenced location of the NGMS, CCR, shut-off valve is presented in table no. 6.131 below:

Table 6.131 Inventory of coordinates in the STEREO 70 system of the NGMS and CCR perimeter

Construction name	Coordinates in Stereo 70			WGS84/TM30NE coordinates	
	Item no	North (X) m	East (Y) m	North (m)	East (m)
Regulation and measurement station (NGMS)	1	281,533.00	792,373.39	4,869,931.31	391,124.62
	2	281,343.00	792,373.39	4,869,741.83	391,112.97
	3	281,343.00	792,243.39	4,869,749.80	390,983.32
	4	281,415.00	792,243.39	4,869,821.60	390,987.74
	5	281,435.90	792,257.49	4,869,841.57	391,003.09
	6	281,533.00	792,257.49	4,869,938.42	391,009.04
Centralized Control Room (CRC)	1	281,633.83	792,324.46	4,870,034.87	391,082.01
	2	281,615.21	792,389.31	4,870,012.32	391,145.55
	3	281,566.01	792,375.72	4,869,964.09	391,128.98
	4	281,583.98	792,310.68	4,869,985.99	391,065.21
The perimeter of the station Tap closing	1	281,513.41	792,976.46	4,869,874.79	391,724.86
	2	281,513.41	792,996.62	4,869,873.56	391,744.97
	3	281,493.13	792,996.62	4,869,853.33	391,743.72
	4	281,493.13	792,976.46	4,869,854.57	391,723.62

6.3.3 Summary of the Neptun Deep project

The Neptun Deep project aims to extract gases from the Neptun perimeter located in the Black Sea, treat them on the Neptun Alpha production platform and transport them to the Romanian shore at the Regulation and Measurement Station (NGMS) located in the Tuzla area.

The main sea and land components of the project are as follows:

- **The underwater infrastructure for Domino and Pelican Sud,** including underwater production wells, supply/adduction pipelines connected to the Neptun Alpha Platform from the Domino and Pelican Sud reservoirs, umbilical systems for electric and hydraulic control from the production platform to the Domino and Pelican Sud drilling centers, and other underwater equipment;
- The unmanned Neptun Alpha **platform for the processing of natural gas from the Domino and Pelican South fields, located in waters with a depth of approximately 130 m, and underwater control equipment located on the production platform;**
- **Natural gas production pipeline** approximately 160 km long and 762 mm (30 inch) outside diameter from the production platform to the onshore NGMS, including an undershore (microtunneling) section;
- **Fiber optic cable** routed parallel to the production pipeline from the production platform to the onshore CCR, including an undershore (microtunneling) section;

- **NGMS (Regulation and Measurement Station)** onshore, operated without personnel, for measurement and transmission of processed gas to NTS;
- **Onshore CCR (Command and Control Room)** located adjacent to the NGMS site which will serve as the main operations monitoring and control Centre for all Neptun Deep project facilities (subsea systems, production platform, production pipeline and NGMS).

6.3.3.1 Summary of the construction/installation works of the project components

6.3.3.1.1 Description of production well drilling operations

The scope of the drilling works includes drilling and equipping ten gas production wells in the Miocene formation of the deep-water Neptun perimeter in the western Black Sea.

The wells will be drilled in a continuous drilling and rigging campaign using an anchor-assisted mobile offshore drilling unit - MODU (*Mobile Offshore Drilling Unit*). Subsea pipelines and breakout heads are planned to be installed after drilling using a multipurpose installation/support vessel.

The current drilling plan consists of drilling a maximum of 10 gas production wells, respectively:

- 6 wells are planned to be drilled up to 3000 m deep, in the Domino field, at a water depth of 800 - 1100 m;
- 4 wells will be drilled to a depth of 3400 m, in the Pelican South deposit, at a water depth of 120 - 130 m;

When drilling production wells, depending on the sections drilled, a water-based drilling fluid and a non-aqueous drilling fluid will be used. Drilling fluid is a mixture of water and several chemicals.

Water-based drilling fluid, a non-hazardous product, will be used during the drilling of the first two sections of each well. While drilling these first two sections, water-based drilling fluids will be discharged from the well directly to the seabed.

The non-aqueous drilling fluid used in drilling the following sections is a mixture chemical with oil-based fluid commonly used in drilling operations. The drilling fluid resulting from the drilling of these sections will be recovered, gravity separated, and treated by centrifugation. The recovered drilling fluid will be reintroduced into the technological process and the detritus resulting from the separation will be transported to the shore for disposal at an authorized economic operator.

6.3.3.1.2 Underwater infrastructure

The subsea infrastructure consists of drilling centers, supply/adduction pipelines (gas transport pipelines from the wells to the production platform), electro-hydraulic control umbilical systems that will supply chemicals to the subsea facilities and other facilities specific to the subsea infrastructure.

The project established 3 drilling centers, each Centre consisting of production wells, manifold, supply/adduction pipelines and umbilical systems as follows:

- The DODC1 (Domino) drilling Centre consists of 3 production wells, a manifold and a gas distribution unit (SDU) located at an approximate depth of 970 – 980 m above sea level;
- The DODC2 (Domino) drilling Centre consists of 3 production wells, a manifold and a gas distribution unit (SDU) located at an approximate depth of 945 – 955 m above sea level;
- Drilling Centre PSDC1 (Pelican) consists of 4 production wells, a manifold and a gas distribution unit (SDU) located at a depth of approximately 130 m above sea level.

The supply/adduction pipelines ensure the transport of gases from the drilling centers to the Neptun Alpha Platform, according to the following segments:

- 14-inch (355.6 mm) diameter, 10.5 km long feed/intake pipe between DODC2 and DODC1 drilling Centre, with corrosion protection anodes;
- 18-inch (457.2 mm) diameter and 26 km long feed/adduction pipeline between the DODC1 drilling Centre and the Neptun Alpha platform, with corrosion protection anodes;
- 10.75-inch (273 mm) diameter 1.5 km long feed/adduction pipeline between the PSDC1 drilling Centre and the Neptun Alpha platform with corrosion protection anodes.

The electro-hydraulic control umbilical system will have sections similar to the supply/adduction pipe as follows:

- Umbilical system between drilling Centre DODC2 and DODC1;
- Umbilical system between the DODC1 drilling Centre and the Neptun Alpha platform.
- Umbilical system between the PSDC1 drilling Centre and the Neptun Alpha platform.

Other specific installations are as follows: pig stations for the purpose of cleaning feed/intake pipelines, subsea closure system (SSIV), equipment, control and monitoring (offshore production platform components and onshore command and control Centre), system direct electric cable heater for pipes from Domino, pipe terminal devices.

Underwater infrastructure installation work involves several stages namely the installation of foundations, which consist of suction pillars and structural supports, followed by the fixing of installations and the installation of feed/supply pipes and umbilical systems. At installation, special vessels will be used for each type of activity.

6.3.3.1.3 Neptun Alpha Platform

The Neptun Alpha production platform is automatic and autonomous, composed of a structural support (*Jacket*) with installations located on two levels topsides. The production platform will be located on the continental shelf, in water between 120-130 m deep and will have a total footprint on the seabed of approximately 3,547 m^2.

The process of installing the Neptun Alpha platform infrastructure involves several stages, as follows:

- Installation of the structural support (Jacket);

- Installation of the topside of the 2-deck production platform;
- Installation of gas processing facilities on the topsides of the production platform;
- Installation of other auxiliary installations.

The jacket will be transported to site by bulk carrier or barge and installed by semi-submersible crane vessel and secured in position by driving piles. The jacket has four legs with 2 piles on each leg.

After installing the jacket, the topsides will be installed.

The production platform provides for a 2-level deck. The upper deck mainly includes processing equipment and power generation equipment. The lower deck mainly includes utilities and underwater control equipment. On the upper deck will be mounted the pedestal crane and a support arm for the low-pressure flare and high-pressure flare systems.

On the jacket will be installed: 2 risers, 7 J-tubes of which 6 are planned for use and 1 spare, 7 tanks.

The main features (processes, utilities, controls, etc.) related to the platform superstructure are presented below:

- Estimated weight: 8000 tons (subject to design for final weight configuration);
- Process control systems and safety systems;
- 2 phase water-gas separation for handling of liquids during welling operations;
- Wet gas cooler;
- Gas dehydration unit;
- Standard Triethylene Glycol (TEG) regeneration system;
- Low pressure continuous flare;
- High-pressure flare for evacuation of gases in emergency situations;
- Water lifting system for cooling from 45m depth;
- Technological wastewater (reservoir water) degassed and discharged into the sea;
- 3x50% gas turbines (2 operational and 1 stand-by), providing 9.2 MW of power to the production platform.
- 1x 100% generator for essential services;
- 1x 50% backup generator;
- Local room for electrical and control systems equipment, including the submarine control system;
- The Direct Electrical Heating (DEH) supply and control module.
- A separate hydraulically actuated unit shall be used for the subsea nozzles/manifolds and surface valves;
- Electro-hydraulic crane platform for maintenance work support;
- Routine access for berthing of support vessels (compensated gangway according to the movements of the vessel), helideck for emergency access.

6.3.3.1.4 Installation of gas production pipeline and fiber optic cable

a) **Installation of gas production pipeline and fiber optic cable in the marine area**

The offshore sections of the gas production pipeline and fiber optic cable will be approximately 160 km long and will be installed parallel on the seabed to near shore with a distance of 30 m between them (near the platform Neptun Alpha the distance between them will be 52 m).

The gas production pipeline will consist of steel pipe segments assembled by welding.

The 762 mm (30 inch) diameter steel pipe will be internally lined with an epoxy resin to ensure flow, externally three layers of extruded polyethylene will be applied over which a concrete jacket will be placed. The purpose of the concrete is to ensure stability on the seabed of the pipeline as well as additional protection for external impacts. In addition, sacrificial anodes will be fitted for additional corrosion protection.

The pipeline is designed for a pressure of 139 barg and the estimated operating pressure is from 102 barg (at the exit from the production platform) to 55 barg (at the shore entry).

The fiber optic cable ensures the control of the offshore facilities and wells at the CCR as well as the monitoring through the cameras installed at the marine platform.

The fiber optic cable is a single-mode fiber optic reinforced tube with 12 optical fiber pairs (24 fibres) without amplification and operating wavelength of 1,550 nm.

The gas production pipeline will be installed on the seabed, using a special vessel with dynamic positioning (no anchors) and S-lay pipeline launching system.

The fiber optic cable will be installed with special underwater equipment that digs the trench, installs the cable, and then covers the trench.

Upon completion of installation, the gas production pipeline will be hydrostatically tested. The effluent resulting from the hydrotesting will be discharged into the sea at a depth of over 950 m in the anoxic zone, using the manifold from the Domino DODC2 drilling center.

b) Installation of gas production pipeline and fiber optic cable through the microtunnel

The production pipeline intersects the shoreline in a high bluff area. Due to this local topography as well as for the protection of the natural protected area ROSAC0273 Cape Tuzla marine area, cliff and beach, the production pipeline and fiber optic cable will undercut the coastal area by means of a cemented microtunnel, approximately 890 m long.

The shore undercrossing will be carried out for a length of 890 m between the land entry point located at kilometer point (KP) 156.965 of the pipeline route and the sea exit point located at KP 156.075 of the pipeline route. The onshore entry point of the microtunnel will be located on private land (surface S4) owned by OMV Petrom. (Appendix A)

The main construction and installation works related to the shore underpass will include:

- Setting up the site organization;
- Construction of the tunnel launch pad in the land area;
- Execution of tunneling works;
- Construction of the outfall and trench for the pipeline;
- Recovery from the sea of the tunnel drilling;
- Installation of GPP and FOC by pulling from shore through microtunnel;
- Tunnel filling and ditch plugging.

The installation of the pipeline through the microtunnel is carried out by pulling it towards the shore from an anchored ship located at sea.

The total estimated Duration for the execution of the shore undercutting works is 10 months.

c) Underground installation of gas production cable and fiber optic cable

In the land area, the gas production pipeline and the fiber optic cable will be installed underground, by the open trench method, and the under-crossing of the mining roads and the railway line is done by horizontal drilling.

6.3.3.1.5 Description of the regulation and measurement station (NGMS) and Centralized control Centre (CCR) construction works

The NGMS will be an automatic, unmanned natural gas metering and custody transfer facility to the National Transportation System located in the vicinity of the CCR site. The NGMS location will be fenced with a total occupied area of approximately 23,183 m^2.

To carry out the works, the organization of the construction site, temporary access road, temporary level crossing with the railway will be arranged.

The NGMS components will be mounted on concrete platforms.

The list of the main buildings/equipment to be built/installed within the NGMS includes:

- Gas quality analyzer (Chromatograph and Moisture Analyzer);
- Equipment room for control, communication and the Integrated Control and Safety System (ICSS);
- 2 inlet filters/separators (N+1);
- Pigging reception station;
- Flow metering skid with 5 lines (N+1);
- 2 flow control valves (N+1);
- 1 shut-off valve (located east of the railway);
- Gas dispersion system in emergency situations (gas vent stack) with a height of 12 m;

- Gas heaters (3x2 MW (3x33%)for meeting the gas temperature conditions at the entrance to the NTS;
- Rainwater collection basin;
- Technological platform;
- Protective fence;
- Personal emergency exit gates;
- Vehicle access gate.

The Centralized Control Room - CCR will be an independent building located near the NGMS. The CCR building will serve as the primary operational control center for all Neptun Deep Project facilities (subsea systems, offshore production platform, natural gas production pipeline and NGMS).

The CCR building will be permanently staffed to monitor and control marine facility, NGMS and production platform operations. The Control Room Operator will also monitor NGMS and production platform security aspects.

The CCR building will mainly include human-machine interface (HMI) operating consoles, offices, equipment room, centralized control room, work permit office, meeting room, bathroom, supply storage room, kitchen, and waiting area, material warehouse.

6.3.3.2 Summary of the technological process in the operating stage

During production, the gas and water mixture will be sent to the Neptun Alpha Platform facilities, through separate flowlines, from the drilling centers of the Pelican South and Domino fields. The Neptun Alpha platform will be equipped with installations and facilities to support the gas production, separation and dehydration process, such as:

- Inlet manifold;
- Input separator;
- Gas dehydration unit;
- Glycol regeneration system;
- Degassing of reservoir water;
- The wet gas cooler;
- Coupling installations;
- Installations for cleaning the well.

In ***the inlet separator***, the complete flow from the wells is separated into produced gas and produced water. The gas from the inlet separator is directed through the gas cooling system (Wet Gas Cooler) to the gas dehydration unit. The liquid discharged from the inlet separator is discharged to the produced water degassing vessel where the residual gas remaining in the mixture of produced water, particulates and chemicals is removed by a flash separation at low pressure (0.5 bar). From the degasser, the separated gas is directed to the low-pressure (LP) flare, while the remaining effluent of produced water will be directed to the discharge caisson.

The inlet separator for overpressure protection is connected to the high-pressure flare system.

The Wet Gas Cooler - tube and shell heat exchanger type - is installed to ensure a constant feed temperature to the downstream TEG contactor.

The gas is cooled to 25°C to maintain an adequate margin over the hydrate formation temperature. The gas is cooled with seawater treated with sodium hypochlorite. The cooling water is then directed to the process water caisson and the gas enters the TEG contactor/gas dewatering unit.

Dehydration of gas produced from the inlet separator is done in the TEG (triethylene glycol) unit using lean TEG. Lean TEG absorbs water during the dehydration process and becomes glycol rich TEG. The water-rich TEG stream is regenerated in a conventional glycol regeneration system. For system start-up and initial filling, the lean glycol is stored in the TEG storage tank with a storage volume of 200 m^3, installed in one of the legs of the jacket.

Dehydrated gas exiting the dehydration unit is routed through the subsea production pipeline to the onshore gas metering station and finally to the NTS for further distribution.

TEG (triethylene glycol) regeneration system

The rich TEG (with water) from the degassing system exits is directed to the TEG regeneration system. The rich TEG is regenerated for reuse by low-pressure flash separation, heating, and fuel gas removal. The regenerated lean TEG (without water) is directed back to the gas dehydration system. Lean TEG from the storage tank will be added to the system to maintain optimal system operating parameters.

Treatment of produced water

The liquid stream collected in the primary separator is estimated to be in the aqueous phase only. Both Domino gas and Pelican gas are very poor in liquid hydrocarbons, and a liquid hydrocarbon fraction is unlikely to exist in the liquid stream.

When starting the wells, the fluid stream may contain some non-aqueous drilling fluid, methanol, and brine from drilling operations. Due to the NAF presence. This effluent is captured and collected onshore for disposal.

Subsequently, during operations, every time the well is shut down/restarted, methanol is injected into the process (to prevent the formation of hydrates inside the flowlines), which ends up in the liquid stream.

The reservoir water is directed to the degasser to allow the absorbed gases (methane and CO_2) to escape. The water is discharged into the sea through the produced water discharge caisson at a depth of 90 m.

During the life of the project, it is assumed that the volume of water produced will be between 50 and 1,590 m^3/day towards the end of the operating period.

The estimated annual volume of reservoir water discharged into the sea is 18,250 m^3/year in the first 10 years and 511,000 m^3/year in the last years of production.

The sea water used in the cooling process will be discharged into the sea and will have an annual volume of 2,766,920 m^3.

<u>Produced water degasser</u>

The produced water degasser provides pressure reduction for gas desorption and separation before the water is discharged to sea via the produced water discharge caisson which is sized and configured to handle normal and abnormal operating events.

The product water degasser vent system is connected to the low-pressure flare system (LP Flare), therefore the degasser is designed to operate at a pressure that matches the pressure of the LP Flare system. The vessel is oriented and sized so that it can operate on a liquid flow basis using static liquid pressure when the LP Flare system pressure is atmospheric.

The level control is provided so that during an emergency depressurization event inside the LP flare that causes the system back pressure to rise, there is no liquid loss event that results in a release of gas into the discharge caisson of produced water.

On the outlet line, the produced water degasser has an oil-in-water analysis system to meet uptime and maintenance requirements. The analyzer is installed downstream of all discharge lines that are routed to the produced water discharge sump so that water quality is confirmed prior to disposal. The regulated water discharge limit is 15 ppmv for oils in water.

The discharge line downstream of the level control valve includes a discharge line directed directly to the open drain tank.

Caisson of discharge of produced water

Produced water resulting from the degasification vessel, water collected at the drain system opened and the water recovered from the flare separators, will be directed to the caisson vertical discharge into the sea.

6.3.3.3 Summary of decommissioning works

The project will operate for an estimated period of maximum 20 years. At the end of the project life, the onshore, subsea and offshore facilities will be decommissioned/abandoned (depending on requirements) and the sites will be restored to their original condition. Demolition/decommissioning/abandonment and restoration works will be carried out based on a specific plan and in accordance with the specific legal provisions regarding authorization, construction and environmental protection and applicable legal standards/regulations in force at the end of the project's life.

Generally, these types of activities include:

- Safeguarding offshore facilities and pipelines;
- Well abandonment works;

- Preparing the topside for dismantling;
- Topside dismantling;
- Jacket dismantling;
- Topside and jacket onshore recycling;
- Subsea infrastructure dismantling;
- Safeguarding onshore facilities and pipelines;
- Demolish above-ground onshore process equipment and piping,
- Demolish below ground onshore equipment and pipelines;
- Demolish buildings (including soft strip);
- Equipment disposal;
- Ground works
- Site remediation;

6.3.4 Impact assessment methodology

The impact assessment methodology is described in point 6.1.4.

6.3.5 Potential impacts in a cross-border context

The potential impacts on the environment, at all stages of the project, were presented in the previous sub-chapters and there the potential impacts in a transboundary context were analyzed.

6.3.5.1 Physical environmental factors

The underwater noise generated from the installation of the Neptune Alpha platform structure has been assessed as leading to potential cross-border impacts.

Greenhouse gas emissions will have an impact on the climate that has a long-lasting transboundary expansion.

6.3.5.2 Biodiversity

6.3.5.2.1 Marine mammals and fish

There is the potential for injury and/or disturbance to marine mammals and fish due to the increase in underwater noise levels during the construction phase.

Monitoring of marine mammals was only carried out on Romanian territory, but marine mammals can move quickly over long distances, following schools of fish, including in the territorial waters of neighboring countries. Given the behavioral particularities of dolphin species, it cannot be stated that a different population of marine cetaceans has strict locations at the national level or at the level of certain marine sites.

Direct impacts may occur due to Impulsive noise from the installation of the Neptun Alpha platform structure, which could lead to a potential transboundary impact. However, underwater noise modeling showed that the maximum level of marine mammal exposure in the northern part of the exclusive economic zone of the Republic of Bulgaria is approximately 145 dB, over a short period of time (2-3 days). This noise level may only induce behavioral changes in the case of the species *Phocoena phocoena*, without being able to cause injuries or accidental killings (Southall et al., 2019). The porpoises will move away from the exposed area, to return once the jacket installation activities are completed.

6.3.5.2.2 Avifauna

The main migration routes of birds predominantly follow the coastline, even in the case of aquatic species. In the area of the production platform located at a great distance from the shore, few bird species may be in transit. This mainly concerns aquatic birds, such as gulls, but also passerines, accipitriformes, strigiformes, which may use the platform's superstructure as a resting place. Different species may reach the area under analysis, diverted by air currents or storms, during the seasonal migration periods, but we cannot speak of the presence of local avifauna.

Given the location of the Neptun Deep project and from the analysis of the potential effects generated by the project, it has been estimated that there will be no transboundary impacts on birds.

6.3.5.3 Socio-economic factors

6.3.5.3.1 Commercial fisheries

Marine fishing takes place along the Romanian coastline and is limited to the marine area up to isobath of 50 m.

Romanian industrial marine fishing is practiced by two methods: trawler vessels carried out at depths greater than 20 m and passive fishing with fixed gears practiced along the coast, in 18 points located between Constanta and Vama Veche.

Romanian coastal fishing vessels using trawl fishing operate over distances of 30-35 nautical miles of the Black Sea, seasonally, depending on the presence of fish in the area.

Therefore, there is no potential for transboundary impact of the project on industrial fisheries.

6.3.5.3.2 Vessel traffic

It is considered that there is no potential for cross-border impacts, in particular as regards transits to/from other countries, including effects on shipping routes to/from other ports of neighboring states.

The establishment of 500 m safety zones around ships used in the construction/installation of the project will be known to seafarers and transport routes will be modified.

6.3.5.3.3 Tourism

Given the location of the Neptune Deep project, it was estimated that there would be no cross-border effects on tourism in neighboring countries.

6.3.6 Impact assessment due to the effects generated by underwater noise

Impact assessment in the previous sections showed that the noise generated by the construction works, that could have a transboundary impact, is the one generated during the installation of the piles for securing the Neptun Alpha platform jacket on the seafloor, therefore only this situation will be assessed in the paragraphs below. The noise modeling in detail is presented in Annex M.

From the modeling scenarios analysis, it's concluded that only the noise level with TTS (Temporary Threshold Shift) impact on the most sensitive marine mammal species, *Phocena phocena* (VHF in this modeling), propagates at a distance up to a maximum of 85 km from the source, in the worst-case scenario.

The modelling considered several possible scenarios, of which we present below those that use the equipment with the highest power, implicitly generating the highest underwater noise level.

The modelled impact ranges, in the 2 scenarios relevant for the impact assessment in a transboundary context are presented in tables 6.132 - 6.133 for criteria of SEL_{cum} (cumulative noise exposure level), for hammering 4 successive piles, a scenario using the maximum hammer energy and an optimal energy used (realistic) scenario.

Table 6.132 Pile hammering method parameters for the maximum limit scenario using the MENCK 3200iS hammer

MENCK 3200iS (maximum limit)	**640 kJ**	**1,600 kJ**	**2,401 kJ**	**3,201 kJ**
Number of strokes	100	3,606	3,205	5,206
Duration	10 min	120 min	80 min	116 min
Shot rate	10 bl/min	~30 bl/min	~40 bl/min	~45 bl/min
1 pillar:12,117 hits, 5.43 hours 4 piles: 48,468 hits, 21.73 hours				

Table 6.133 Pile hammering method parameters for the best estimated scenario using the MENCK 3200iS hammer

MENCK 3200iS (best estimate)	**640 kJ**	**1,600 kJ**	**2,401 kJ**	**3,201 kJ**
Number of strokes	100	1,383	1,190	1,432
Duration	10 min	46 min	30 min	32 min
Shot rate	10 bl/min	~30 bl/min	~40 bl/min	~45 bl/min
1 Pillar:4,105 strikes, 1.97 hours 4 piles: 16,420 hits, 7.87 hours				

Scenario: MENCK 3200 iS hammer at full energy

SEL_{cum} cumulative pulse noise exposure in the scenario with hammer use at maximum energy to install 4 successive piles is shown in the figure below, the PTS (Permanent Threshold Shift) and TTS (Temporary Threshold Shift) results of modeling can be found in Table no. 6.134 and 6.135.

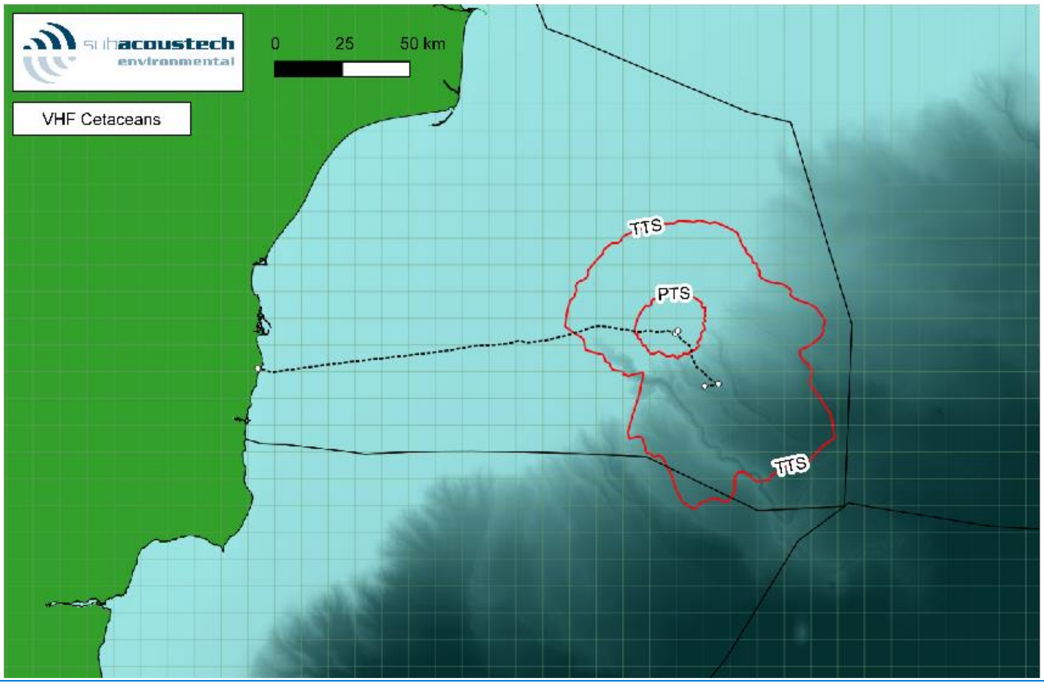


Figure 6.108 SEL cumulative pulse noise exposure level (Southall et al., 2019) species *Phocena phocena* with the hammer used at optimal energy for the installation of 4 piles, the inner isoline is the PTS limit and the outer isoline is the TTS limit

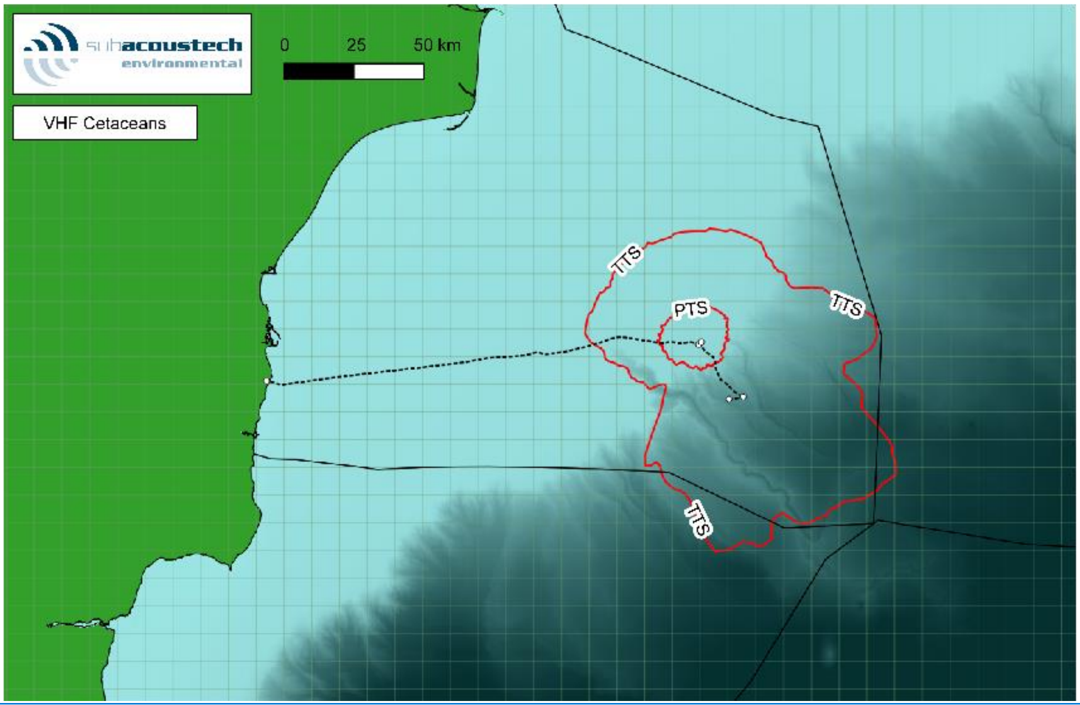


Figure 6.109 Exposure level to cumulative noise impact SEL_{cum} (Southall et al., 2019) species *Phocena phocena* with the hammer used at maximum energy successive 4 piles , the inner isoline is the PTS limit and the outer isoline the TTS limit

Table 6.134 Synthesis of Southall et al. (2019) model of cumulative impact PTS for marine mammals associated with noise generated during installation using MENCK 3200 iS hammer

Southall et al.(2019) (MENCK 3200iS Maximum energy)		**SEL_{cum} weighted** (marine mammal moves away from noise source at speed 1.5 m/s)			
		Impulsive		**Non impulse (continuous)**	
		HF (185dB)	**VHF (155 dB)**	**HF (198 dB)**	**VHF (173 dB)**
One pillar	Maximum	< 100 m	15 km	< 100 m	< 100 m
	Minimum	< 100 m	7.5 km	< 100 m	< 100 m
	Intercede	< 100 m	11 km	< 100 m	< 100 m
4 pillars	Maximum	< 100 m	15 km	< 100 m	< 100 m
	Minimum	< 100 m	7.9 km	< 100 m	< 100 m
	Intercede	< 100 m	12 km	< 100 m	< 100 m

Table 6.135 Synthesis of the Southall et al. (2019) model of TTS cumulative impact for marine mammal, associated with the installation using MENCK 3200iS hammer

Southall et al.(2019) (MENCK 3200iS Maximum energy)		SEL$_{cum}$ weighted (marine mammal moves away from noise source at speed 1.5 m/s)			
		Impulsive		Non impulse (continuous)	
		HF (170 dB)	VHF (140 dB)	HF (178 dB)	VHF (153 dB)
One pillar	Maximum	2.5 miles	66 km	< 100 m	17 km
	Minimum	1.1 miles	19 km	< 100 m	9.6 miles
	Intercede	1.8 km	42 km	< 100 m	14 km
4 pillars	Maximum	2.6 km	85 km	< 100 m	18 km
	Minimum	1.2 miles	19 km	< 100 m	9.9 miles
	Intercede	1.8 km	48 km	< 100 m	14 km

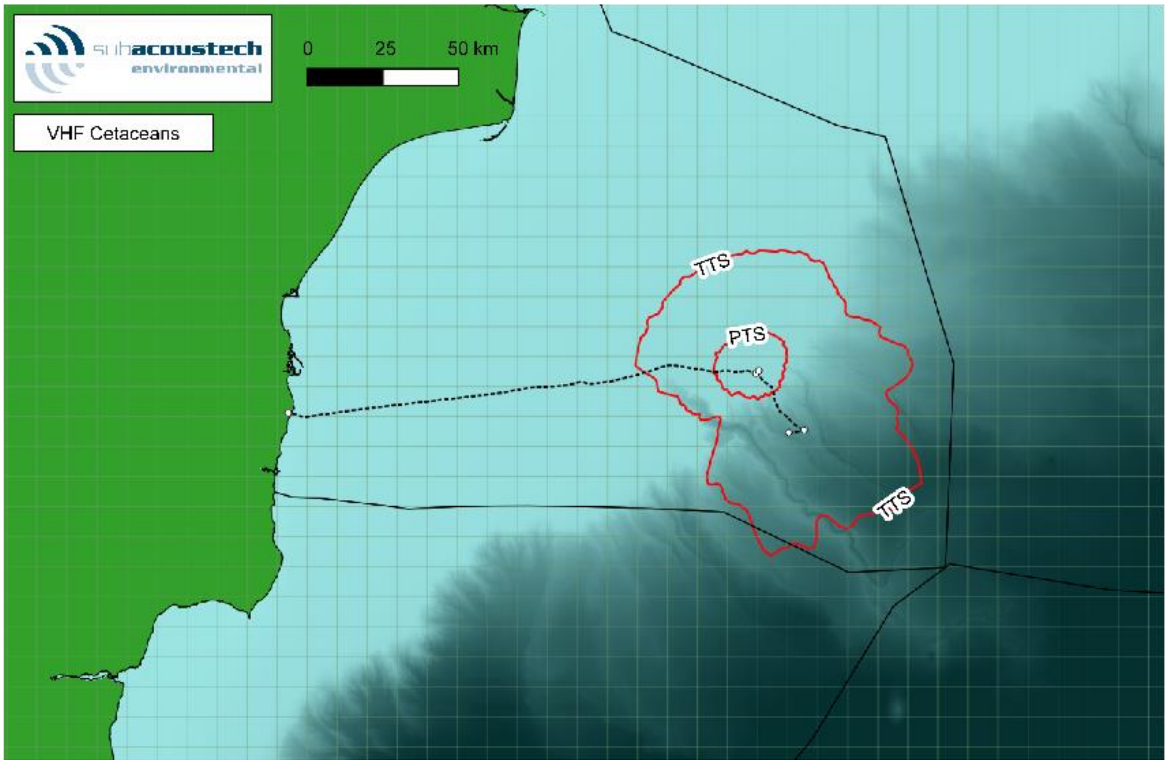
Where
SEL$_{cum}$- Cumulative noise exposure limit – Unique value for the collected, combined total sound exposure over a specified time or multiple instances of a noise source.
PTS (Permanent Threshold Shift) - Total or partial permanent hearing loss caused by an acoustic trauma.
TTS (Temporary Threshold Shift-temporary hearing loss)

According to Southall et al. et al. (2019), as sound pulses propagate in water, they dissipate and also lose their most harmful characteristics (e.g. rapid pulse rise time and peak sound pressure) and become more like "non-pulse" noise at greater distances.

Thus, the above tables also show distances for exposure to continuous noise that can significantly affect marine mammals.

Scenario: MENCK 3200 iS hammer at optimum energy

SEL$_{cum}$ cumulative impulse noise exposure in the optimal energy estimation scenario (closest to the actual power expected) for hammering 4 successive piles is shown in the figure below, with PTS and TTS modelling results found in Table 6.136 and Table 6.137.



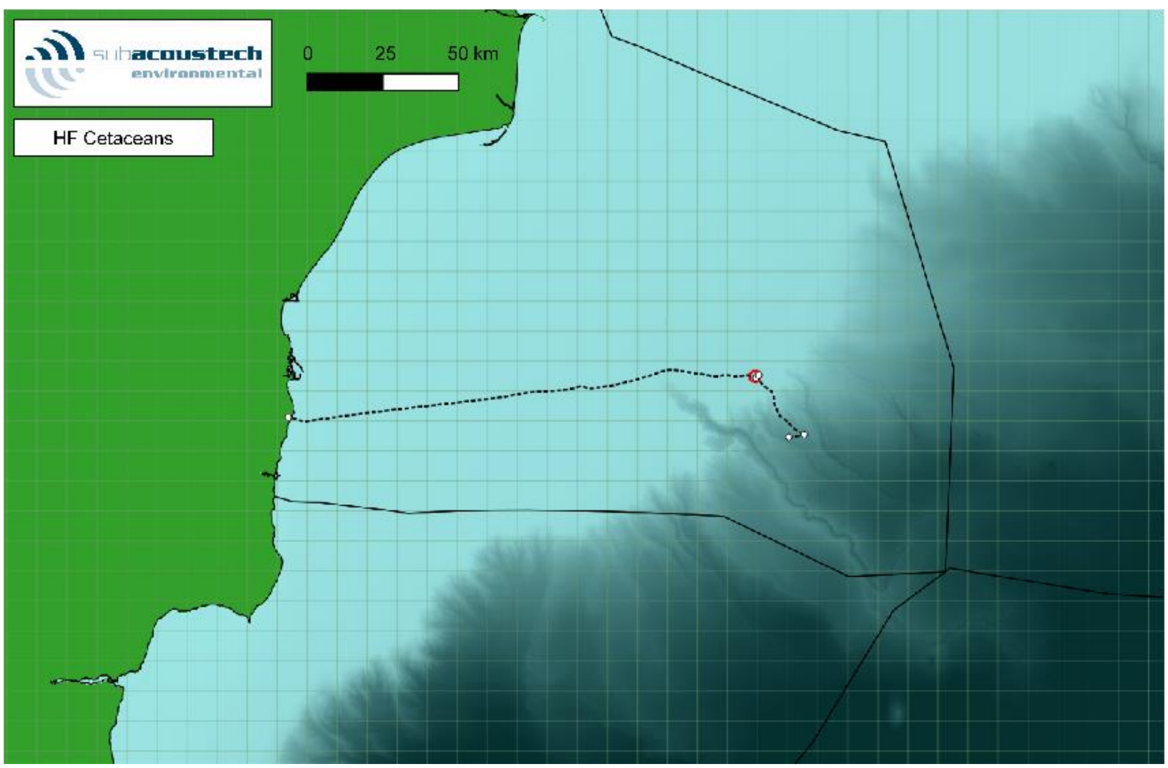


Figure 6.110 SEL_{cum} cumulative impulse noise exposure level (Southall et al., 2019) with hammer in the best-case scenario for installing 4 piles successively, the inner isoline is the PTS limit and the outer isoline is the TTS limit

Table 6.136 Synthesis of Southall et al. (2019) model of PTS noise cumulative impact over marine mammal, impact associated with the installation using MENCK 3200iS hammer

Southall et al.(2019) (MENCK 3200iS Best Screenplay)		SEL$_{cum}$ weighted (mammal moves away from noise source at speed 1.5 m/s)			
		Impulsive		Non impulse (continuous)	
		HF (185dB)	VHF (155 dB)	HF (198 dB)	VHF (173 dB)
One pillar	Maximum	< 100 m	14 km	< 100 m	< 100 m
	Minimum	< 100 m	7.1 km	< 100 m	< 100 m
	Intercede	< 100 m	11 km	< 100 m	< 100 m
4 pillars	Maximum	< 100 m	15 km	< 100 m	< 100 m
	Minimum	< 100 m	8.1 km	< 100 m	< 100 m
	Intercede	< 100 m	12 km	< 100 m	< 100 m

Table 6.137 Synthesis of Southall et al. (2019) model of TTS cumulative impact for marine mammals associated with the installation using MENCK 3200iS hammer

Southall et al.(2019) (MENCK 3200iS Best Screenplay)		SEL$_{cum}$ weighted (mammal moves away from noise source at speed 1.5 m/s)			
		Impulsive		Non impulse (continuous)	
		HF (170 dB)	VHF (140 dB)	HF (178 dB)	VHF (153 dB)
One pillar	Maximum	2.4 km	47 km	< 100 m	17 km
	Minimum	1.2 miles	19 km	< 100 m	8.9 km
	Intercede	1.8 km	36 km	< 100 m	13 km
4 pillars	Maximum	3.1 km	71 km	< 100 m	19 km
	Minimum	1.4 km	19 km	< 100 m	11 km
	Intercede	2.2 km	45 km	< 100 m	15 km

Where
SEL$_{cum}$- Cumulative noise exposure limit – Unique value for the collected, combined total sound exposure over a specified time or multiple instances of a noise source.
PTS (Permanent Threshold Shift) - A permanent total or partial loss of hearing caused by acoustic trauma.
TTS (Temporary Threshold Shift-temporary hearing loss)
HF(185dB)- high frequency cetaceans with noise exposure limit of 185 dB.

Thus, the underwater noise assessment conducted by Subacoustech Environmental Ltd., for the Neptune Deep project, forecasts that maximum PTS impact distances for marine mammals are predicted for auditory groups of VHF cetaceans (*Phocena phocena*) according to the study of Southall et al. (2019), for pilling installation, considering the distance from the noise source, resulting in SEL intervals up to 15 km for PTS at sequential installation of four piles, and variable between 71-85 km for TTS impact, assuming the use of larger hammer and upper limit installation scenario.

This assumes that noise retains its impulsive characteristics at this great distance. In reality, noise becomes less impulsive as it moves away, and impact distances in practice are expected to be much smaller.

It is important to note that the modelling was carried out without considering the mitigation measures such as soft start techniques.

Without implementing impact reduction measures, impulse noise from jacket installation by piles hammering will be negative, direct, short term, with medium intensity, and reversible when the activity ends.

Given the high sensitivity of the receptor, and the moderate magnitude, the significance of the impact will be moderate.

6.3.6.1 Impact assessment

The table below shows the impact assessment by magnitude and receiver sensitivity without the application of impact mitigation measures. The impact significance matrix is presented in point 6.1.4.3.

Table 6.138 Evaluation of the impact on the acoustic environment during the construction stage

Effect	Magnitude components		Magnitude	Sensitivity	Impact
Increasing the level of underwater noise	*Nature effect*	Negative	Medium	Medium	Moderate
	Effect type	Direct			
	Reversibility of the effect	Reversible			
	Extension	transboundary			
	Duration	Short term			
	The intensity	Medium			

The magnitude will be Medium when increasing the noise level because it will have an Medium intensity on the marine environment receptors in the neighboring countries, for a short period of time (it is estimated that the installation of the first 4 piers of the jacket which generate the highest noise level will it lasts 16 hours (4 hours/pillar), followed by a break after which the next 4 pillars are installed).

6.3.6.2 Prevention and Mitigation Measures

During the construction works in the marine area, the avoidance, prevention and reduction measures are the following:

- Applying the soft start. It is normal practice to start with low hammer power (20% power) for 20 min (soft start) and gradually increase the power until maximum power is reached. At the first low-energy, low-noise hammer blows, marine mammals and fish will leave the area.

- The construction works will be carried out in stages, the installation works of the jacket pillars will not be carried out simultaneously with other works;
- All ships used in construction must comply with MARPOL rules.

6.3.6.3 Residual impact assessment

By implementing the measures established in point 6.2.9.1.3, the residual impact is presented in the table below.

Table 6.139 Evaluation of the residual impact on the acoustic environment during the construction period

Effect	Magnitude	Sensitivity	Impact	Residual Impact
Increasing the underwater noise level	Medium	Medium	Moderate	Minor
GENERAL ASSESSMENT OF The acoustic environment factor	**Insignificant impact**			

It is normal practice to start with low hammer power (20% power) for 20 min (soft start) and gradually increase the power until maximum power is reached. At the first low-energy, low-noise hammer blows, marine mammals and fish will leave the area. Practically after the first pile is struck, marine mammals and fish will move away, and the effects of the noise can create a disruptive impact on them.
Based on the current conditions of the evaluated component, the characteristics and works of the project, as well as the appropriate implementation of the measures proposed above, a minor/ insignificant negative impact on the acoustic environment is expected during the construction phase.

6.3.7 Air polluting emission associated with Neptun Deep project

All project stages of activities generate greenhouse gas emissions which requires a cross-border impact assessment.

The GHG emissions reported by Romania in 2022 were 117.09 Mt.[45]

The amounts of greenhouse gases estimated to be generated by the works associated with the Neptune Deep project are as follows:

- GHG emissions associated with construction works in the marine area, estimated are 134.25 tCH_4 (3,759 tCO2e) and 240,998tCO 2e, represent 0.21% of the total GHG emissions reported by Romania in 2022;
- GHG emissions associated with well drilling works, estimated 549,634 tCO_{2e} represent 0.47% of the total GHG emissions reported by Romania in 2022;

[45] EDGAR - Emissions Database for Global Atmospheric Research, Source: https://edgar.jrc.ec.europa.eu/report_2023

- GHG emissions associated with the activity carried out during the operation phase are estimated at 89,197.56 tCO 2 (89,197.56 tCO2e), 22.18 t CH4 (621.04 tCO2e), 0.01 t NO2 (2.65 t CO2e), represent a total emissions of 89,821.25 tCO 2e respectively 0.077% of the total GHG emissions reported by Romania in 2022.

In order to determine the concentration of pollutants in different averaging periods under operating conditions of the equipment on the platform, Air Pollutant Dispersion Modeling was carried out, [46] using BREEZE AERMOD v11 Pro Plus software. Detailed modelling is shown in Annex M.

From the analysis of scenario modeling, it emerged that only pollutant emissions in situations of abnormal operation of offshore equipment disperse over long distances, in the worst-case scenario. These situations are as follows:

- Partial shutdown with hot restart
- Emergency shutdown with cold restart
- At the beginning of production - Maximum pressure - partial discharge Domino.

The modelling shall show pollutant concentrations over certain averaging periods at certain distances as follows:

- For partial shutdown situation with hot restart after the 1-hour averaging period, the NOX dispersion reaches the Exclusive Economic Zone of Bulgaria with a concentration of 5 µg/m^3. This concentration is below the limit quality concentration indicated by WHO and those stipulated in Romanian legislation (200 µg/m^3 for 1 hour, and after the 24-hour mediation period, NOX is also present in the Exclusive Economic Zone of Bulgaria. The modelling shows concentrations in this area of 1 µg/m^3 which is below the ambient air quality limit concentration established by the World Health Organization (WHO) and in the Romanian air quality law (Law 104/2011) of 25 µg/m3 for 24 hours. PM10 levels above 24 hours have no cross-border impact.

[46] Source: IO Consulting – Neptun Deep Project - NEPTUN DEEP AIR DISPERSION STUDY

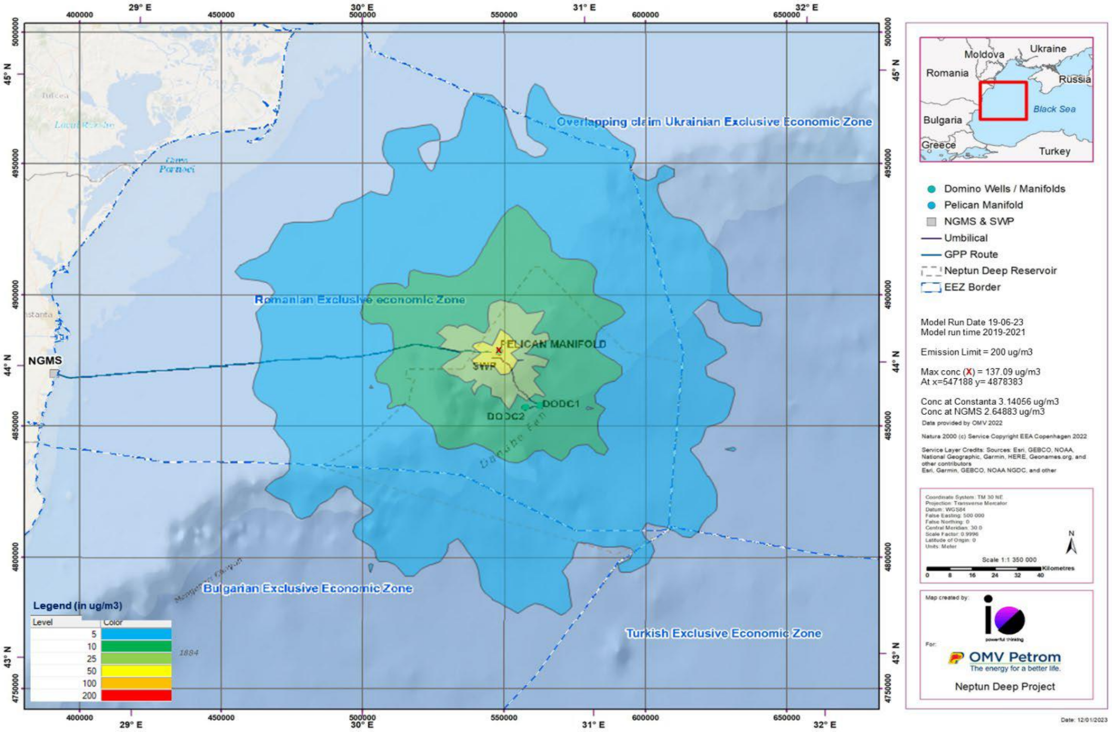


Figure 6.111 NOx emissions dispersion in 1 hour from platform to hot start

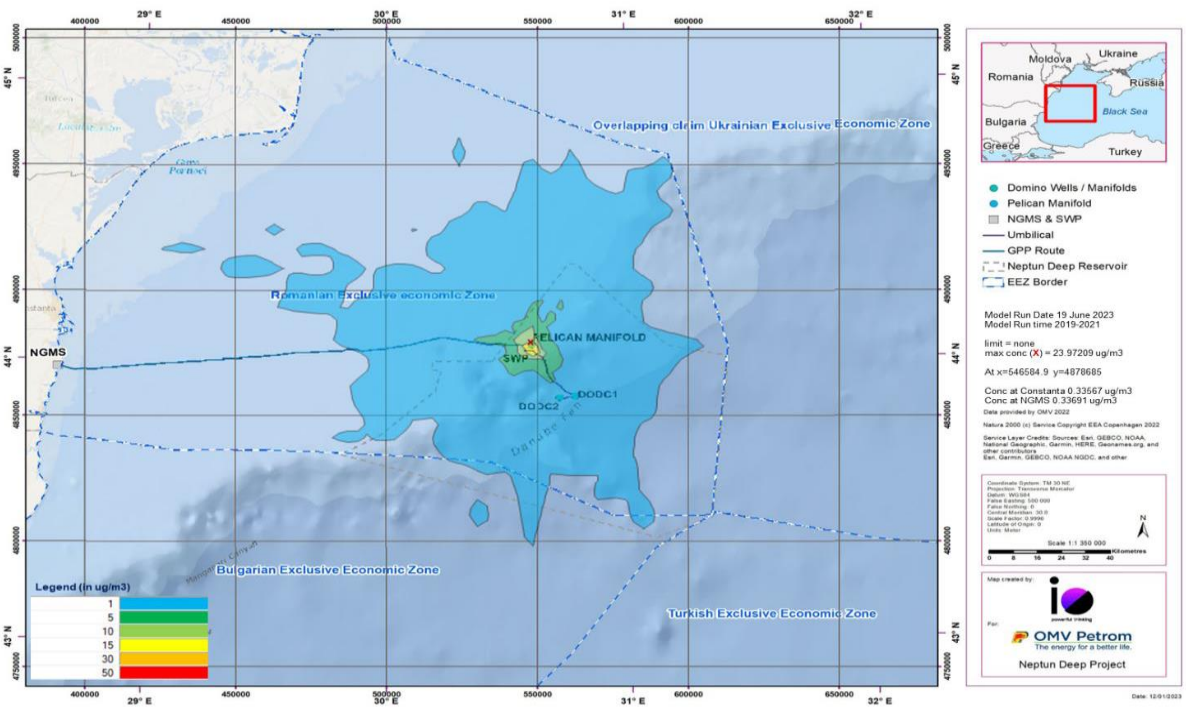


Figure 6.112 24-hour NOx emissions dispersion from platform to hot start

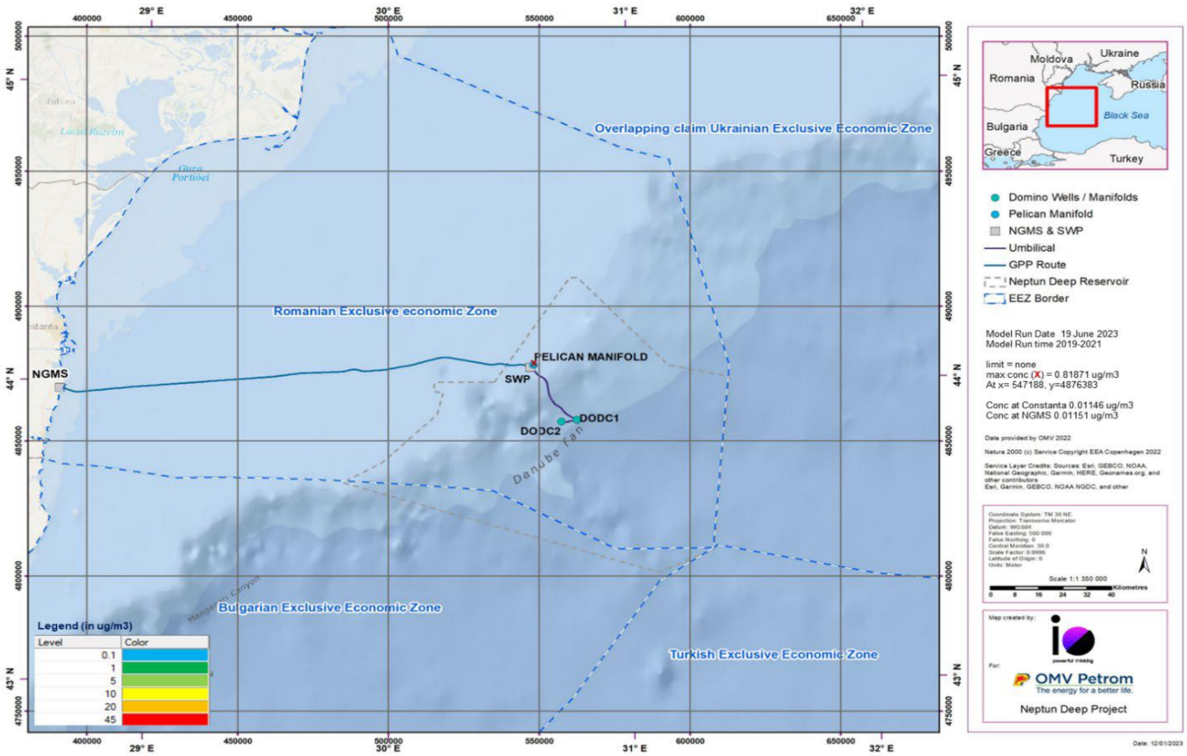


Figure 6.113 PM10 emissions dispersion in 24 hours from platform to hot start

- In case of emergency shutdown with cold restart, after the 1 hour averaging period, the dispersion of the NOX reaches the Exclusive Economic Zone of Bulgaria with an estimated concentration of 5 µg/m^3. This concentration is below the limit quality concentration indicated by WHO and provided for in Romanian legislation (200 µg/m^3 for 1 hour). After 24 hours, the simulation indicates that NOx is still present in Bulgaria at a concentration of 1 µg/m3 and this is well below ambient air quality limits for WHO and Romania (25 µg/m3).

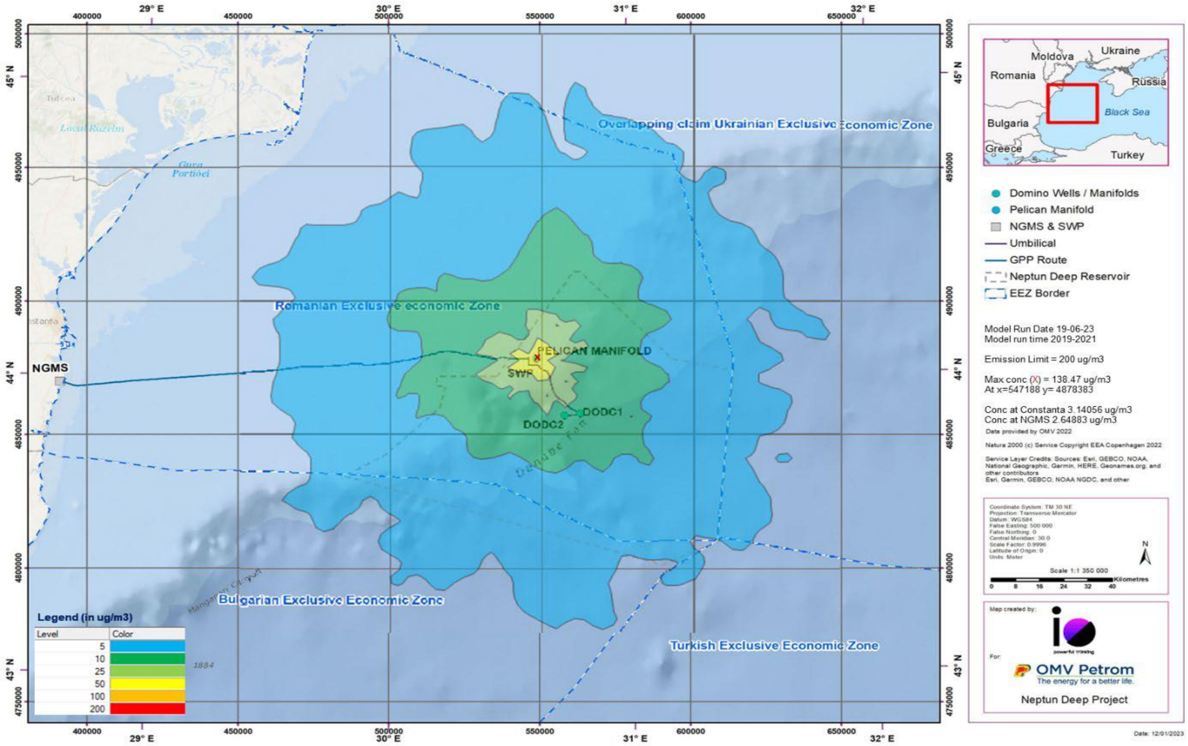


Figure 6.114 NOx emissions dispersion in 1 hour from platform to cold start

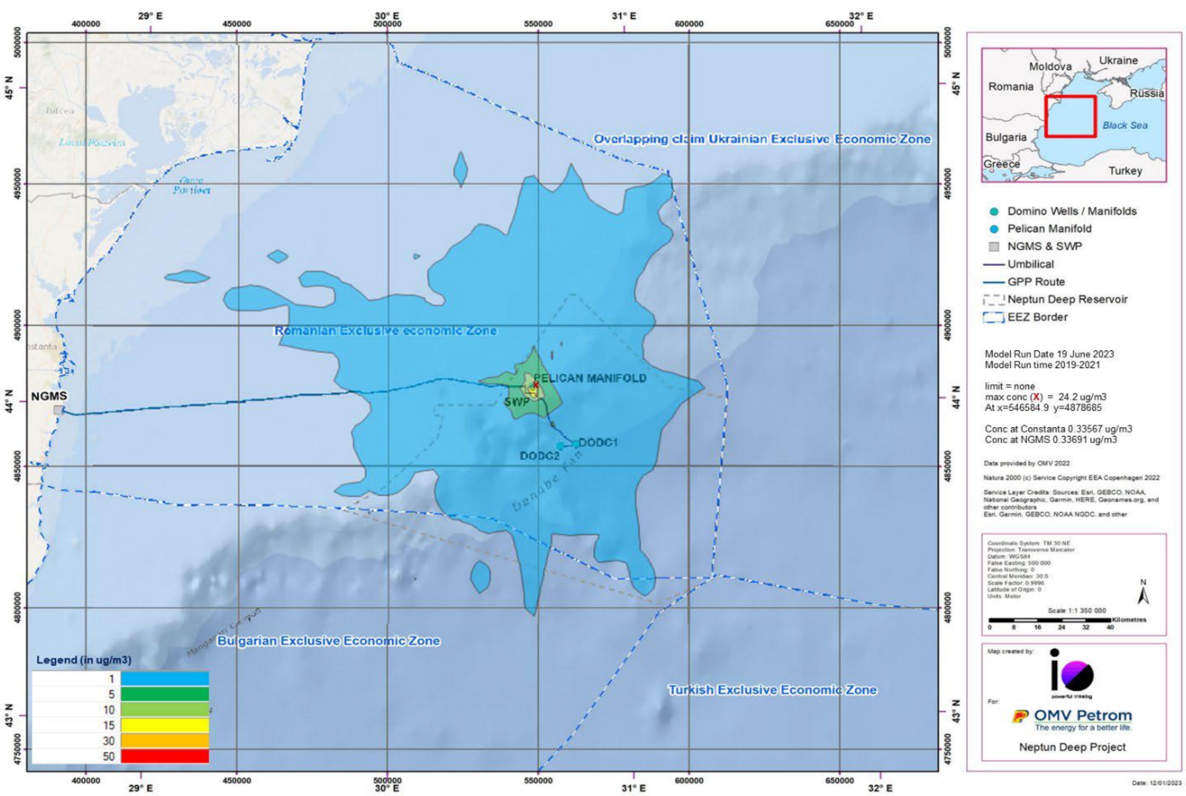


Figure 6.115 24-hour NOx emissions dispersion from platform to cold start

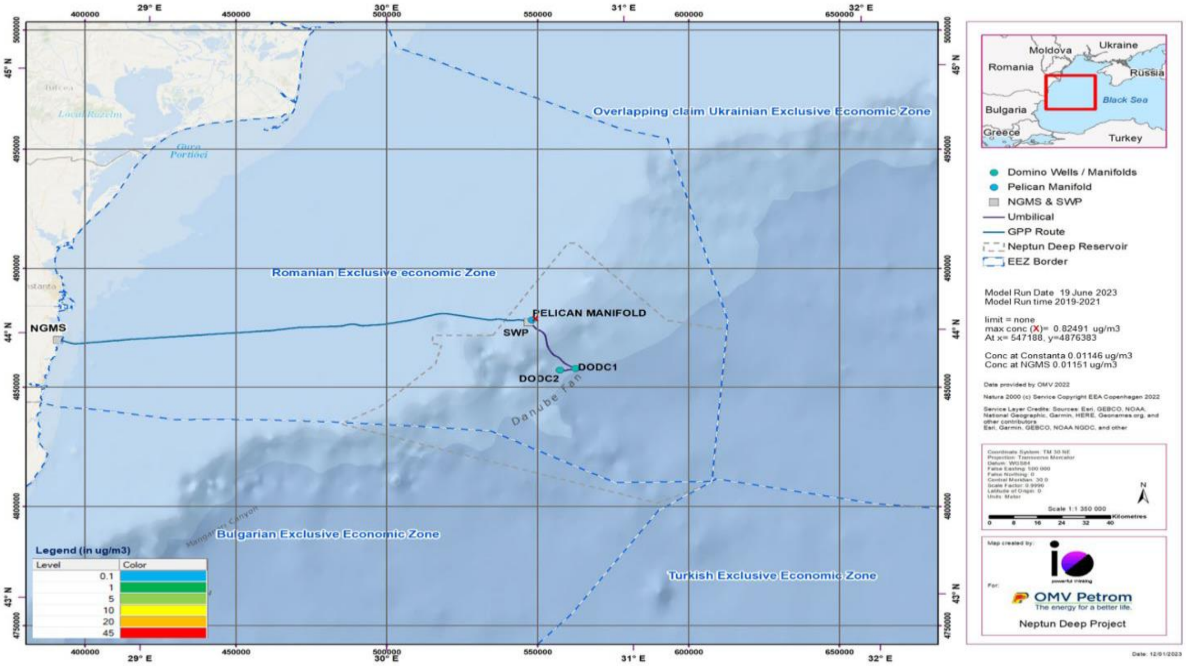


Figure 6.116 PM10 emissions dispersion in 24 hours from platform to cold start

- In case of partial discharge at Domino during averaging periods of 1 and 24 hours, NOx dispersion reaches Bulgaria with concentrations of 5 µg/m 3 and 1 µg/m^3 respectively. These concentrations are below the maximum concentrations set by WHO and Romanian regulations (200 µg/m3 during the 1-hour averaging period and 25 µg/m3 during the 24-hour averaging period).

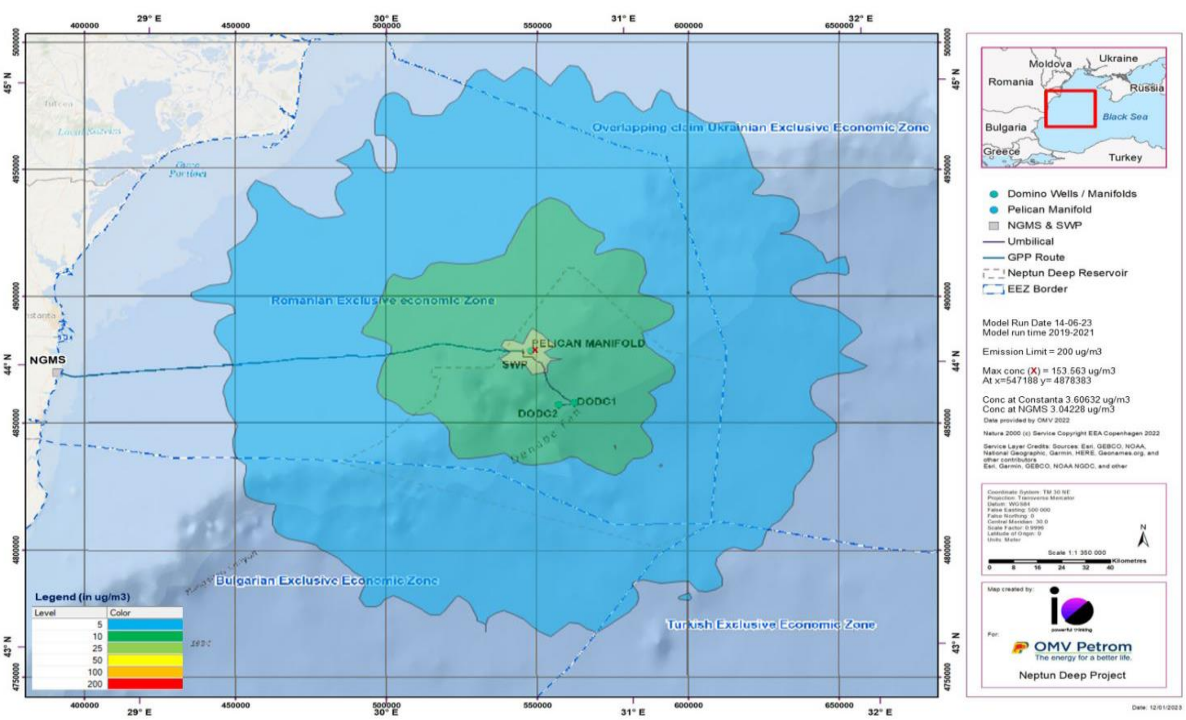


Figure 6.117 NOx emissions dispersion in 1 hour from platform to partial shutdown Domino

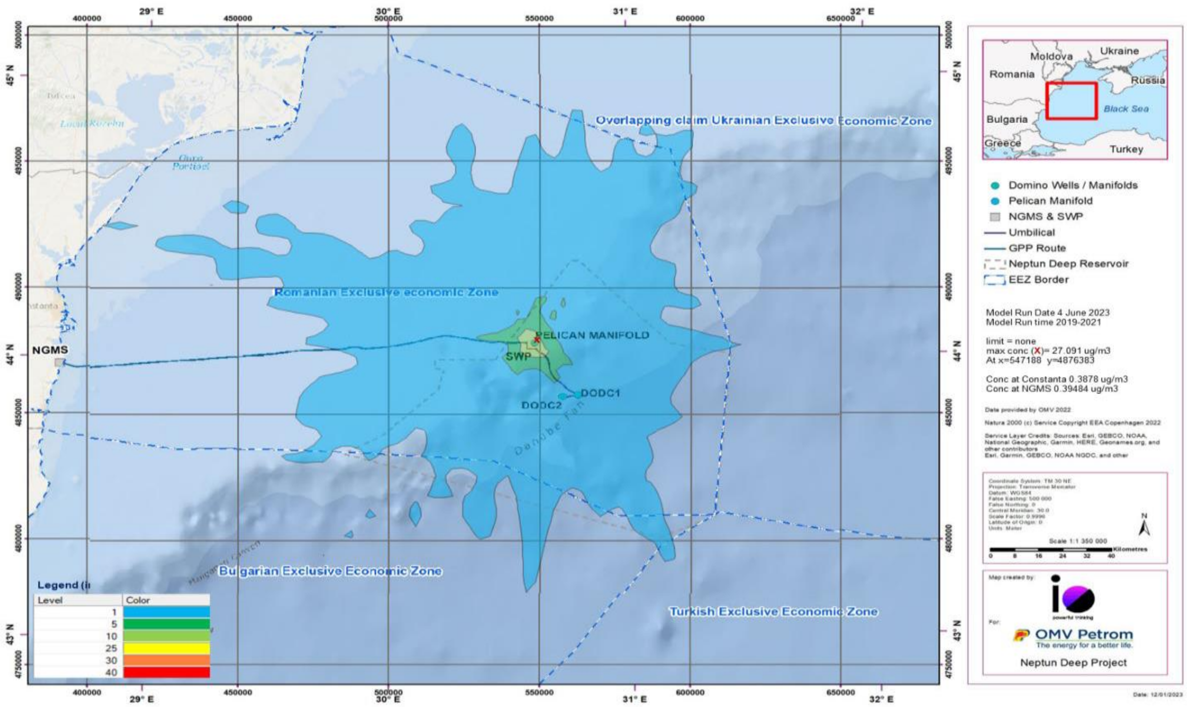


Figure 6.118 NOx emissions dispersion in 24 hours from platform to partial shutdown Domino

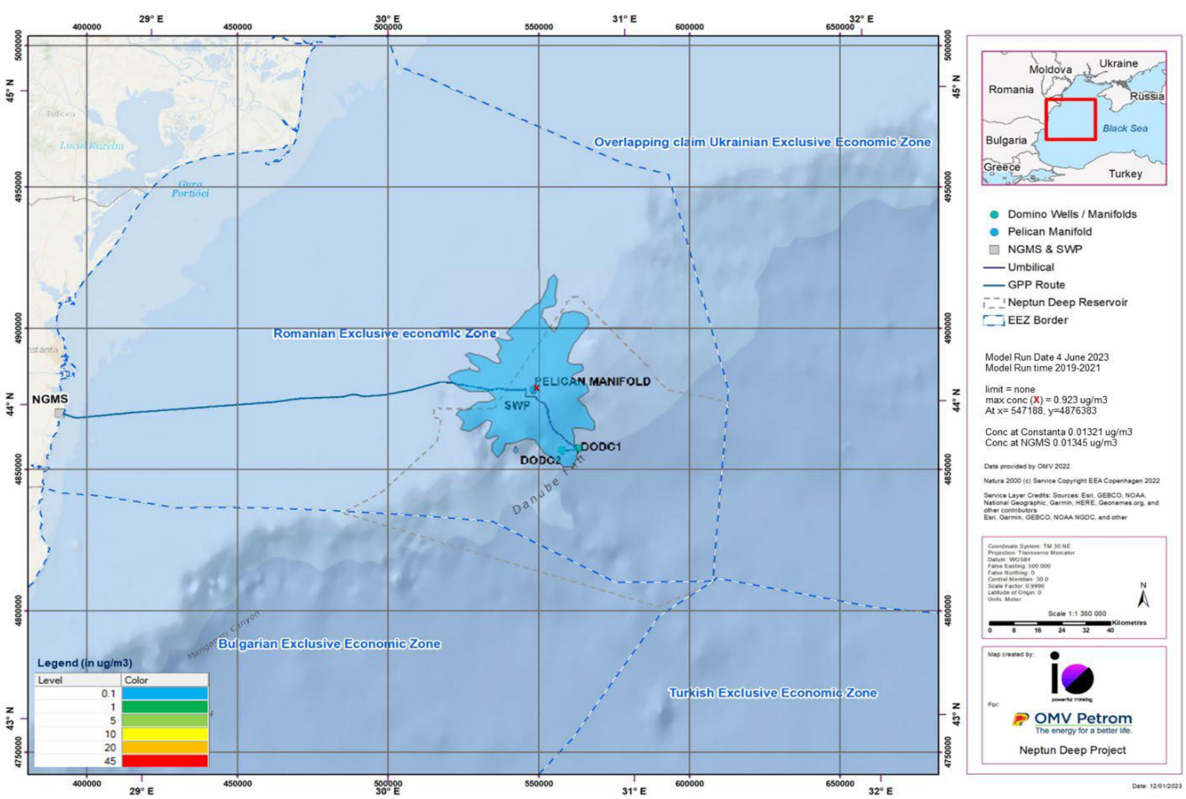


Figure 6.119 PM 10 emissions dispersion in 24 hours from platform to partial shutdown Domino

Given that the concentration of pollutants is below WHO limits, the assessed transboundary impacts associated with emissions of pollutants to air are insignificant.

6.3.7.1 Impact assessment

The table below shows the trans-boundary impact assessment of GHG emissions, considering the magnitude and sensibility of the receptor, without mitigation measures.

The matrix of impact significance is presented at Section 6.1.4.3 of EIA.

Effect	Magnitude components		Magnitude	Sensitivity	Meaning Impact	Potential cross-border impact
Construction stage						
GHG emissions	*Nature effect*	Negative	Low	High	Moderate	Yes
	Effect type	Direct				
	Reversibility of the effect	Irreversible				
	Extension	Transboundary				
	Term	Long term				
	The intensity	Low				
Operation stage						
Emissions of pollutants in the offshore area	*Nature effect*	Negative	Low	Low	Minor	Yes, in the event of abnormal operating conditions but under the WHO limits
	Effect type	Direct				
	Reversibility of the effect	Reversible				
	Extension	Local				
	Term	Long term				
	The intensity	Low				
GHG emissions	*Nature effect*	Negative	Medium	High	Moderate	Yes
	Effect type	Direct				
	Reversibility of the effect	Irreversible				
	Extension	Transboundary				
	Term	Long term				
	The intensity	Low				
Decommissioning stage						
GHG emissions	*Nature effect*	Negative	Low	High	Moderat	Yes
	Effect type	Direct				
	Reversibility of the effect	Irreversible				
	Extension	Transboundary				
	Term	Long term				
	The intensity	Low				

6.3.7.2 Mitigation measures air and climate trans-boundary context

Air

- Use of MARPOL 73/78 Annex VI class certified vessels and drilling platform – Prevention of air pollution from ships.
- Use of ships and drilling platform holding the "Ship Energy Efficiency Management" class certification.
- Use of low Sulphur fuel in accordance with IMO requirements.
- Maintaining good operating practices, inspection and maintenance schedules for all equipment, facilities and vehicles involved in the project.

Climate

- Adhere to relevant design guidelines and include mitigation measures to reduce accidental gas leaks.
- Incorporate BAT studies into the design and operation process, including review of design, equipment efficiency and appropriate sizing of equipment as needed, in later stages of the project.
- Compliance with any relevant legal requirements regarding emission limits.
- Inform and impose the emission reduction company policies to the Neptun Deep Project contractors.
- Use of equipment and machinery with low fuel consumption to limit GHG emissions.
- Maintaining routine maintenance procedures to ensure that engines of machines, equipment, ships are operational at the defined operational performance and at the specified emission level.
- Implementation of environmental management plans, preparation and response for emergency situations and intervention in case of accidents that might generate additional GHG.

6.3.8 Transboundary impact assessment on water

On the onshore area of the project, two identified groundwater bodies extend on Bulgarian territory, namely RODL04 - Cobadin - Mangalia and RODL06 - Wallachian Platform. The onshore works carried out at all stages of the project are not likely to lead to an impact on groundwater bodies.

The offshore section of the project is located in the coastal water body BLK_RO_RG_CT and the marine water body BLK_RO_RG_MT01.

During the construction phase, the hydrotesting effluent of the production pipeline, of the supply/transmission pipeline will be discharged in the area of the DODC2 drilling center at a depth of 950 m, deep in the anoxic zone of the Black Sea. The effluent dispersion modelling indicates an extent of local impact, felt in the discharge area, maintained on a water column (with variations) between a depth of 950 m and over 800 m, having an attenuation rate as it moves away from the source, die to natural dilution.

Unplanned events cannot be quantified given the uncertainty of their occurrence, but the effects associated with their occurrence may have an impact on water. On transboundary context only the oil spills that could occur due to an offshore major accident should be considered. Transboundary effects for accidental fuel pollution are described in Section 6.3.8.1 below.

The modelling carried out to quantify and document the potential risk to the marine environment posed by substances in the produced water discharged through the discharge caison of the production site indicates that the area affected by effluent extends, according to DREAM simulations, within a radius of approx. 1.5 km around the fixed source (discharge caisson). It can be estimated that the extent of the impact will be local, felt in the discharge area, maintained in the water column (with variations) between a depth of 40 m and over 100 m, having a attenuation rate as it moves away from the source, due to natural dilution.

The impact on water at the operational stage, due to local emissions of metal ions from sacrificial anodes, is represented by the local increase in the concentration of metals in water.

Regarding natural radioactivity, reservoir waters may contain low concentrations of natural radionuclides, which are not harmful at the concentrations found in the reservoir water itself, as these concentrations are below detection limits. However, if it were to accumulate in scale deposits inside the pipelines or equipment, it could become a problem.

The risk of Naturally Occurring Radioactive Material (NORM) accumulation depends on the geological formation, deposit, well and process conditions (pressure and temperature), which influence sulfate and carbonate scaling trends.

From the tests carried out during the exploration phase on reservoir water samples from Domino and Pelican South reservoirs, the risk of barium sulfate and calcium carbonate scale is unlikely.

However, for more safety, it was decided to inject a scale inhibitor into the well head to eliminate the occurrence of any potential scale deposits.

Based on the project information provided by the project holder, it is assessed that there is no potential risk of an increase in the concentration of natural radionuclides in the Black Sea as a result of the project.

As such, there is no risks associated with technogenic increase in ionizing radiation that could lead to the contamination of marine waters, coastal waters, and implicitly of the surface and/or underground waters in the onshore area, both on Romanian and Bulgarian territory.

6.3.8.1 Accidental spills

Modeling of potential accidental pollution during construction was carried out by OIL SPILL RESPONSE Ltd[47], using the OSCAR version contained in the Marine Environmental Modeling Workbench (MEMW) 13.1.0, a model that has been fully validated and calibrated using various field observations from a series of experimental oil spills.

[47]Oil Spill Response Ltd, Oil Spill Modeling Report For: Neptun Deep, Romania

OSCAR estimates movement of oil at the water surface and throughout the water column.

Each model shows the direction of movement of the layer and the time of dispersal of the fuel under conditions in which equipment and/or absorbent substances are NOT intervened in accordance with the procedures provided in the Intervention Plan in case of accidental pollution.

6.3.8.1.1. Input Data

Accidental release scenarios

Modeling was performed for two discharge scenarios each for two seasons, respectively summer (June-September) and winter (October-May).

Table 6.140 Scenarios used in the modeling of accidental pollution

Input data	Scenario 1	Scenario 2
Description	Accidental discharge from platform installation vessel	Accidental spillage of fuel from the drilling platform
Discharge point	44° 02' 51" N 030° 35' 14" E	44° 03' 19" N 030° 35' 56" E
Season	winter (October-May) summer (June-September)	winter (October-May) summer (June-September)
Spill depth	0m (on the surface)	0m (on the surface)
Flow	300 m^3/h	41.52 m^3/h
Duration of discharge	1 hour	4 hours
The spilled volume	300 m^3	165 m^3
Amount spilled	264 tons	146 tons
Layer travel time	14 days	14 days
Fuel temperature	Winter – 11.6 °C Summer- 23.6 °C	Winter – 11.6 °C Summer- 23.6 °C
No. total of trajectories	150	150
The time interval between trajectories	8 days, 2 hours	4 days, 1 hour
The nearest coastal area	~117 km, Sfântu Gheorghe, Romania	~117 km, Sfântu Gheorghe, Romania

Metocean data

The hydrodynamic data that were used as input data are as follows:

Table 6.141 Hydrodynamic data used

Metocean data		
data	Currents – Reanalyze the Black Sea	Wind - CFRS
Spatial resolution	3 km	16 km
Temporal resolution	24 hours	1 hour
Time frame	May 2015- May 2020	May 2015 - May 2020

Hydrocarbon characteristics

Table 6.142 The physico-chemical characteristics of the fuel used in the modeling:

Name	API	Specific density	Viscosity	Pour point	Paraffin content	Asphaltene content
MGO (marine fuel)	30	0.876	1.7 – 4.5 cSt @ 40°C	-	-	-
Hydrocarbon modeling	28.4	0.885	12cSt@ 13°C	-36 °C	3.11%	0.02%

Limit Values

Table 6.143 The limit values used in the modeling are as follows

	Value	Description
Surface	0.04 µm	The Bonn Agreement on Fuel Appearance Code (BAOAC) defines five oil layer thicknesses based on their optical effects and actual colors. 0.04 µm is the minimum thickness that can be seen with the naked eye.
The Shoreline	0.1 liters/m ^{2}	Minimum limit value for slight coverage of the fuel shore. According to the ITOPF document [48]"Recognition of oil on shorelines". $^{2\ is}$ assumed to be the lethal limit for invertebrates on hard substrates and sediments in intertidal habitats. Shore coverage greater than 0.1 liters/m ^{2} would be sufficient to cover individuals of the invertebrate species and affect its survival and reproductive capacity [49].

[48]ITOPF 2011b, The International Tanker Owners Pollution Federation Limited (ITOPF) (nd) 'Technical Information Paper 06: Recognition of oil onshorelines', accessible online via: https://www.itopf.org/fileadmin/uploads/itopf/data/Documents/TIPS_TAPS_new/TIP_6_Recognition_of_Oil_on_Shorelines.pdf

[49]French-McCay, Deborah. (2009). State-of-the-Art and Research Needs for Oil Spill Impact Assessment Modeling. Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response. 2 .

To highlight the thickness of the emulsion layer on the sea surface, the color code according to the Bonn Agreement was used.

At the same time, the color code regarding the shoreline maps derives from the ITOPF Technical Information Document (TIP) no. 6 "Onshore Oil Reconnaissance" (ITOPF, 2011b). Light landfall with a fuel layer is considered insignificant in ITOPF [2] , no response plan is required for a very lightly landfall, other than monitoring the oil spill.

Table 6.144 Bonn Agreement Oil Appearance Levels (2016)[50]

Code	Description-Appearance	Layer thickness	Liters per 100 ^{km2}	m ^{3} per 100 km ^{2}
1	Silver gray	0.04-0.30 (µm)	40 -300	0.04 of c -0.3
2	Rainbow	0.30-5.0	300-5,000	0.3-5.0
3	METAL	5.0-50	5000-50,000	5.0-50
4	Real hydrocarbon color discontinuous	50-200	50,000-200,000	50-200
5	Continuous true hydrocarbon color	>200	>200,000	>200

6.3.8.1.2 Interpretation of results

Surface – Probability of impact

This shows the probability that a water surface will be affected by the fuel layer at any given time during the simulation. Exposure time is not considered - the surface impact can last for 1 hour or it can last for the entire Duration of the simulation. Similarly, fuel layer of any thickness above the 0.04 µm threshold will be indicated.

This result is useful to understand the probability of impact on a given area, as well as the predominant direction of layer movement in each season.

Area – The minimum time the layer reaches an area

This indicates the shortest time, after the start of the simulation, at which the fuel layer has reached the location. Other simulations may result in a longer time to the first impact. It is reasonable to assume that this oil should not reach this location before the 'minimum arrival time,' and in most cases, it will take longer or may not arrive at all.

[50] https://www.bonnagreement.org/publications , The Bonn Agreement Oil Appearance Code(2016)

This result is useful to help determine the positioning and response time of resources that will be mobilized to assist in the response.

Area – Maximum layer thickness

This shows the thickest estimated layer at a particular location during any of the simulations. Other simulations will affect the area with a thinner oil layer. It is reasonable to assume that fuel should not be found at this location in thicknesses greater than the "maximum emulsion thickness." This data is useful for determining the appropriate response techniques for each area.

Coastal area – Probability of impact

This shows the probability that a coastal area will be affected at any given time during the simulation.

This result is useful for understanding the likelihood of shoreline impact on a given area, it can be used to inform the level of shoreline response planning required and in which areas.

THE TRAJECTORY OF THE LAYER

While the stochastic results show a summary of many simulations, each trajectory run shows a particular displacement result in more detail. It should be remembered that notable outcomes have been selected to run as trajectory models, and many other outcomes are also possible.

Surface – maximum thickness

This shows the maximum estimated fuel layer thickness at any given time during the simulation. Shows where the layer has moved. Not all areas are affected at the same time and not always to the indicated thickness.

This result can be used to illustrate where different response techniques may be viable options.

Surface – Daily position

This shows the position of the fuel layer at 24-hour intervals. The position of the layer was shown after 24 hours, 48 hours, etc. Between these times, fuel may affect other areas not shown. The "maximum thickness" result provides a complete picture of all affected areas during the simulation.

This result is useful to understand the area that can be affected at a given time and also to understand the speed of layer movement.

Mass balance graph

This result indicates the status of the fuel in the model. The fuel starts the simulation at the sea surface, but over time will be transferred to other states as weathering processes occur.

The result is useful to understand the expected state of the layer.

6.3.8.1.3 Modeling results

All modeling results were created with thresholds applied. Thresholds are used to present information that is significant, either in terms of spill response or environmental impact.

The stochastic results for the accidental discharge scenario from the platform installation vessel were calculated from 150 trajectories per season. The scenario involves the instantaneous discharge of 300 m^3 of MGO in both the winter and summer seasons in the area of the shallow water production platform. The displacement of the hydrocarbon layer is followed over a period of 14 days.

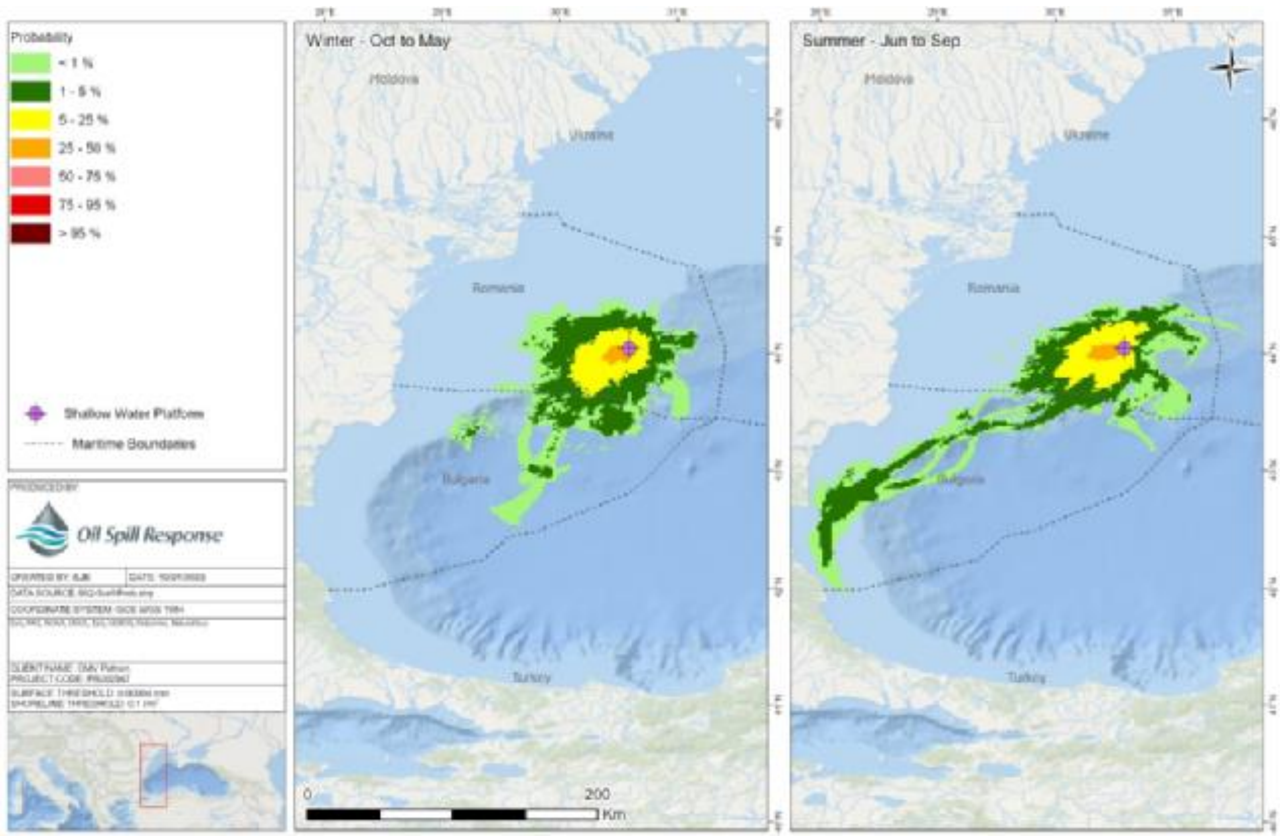


Figure 6.120 The probability that the water surface to be affected

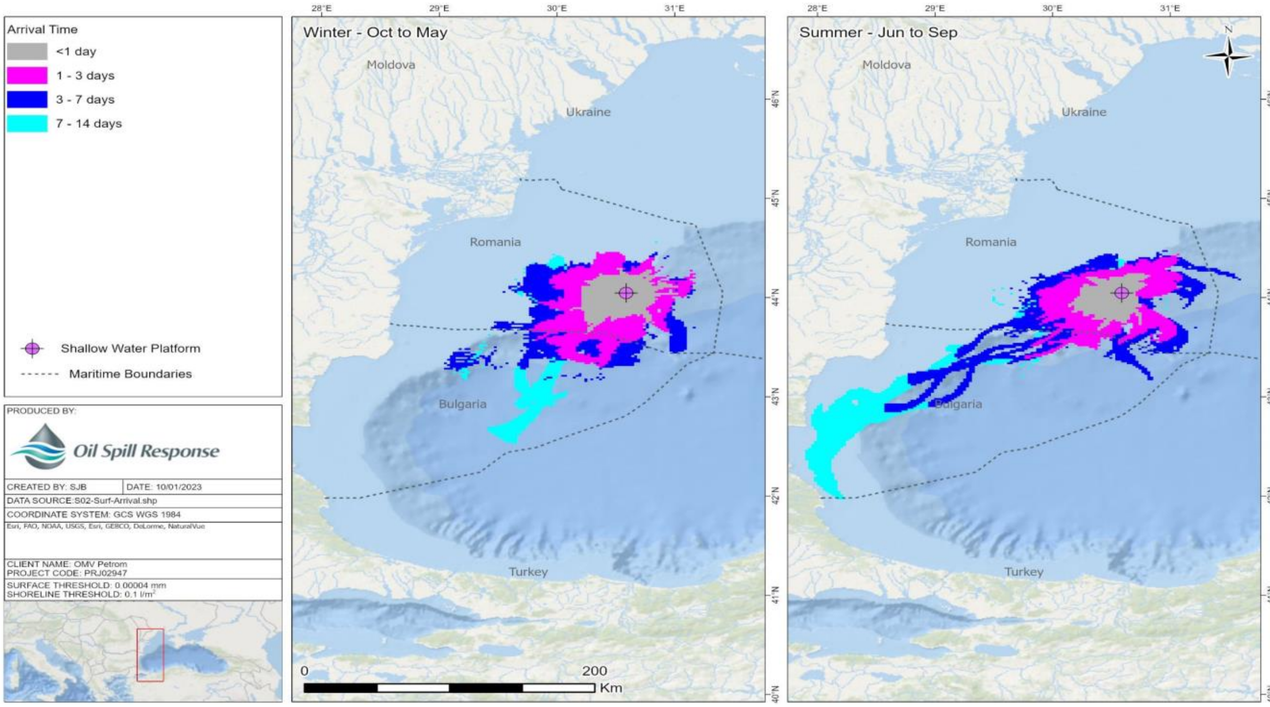


Figure 6.121 The minimum time when the layer reaches an area

The results of stochastic modeling (figure 6.7) show that in most situations, the impact on surface waters will remain within the limits of Romanian waters. About 25% of the oil from the surface could reach across the sea border in Bulgaria in the winter season and 21% in the summer season. It is also possible, but extremely unlikely, that oil from the surface could affect the waters of Ukraine and Turkey during the summer season (<1%).

The surface layer could reach up to about 100 km away in most directions, apart from a small number of situations where environmental conditions allow the surface layer to persist long enough to be transported to the southwest. This is more pronounced in the summer season.

Figure 6.8 indicates the time at which the fuel layer reaches the zone of influence. Thus, in the winter season the layer does not reach the area of the protected areas on the territory of Bulgaria, but in the summer season the layer arrives after one day on the territory of Bulgaria and in 10 days to the marine area of the Emona protected area, 12 days to Ropotamo and 13 days at Strandzha.

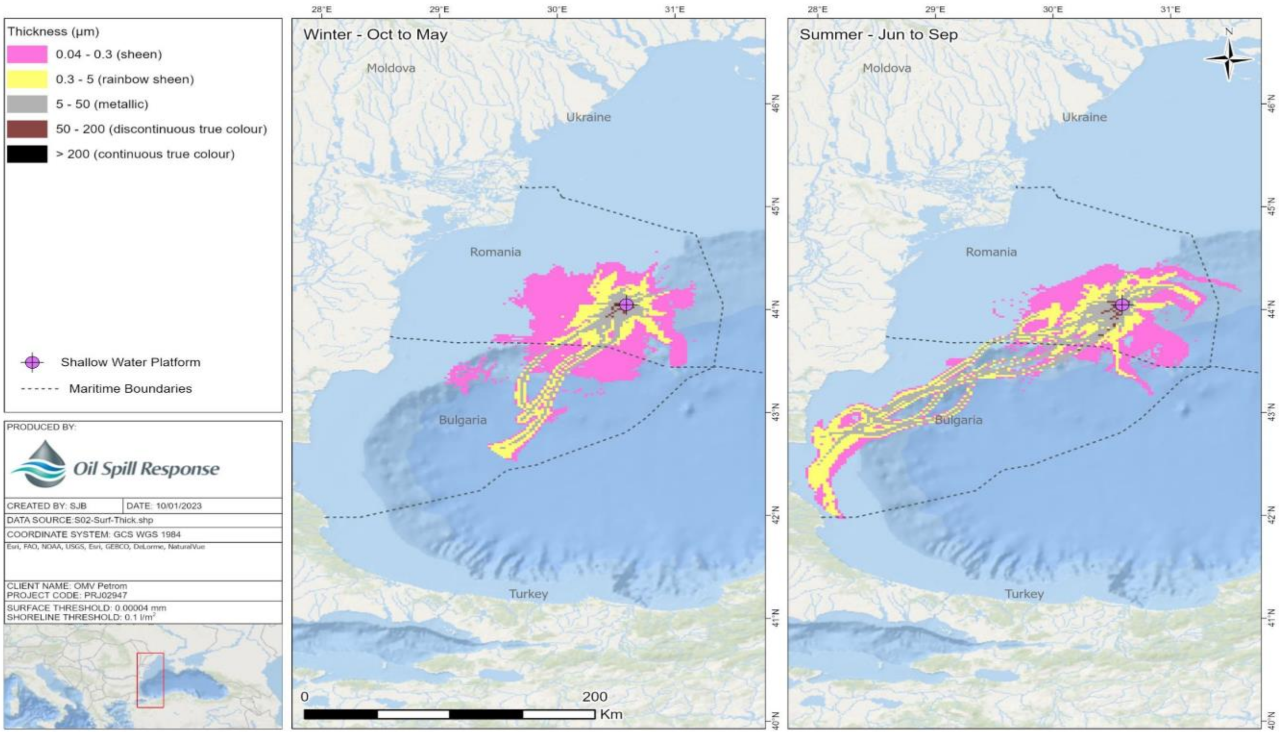


Figure 6.122 Maximum thickness of fuel layer on water surface

Figure 6.114 indicates the maximum layer thickness according to its color according to the hydrocarbon color code established by the Bonn Agreement. In the winter season, on the territory of the Republic of Bulgaria, the thickness of the layer will be between 0.04-50µm.

It is estimated that the fuel layer reaches the Bulgarian maritime border in about 1 day at the earliest. It should be noted that this is the fastest impact among the 150 simulations per season performed. Other simulations will either not affect at all or take more than 1 day to reach the sea border of Bulgaria.

In most simulations, after 7 days there is no fuel layer on the water surface. Only a few simulations show that the fuel layer persists beyond 7 days, these are the ones moving to the southwest.

As one moves away from the spill point, the fuel layer thickness is expected to spread into layers of metal thickness (5-50 µm) or less.

Marine water near the Canionul Viteaz protected natural area is affected in 71% of the simulations. The simulation results show that in the winter season scenario, the fuel layer reaches the Canionul Viteaz area in approximately 3 hours.

The impact on this site was further studied with additional trajectory simulations. It should be remembered that "impact" is considered to occur when the surface fuel layer exceeds the silver gloss threshold - 0.04µm.

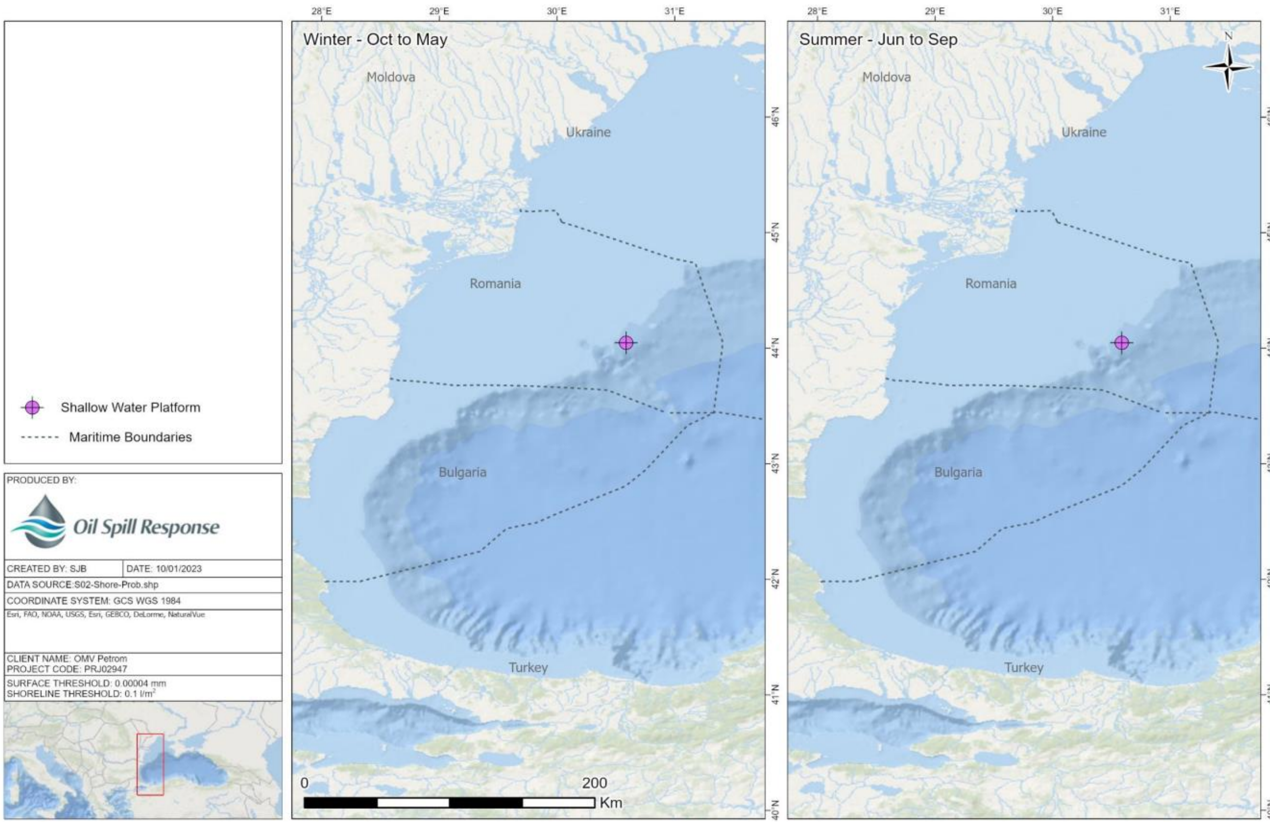


Figure 6.123 The probability that the coastal area will be affected

Figure 6.115 indicates that the coastal area in both Romania and Bulgaria will not be affected.

The presentation below focuses on scenario 1, many of the comments are applicable to scenario 2 as well.

Table 6.145 Statistical analysis - water surface

Summary of accidental pollution modeling		
Accidental pollution/description	Platform installation vessel	Scenario 1
Median crossing		
Midline identified	The shortest probability and Duration when the layer hits the boundary	
	Winter	Summer
Romania	Pollution area	
Bulgaria	25% 0 days, 22 hours	21% 1 day, 2 hours
Turkey	0% It's not necessary	<1% 13 days, 20 hours
Ukraine	0% It's not necessary	<1% 4 days, 16 hours

Table 6.146 Statistical analysis – sensitive areas

Sensitive areas		
Sensitive areas (Protected areas)	**Winter**	**Summer**
Viteaz Canyon, ROSCI 0311	71% 0 days, 3 hours	71% 0 day, 5 hours
Emona, BG0000573	0% It's not necessary	3% 10 days, 0 hours
Ropotamo, BG0001001	0% It's not necessary	1% 12 days, 2 hours
Strandzha, BG0001007	0% It's not necessary	<1% 13 days, 0 hours

6.3.8.1.4 Trajectory modeling

The modeling of the trajectory took into account the following aspects:

- **The biggest impact on the waters of the neighboring country**. In this case the trajectory of the fuel layer resulting from the simulations consistently shows the displacement to the southwest as a result of the action of currents and winds. The layer, however, remains on the surface without dispersing in the mass of water, its movement being slow. Closer examination of the pattern suggests that this is caused by a period of unusually calm winds that do not generate enough mixing to disperse fuels.
- **The fastest impact on the maritime border and the area of the protected natural area.** The same simulation resulted in the fastest result for both the Bulgarian maritime border and the nearby Valiant Canyon protected nature area. This is not surprising since both areas are in the same direction from the launch site. In this situation, a closer examination of the pattern shows that this occurs during a period of strong northerly winds, which rapidly pushed the layer south towards the protected area and the maritime boundary. The mass balance plot shows that the effect of the strong wind is to increase the rate of natural dispersion and in the first 12 hours, most of the fuel is in the water column. The mass balance plot shows that the fuel reappears at the surface on days 1 and 3, when the wind speed then decreases. After 4 days, very low fuel remains on the surface of the water.
- **The greatest impact on the protected natural area (Viteaz Canyon).** The simulation that resulted in the largest surface impact on Canionul Viteaz shows the fuel layer initially moving to the southwest and then curving to the northwest. Closer examination of the model shows moderate northerly winds at the time of release combined with a strong current pushing the initial fuel southward into the protected natural area. This combines to create a situation where the surface layer is moved quickly to the sensitive area, but the winds are not strong enough to disperse the layer before it gets there. Natural dispersion continues to reduce the amount of fuel on the sea surface and after 36 hours very low fuel remains on the surface. 75% of the surface of Canionul Viteaz is affected by the fuel layer on the water surface at any given time during this simulation.

Layer condition

The condition of the layer depends on the environmental conditions it is exposed to and there is no "typical" shedding to comment on. Information obtained from trajectory models suggests that the rate of natural dispersion in the water column will play an important role in the condition of the spilled fuel. Natural dispersal will occur more rapidly during periods of stronger wind and, as illustrated by the "most impact on neighboring country" trajectory, much slower during periods of calm weather. The situations examined here are some of the extreme cases, most cases will fall somewhere in the middle. Stochastic model results suggest that low fuel layer on the water surface persists beyond 7 days in most situations.

Evaporation and biodegradation also play a role, but in general the effect is less than natural dispersion. Sedimentation is negligible in the studied trajectories.

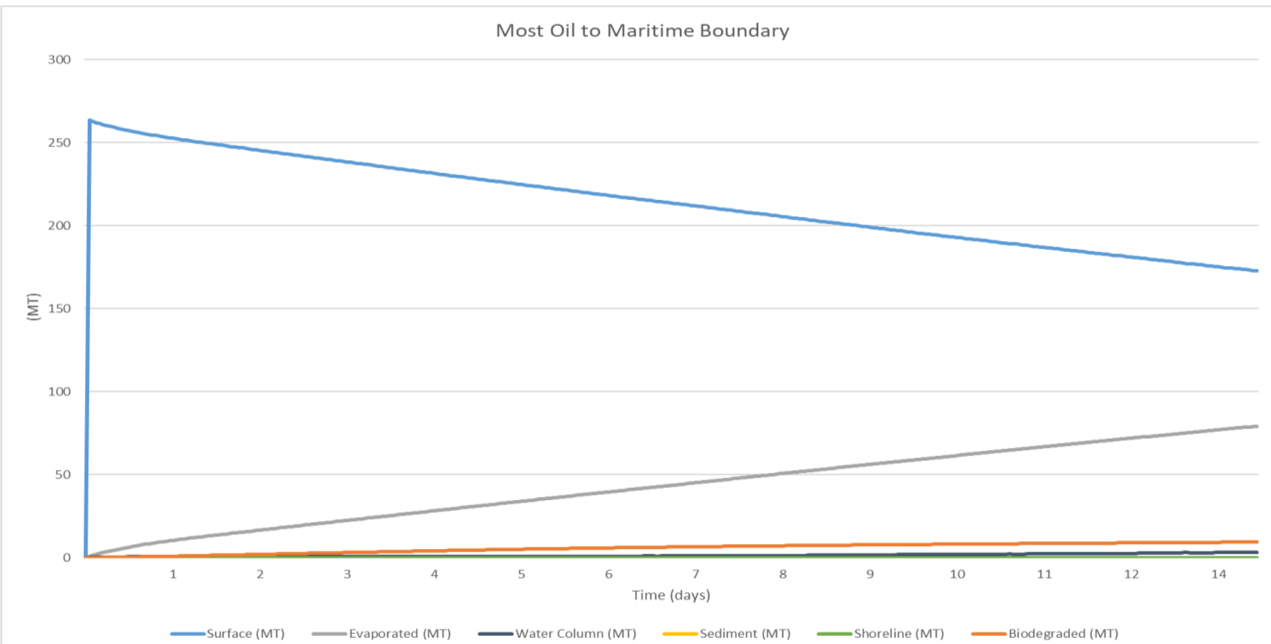


Figure 6.124 Mass balance chart-Highest impact on neighboring country waters

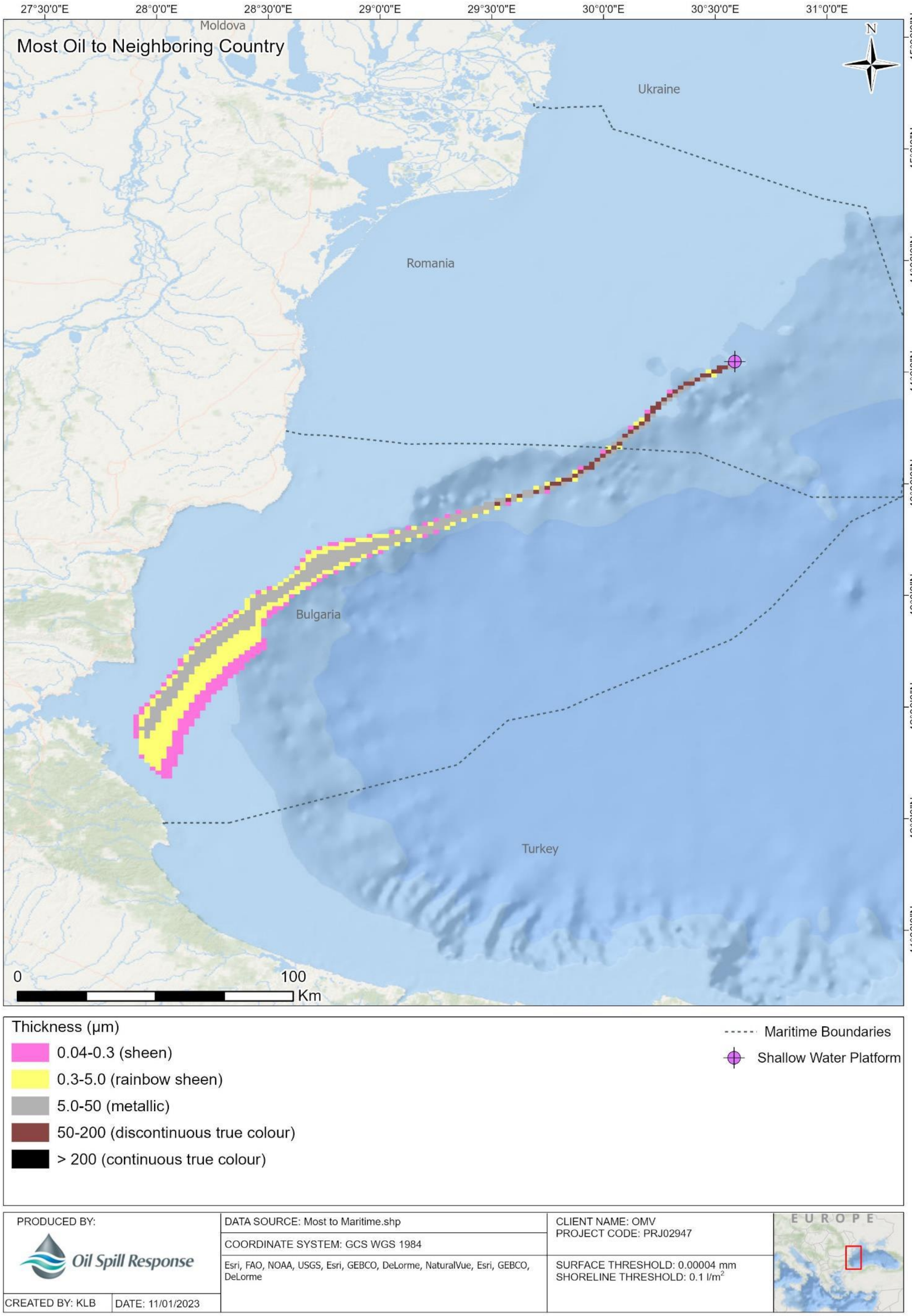


Figure 6.125 Affected area - largest impact on neighboring country's waters

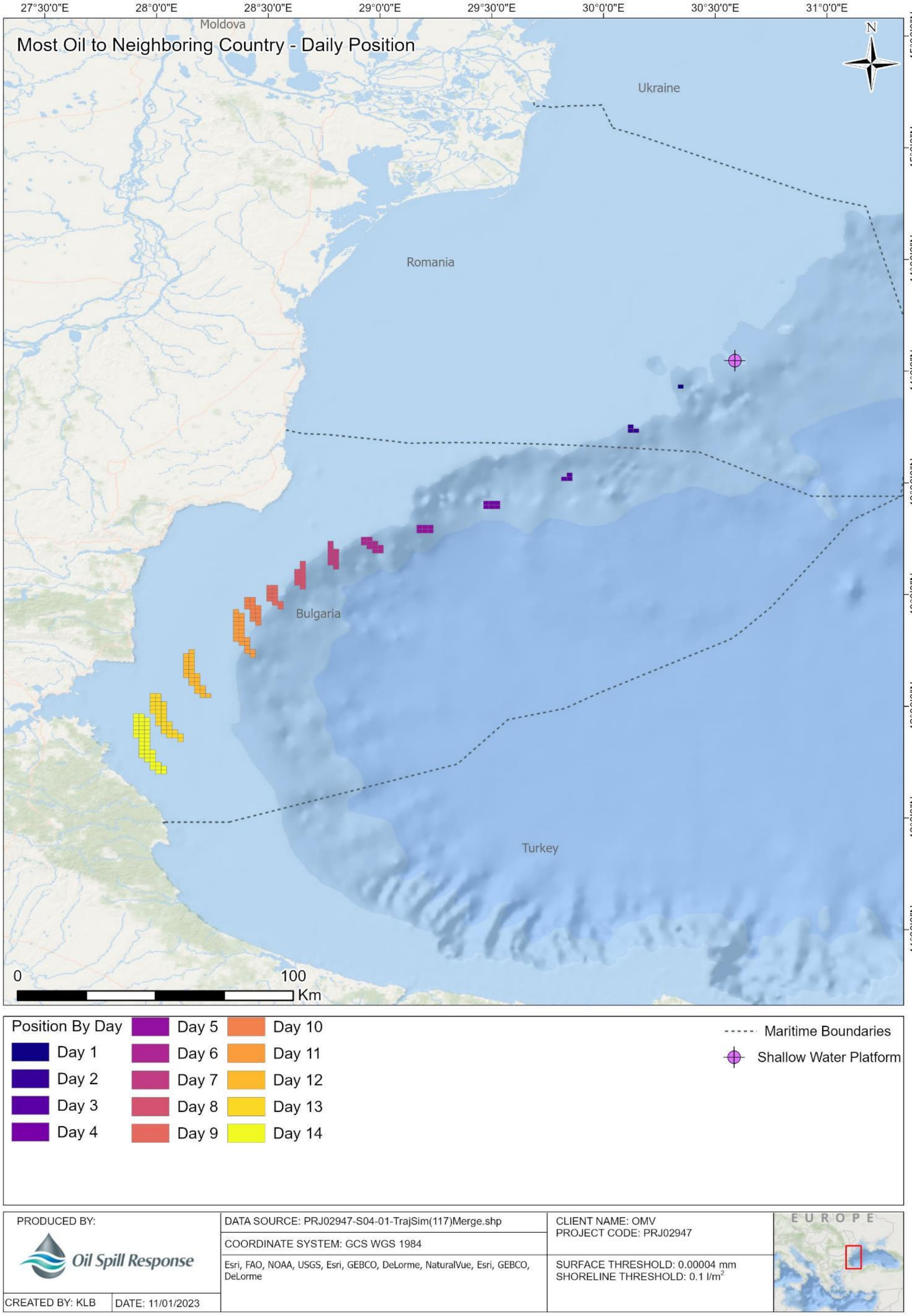


Figure 6.126 Layer position by days - Greatest impact on neighboring country waters

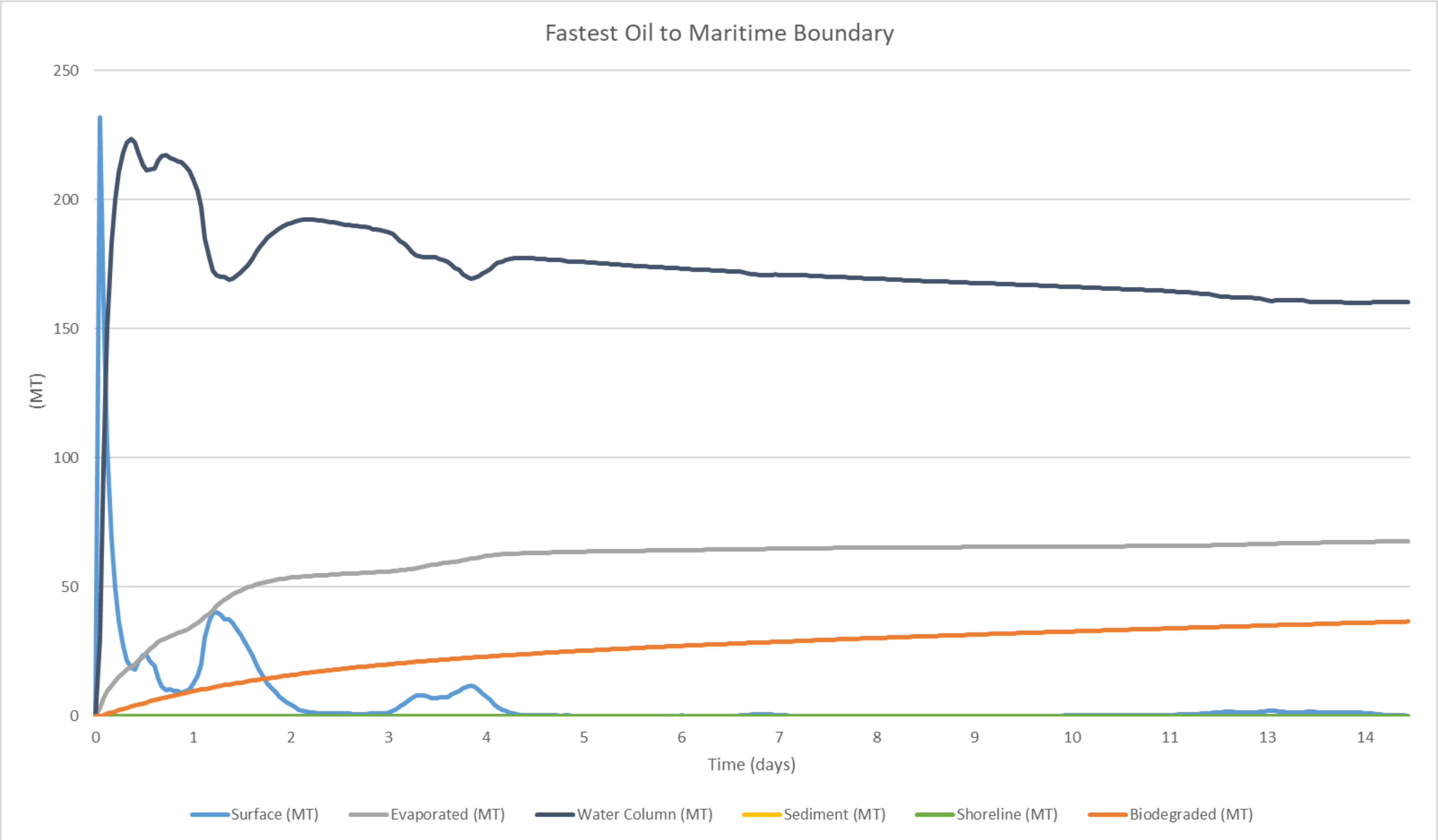


Figure 6.127 Mass balance chart- Fastest impact on neighboring country waters.

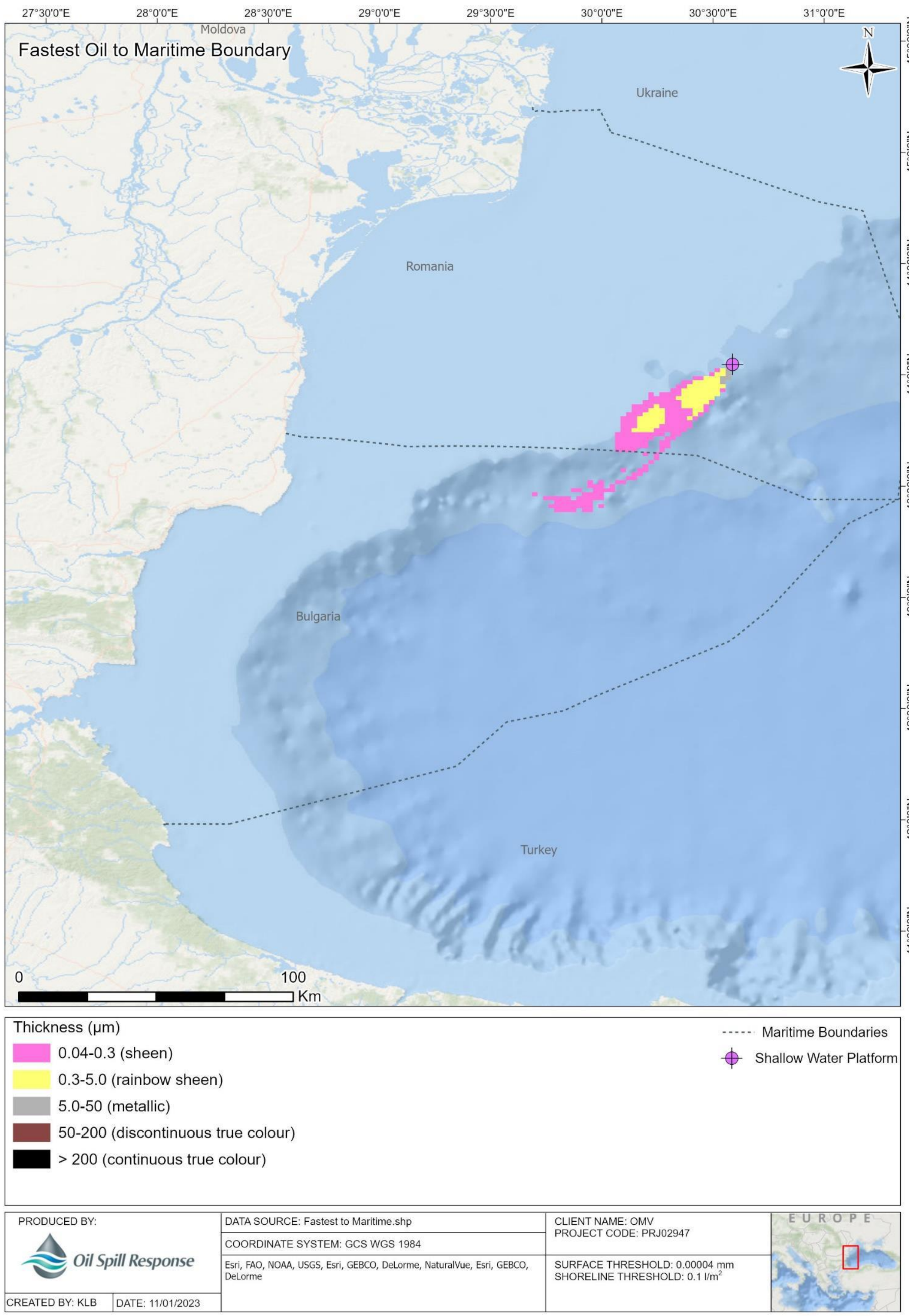


Figure 6.128 Area affected - Fastest impact on neighboring country's waters

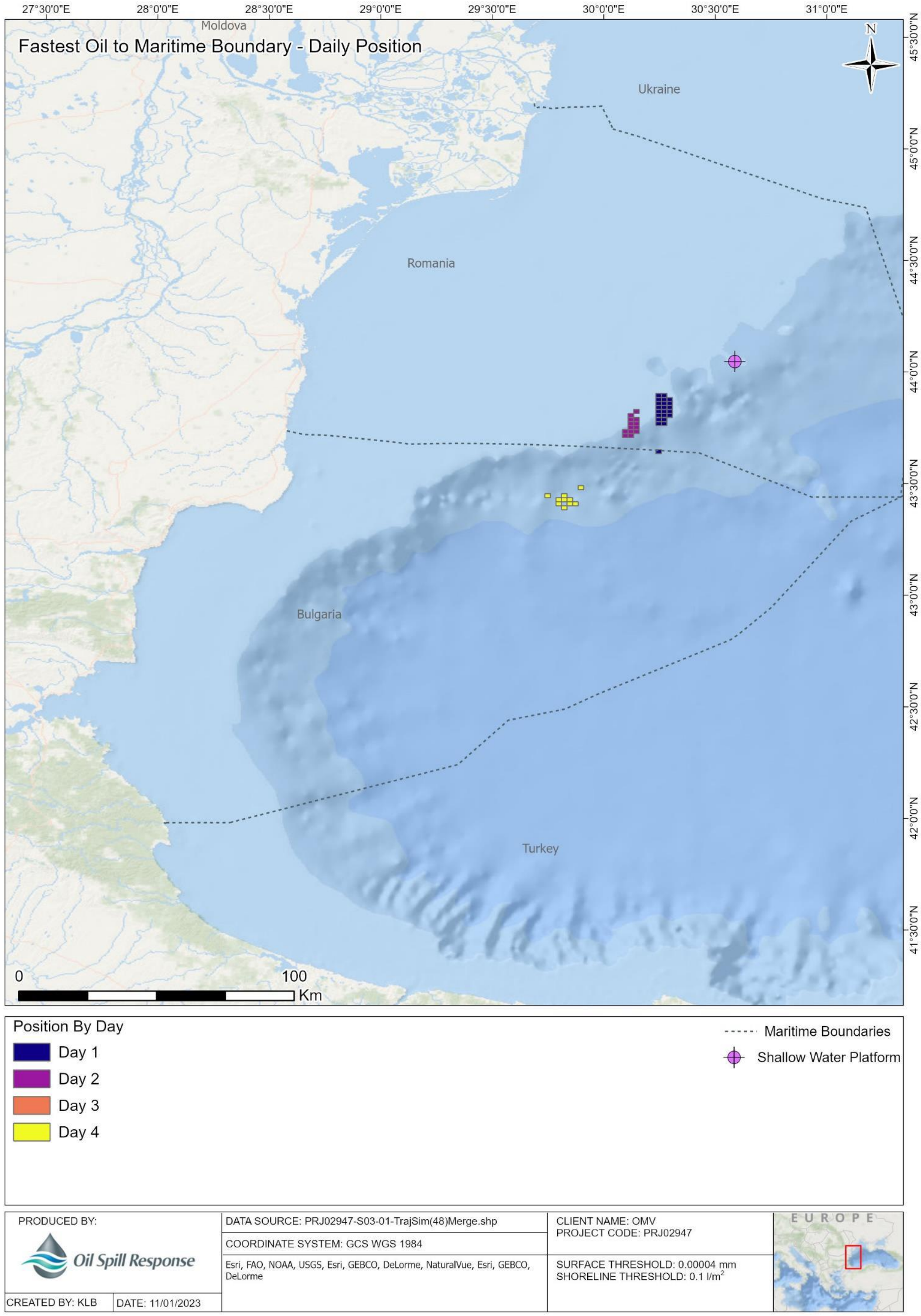


Figure 6.129 Layer position by days - Fastest impact on neighboring country waters

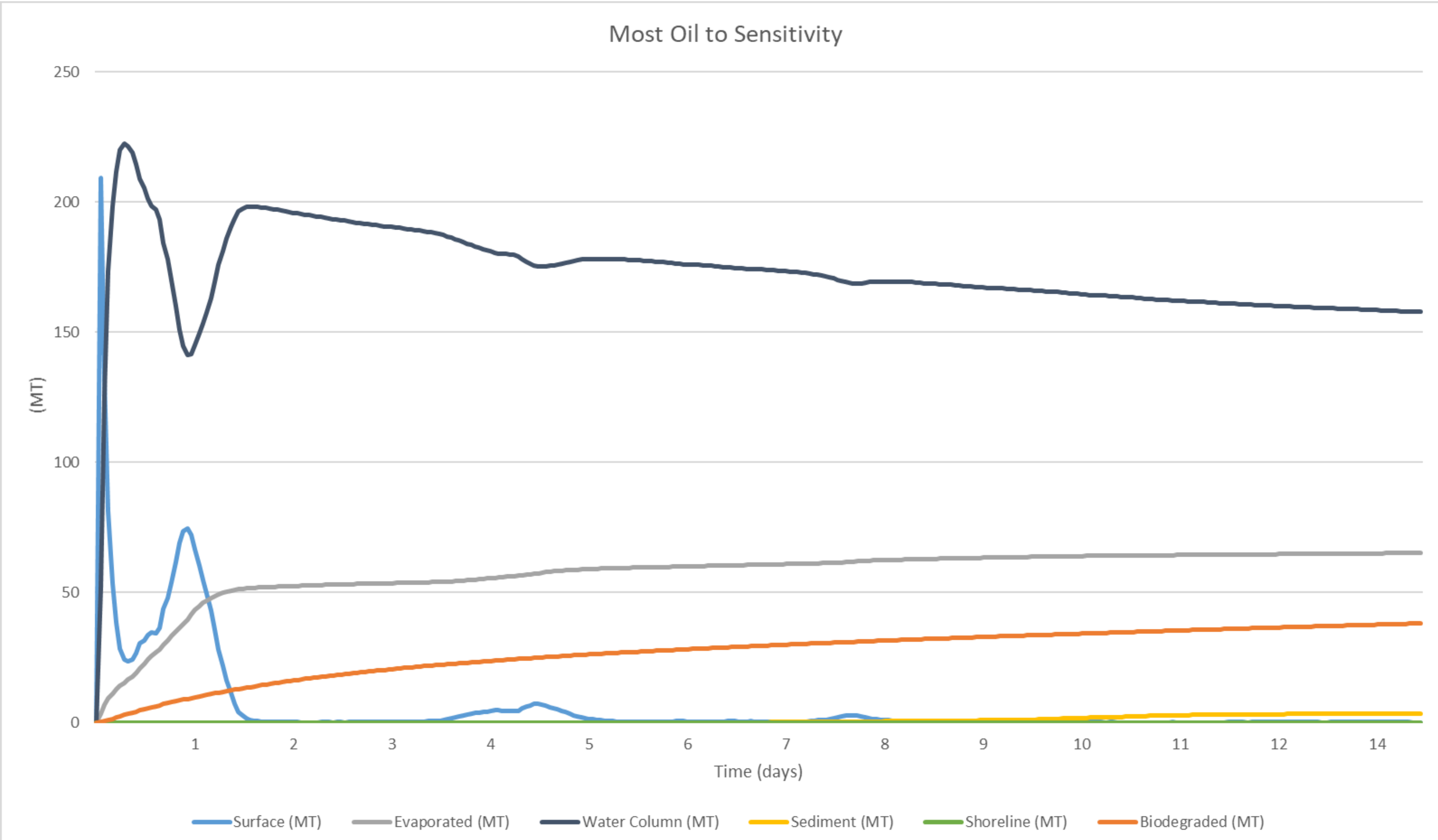


Figure 6.130 Mass balance graph - The greatest impact on the protected natural area (Viteaz Canyon).

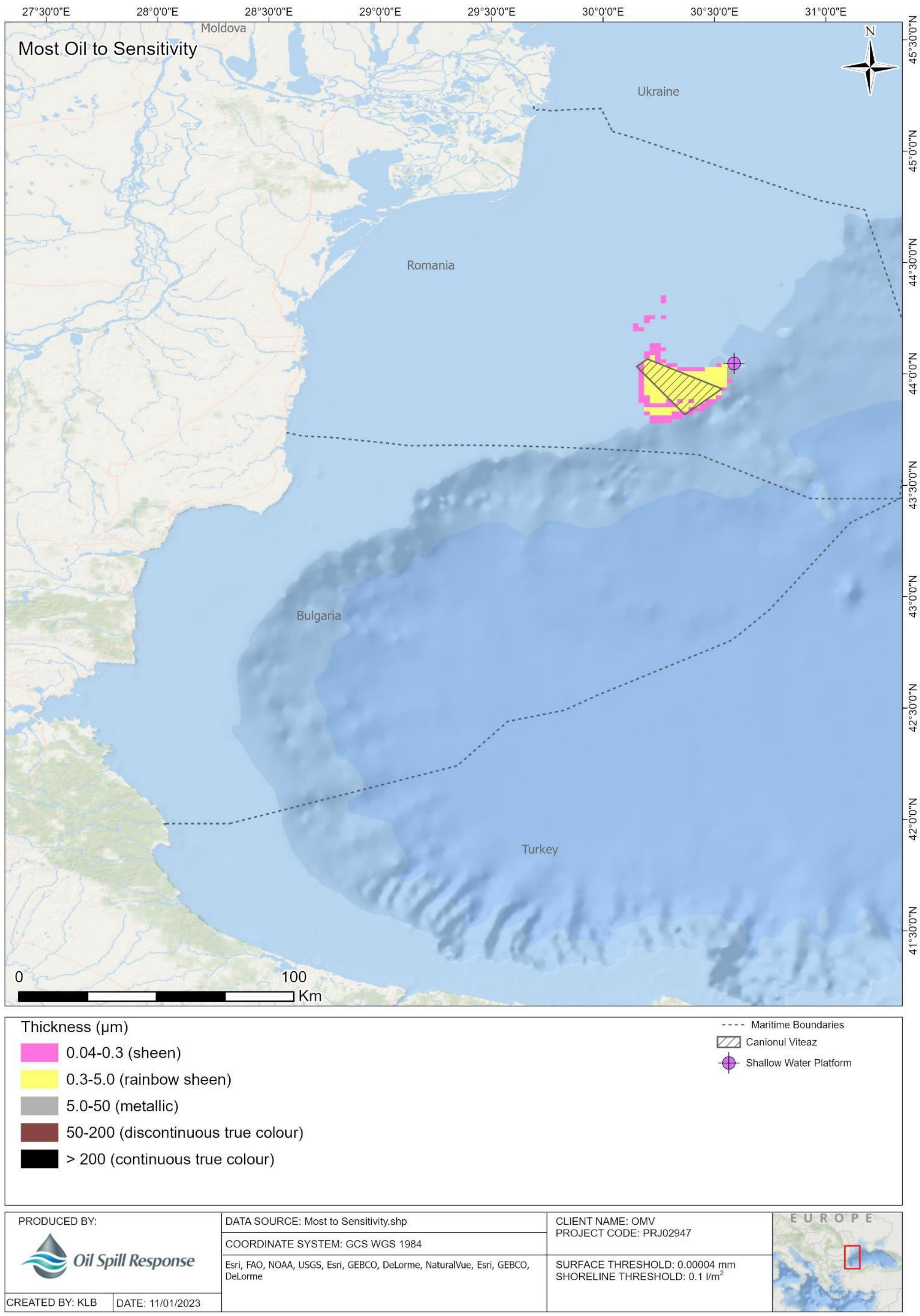


Figure 6.131 ***Affected area - The greatest impact on the natural protected area (Viteaz Canyon).***

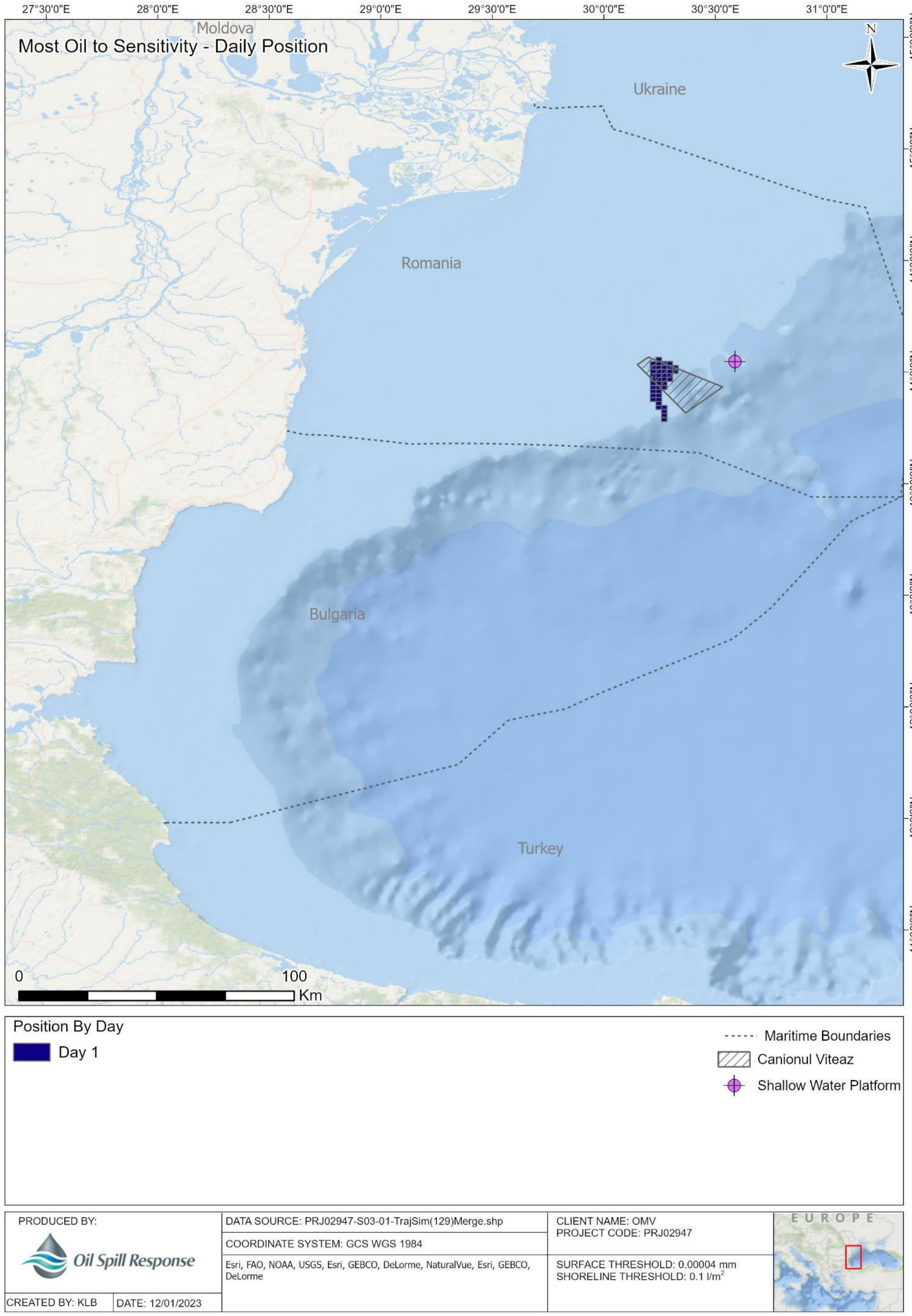


Figure 6.132 Layer position by days - The greatest impact on the natural protected area (Viteaz Canyon)

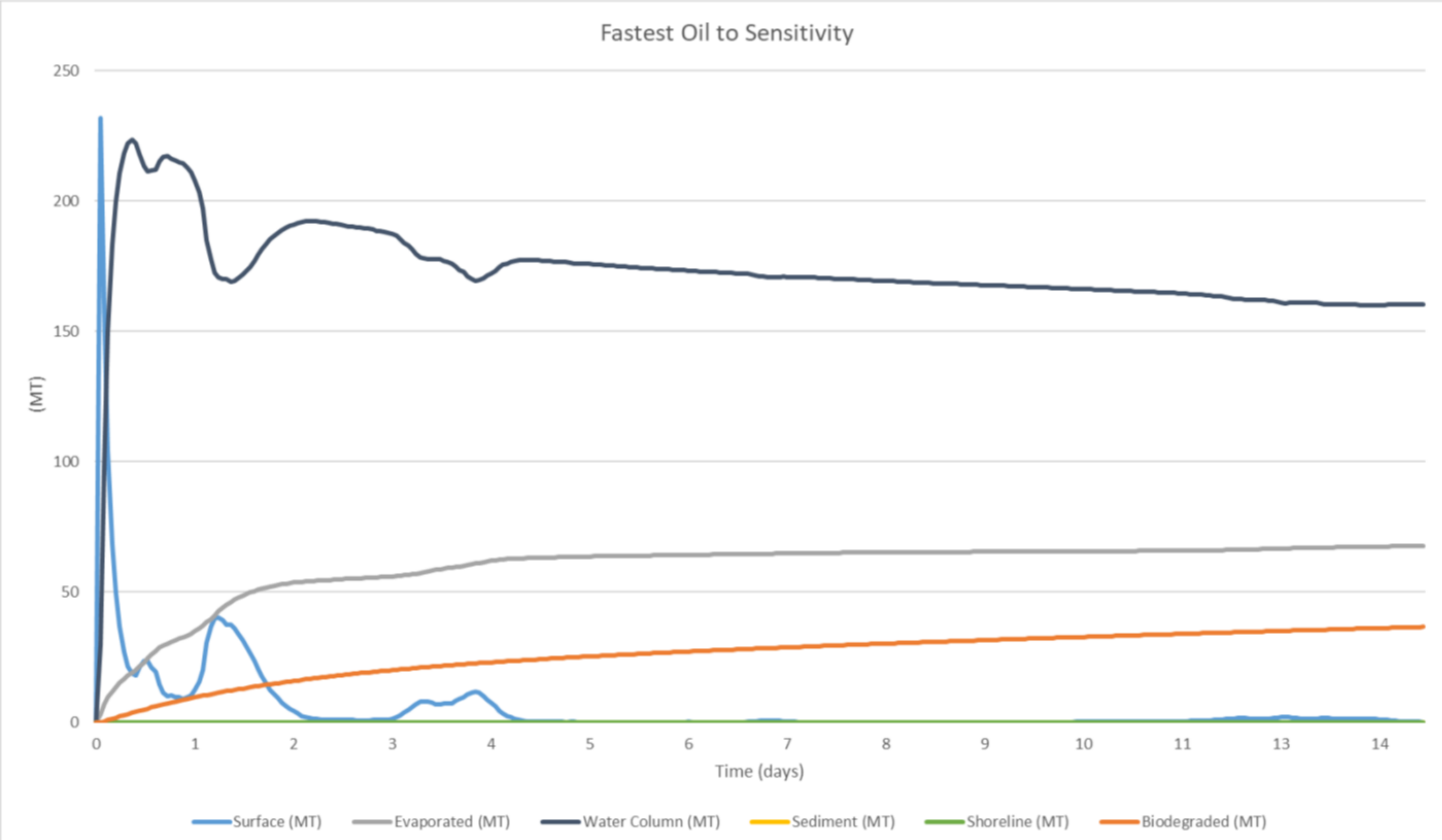


Figure 6.133 Mass balance graph- Fastest impact on sensitive areas

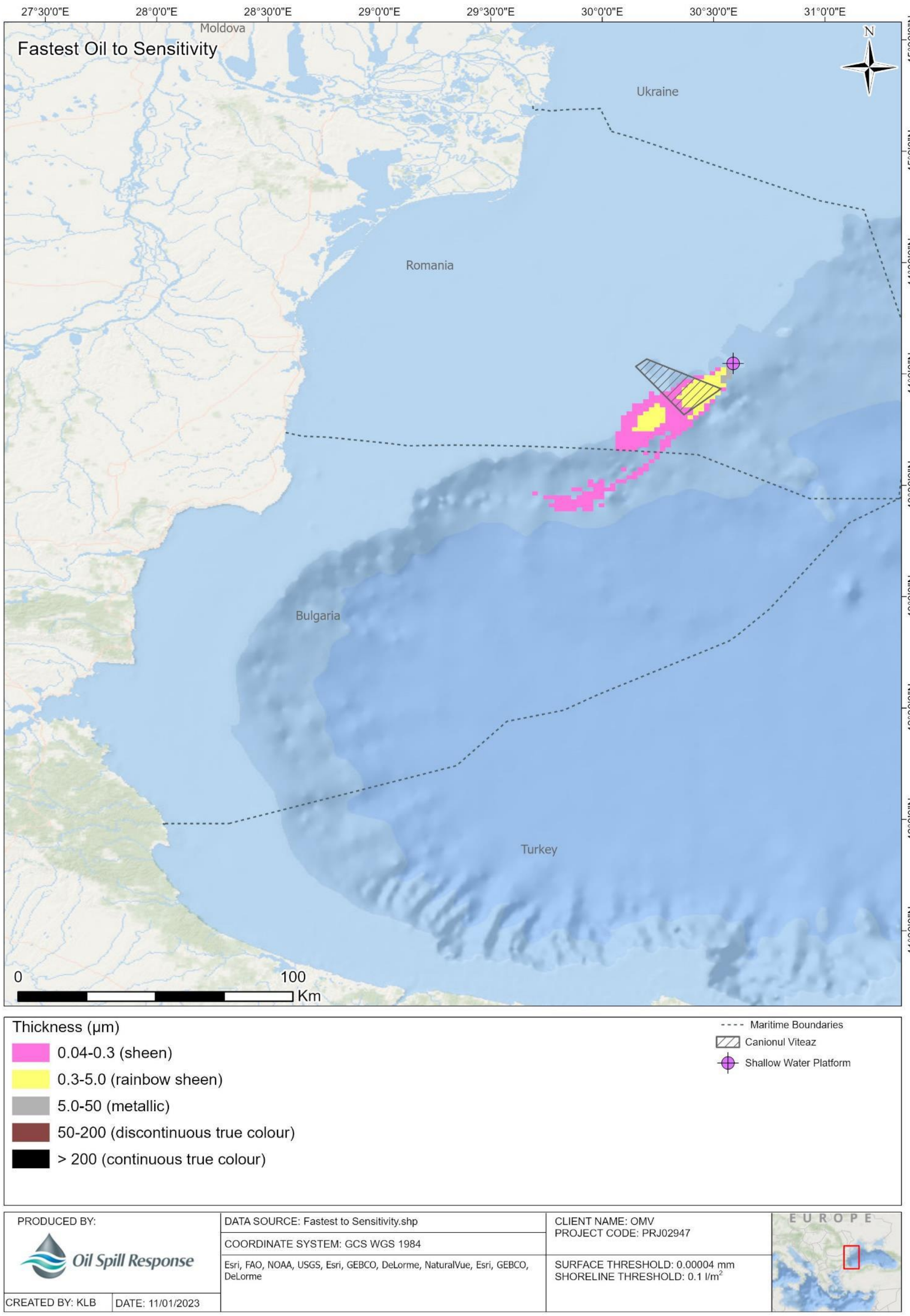


Figure 6.134 Affected surface - Fastest impact on sensitive areas

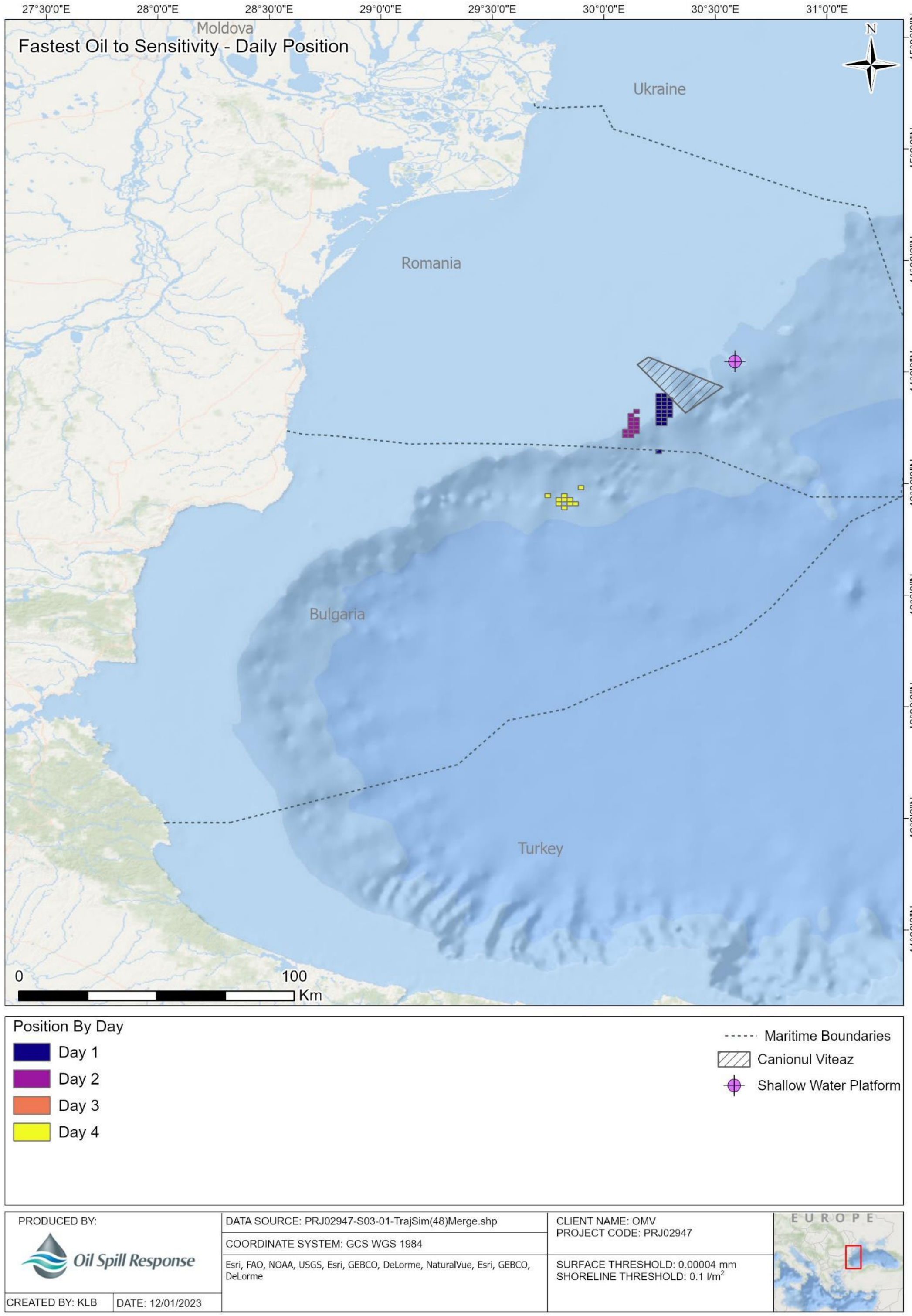


Figure 6.135 Layer position by days -Fastest impact on sensitive areas

Scenario 2 – Accidental spill from drilling rig

Scenario 2 simulates a similar but smaller release of MGO from the drilling rig. The overall results of the stochastic models are very similar to those of scenario 1. The above description of the modeling results regarding the effects of a spill in scenario 1 are also applicable to scenario 2.

The stochastic results for the oil rig spill scenario were calculated from 150 trajectories per season. The scenario consists of discharge of 165 m^3 of MGO during 4 hours in both winter and summer season from the drilling rig at the Pelican Drilling Centre. The fuel is tracked for another 14 days.

Table 6.147 Statistical analysis - water surface

Summary of accidental pollution modeling		
Accidental pollution/description	The drilling platform	Scenario 2
Median crossing		
Midline identified	**The shortest probability and Duration when the layer hits the boundary**	
	Winter	**Summer**
Romania	Pollution area	
Bulgaria	15% 1 day, 3 hours	15% 1 day, 5 hours
Turkey	0% It's not necessary	<1% 12 days, 13 hours
Ukraine	0% It's not necessary	<1% 4 days, 15 hours

Table 6.148 Statistical analysis – sensitive areas

Sensitive areas		
Sensitive areas (protected areas)	**Winter**	**Summer**
Viteaz Canyon, ROSCI 0311	59% 0 days, 4 hours	67% 0 day, 7 hours
Emona, BG0000573	0% It's not necessary	3% 9 days, 23 hours
Ropotamo, BG0001001	0% It's not necessary	1% 11 days, 1 hour
Strandzha, BG0001007	0% It's not necessary	<1% 11 days, 21 hours

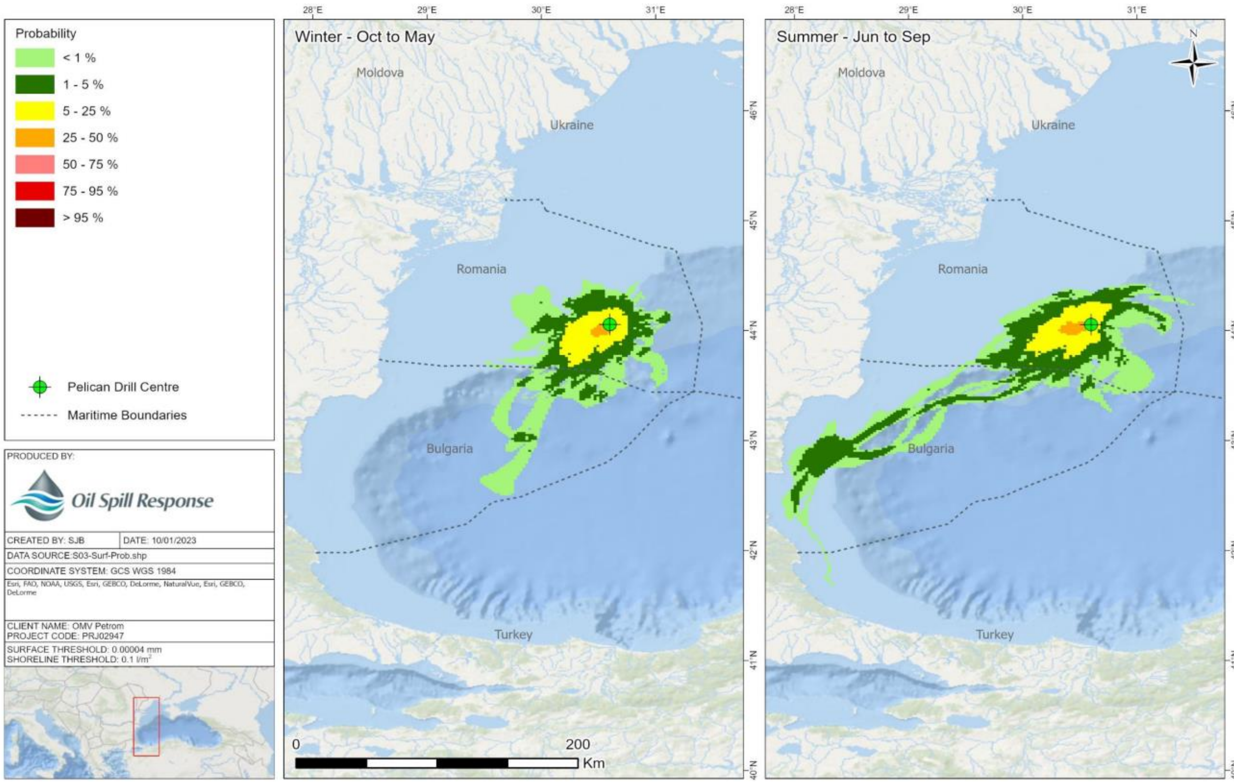


Figure 6.136 The probability that the water surface will be affected – scenario 2

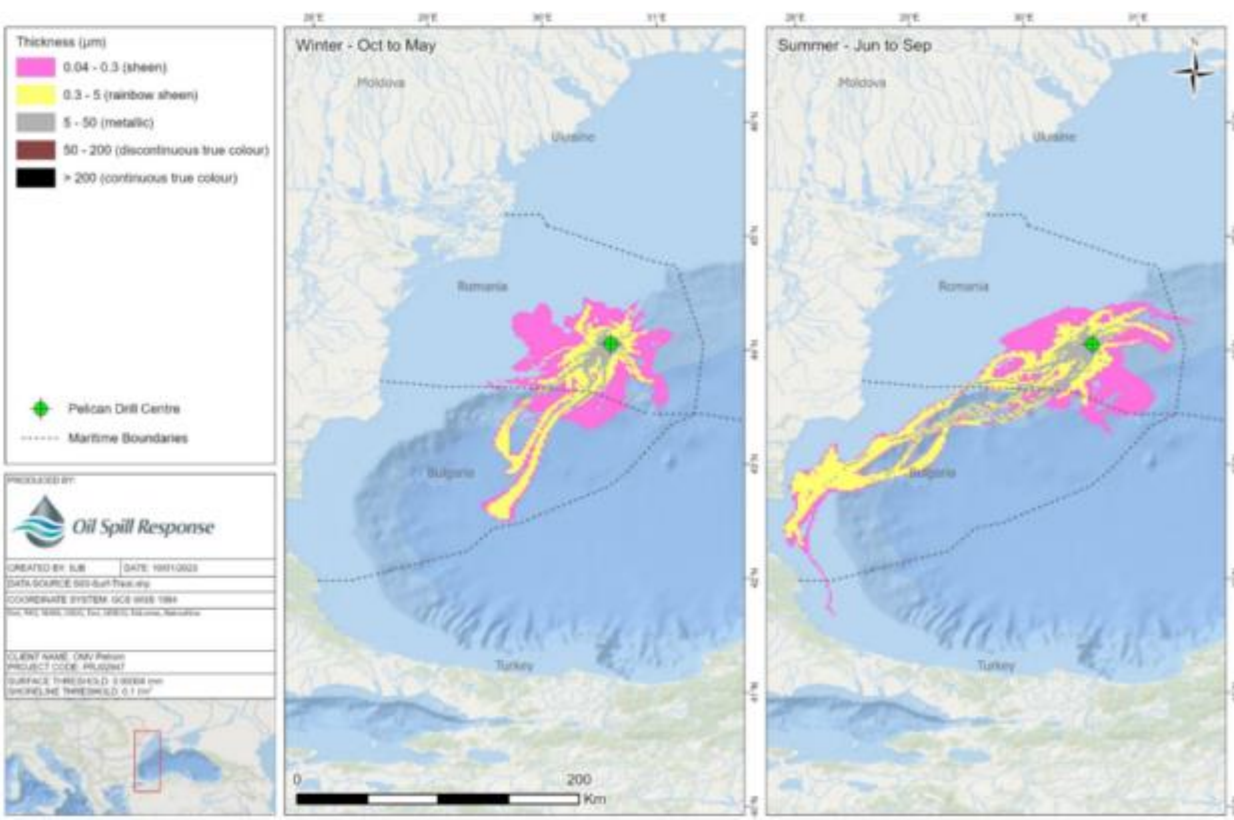


Figure 6.137 Maximum fuel layer thickness on water surface

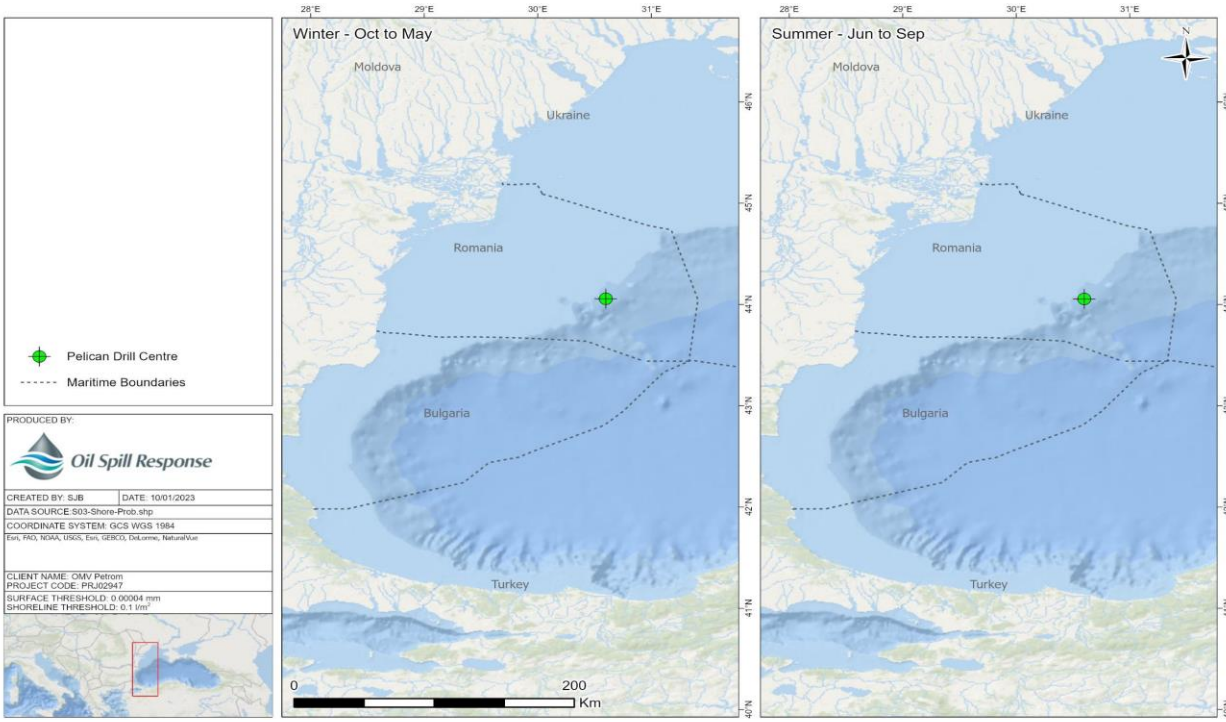


Figure 6.138 Probability of affecting the coastal area - scenario 2

6.3.8.1.5 Negative effects of accidental spills on the environment in transboundary context

MGO fuel contains a higher proportion of low molecular weight compounds than many other oils. The main environmental impact from the accidental spillage of petroleum products will come from acute toxicity rather than the physical effects of suffocation. All scenarios considered in the modeling result in a surface discharge, which is likely to diminish the environmental impact, as a large part of the petroleum product will quickly evaporate. In the water column, the concentration of petroleum product will probably be highest near the surface and will decrease with depth.

It Is Important to specify that the modeling was carried out without considering the measures for combating accidental pollution.

Studies on the effects of accidental hydrocarbon spills have concluded that the extent of damage caused by a hydrocarbon spill in sea water depends on the extent and area of the spill, the chemical composition of the spilled fuel, climatic conditions, remediation measures, and response times.

The methods commonly used to respond to accidental pollution include containment and mechanical recovery, in situ burning, the use of absorbent materials, bioremediation, and the application of dispersants, as appropriate.

Within the water column, small droplets of hydrocarbons undergo further processes such as biodegradation, dissolution, and eventually sedimentation, in cases where the phenomenon of biodegradation predominates.

The modeling results indicate that the impact on surface waters will remain within the limits of Romanian territorial waters, the probability of affecting water quality on the territory of the Republic of Bulgaria is low.

In case of an operational pollution in the offshore location area of the project, the immediate impact would be felt on the aquatic organisms that populate the area where the hydrocarbon film moves.

As a result of the change in water quality, it is expected that the fauna with increased mobility will undergo changes in behaviour, in the sense of avoiding the area affected by the spill, an aspect that leads to the exclusion of the affected surface from the area of feeding, reproduction, migration, etc., for the period of the pollution will persist.

The trajectory modelling performed for Scenario 1 (worst case scenario) shows that the plume moves initially to the southwest and then curves to the northwest, affecting the surface ROSCI0311 Canionul Viteaz, 75% of the surface of the protected natural area will be affected by surface layer film at any given time during this simulation.

It must be remembered, on the one hand, that in a real situation of accidental production of hydrocarbon pollution, their level will not persist in the sea water at the experimental critical concentrations, intervening with immediate actions to clean the affected area, according to the procedures of intervention established in the Accidental Pollution Intervention Plan.

6.3.8.2 Impact assessment of water in transboundary context

The table below shows the impact assessment by magnitude and receiver sensitivity without the application of impact mitigation measures. The impact significance matrix is presented in point 6.1.4.3.

Table 6.149 Impact assessment in a cross-border context

<table>
<tr><th>Effect</th><th colspan="2">Magnitude components</th><th>Magnitude</th><th>Sensitivity</th><th>Meaning Impact</th></tr>
<tr><td rowspan="6">Accidental pollution</td><td>Nature effect</td><td>Negative</td><td rowspan="6">Medium</td><td rowspan="6">High</td><td rowspan="6">Moderate</td></tr>
<tr><td>Effect type</td><td>Direct</td></tr>
<tr><td>Reversibility of the effect</td><td>Reversible</td></tr>
<tr><td>Extension</td><td>Transboundary</td></tr>
<tr><td>Duration</td><td>Short term</td></tr>
<tr><td>The intensity</td><td>Medium</td></tr>
</table>

The magnitude will be medium for accidental pollution, as the medium intensity of the effects on the sensitive receptors and marine ecosystems, given the thin layer that reaches the sensitive areas, and for a short period of time.

6.3.8.3 Prevention and Mitigation Measures

In the event of accidental pollution in the marine area, the avoidance, prevention and reduction measures are the following:

- Application of the action plan in case of accidental hydrocarbon pollution
- Develop and implement safe fuel transfer procedures
- Establishing operational procedures for the boat/vessels affected by the Project in the work area, avoiding the collision of vessels
- Enforcement of safety zones around project facilities and activities
- Proposing a schedule and an adequate number of vessels for the transport of construction materials and equipment to avoid congestion in the area, if possible
- Implementation of adequate staff training and field drills for oil spill prevention, containment and response
- Ensuring that spill response and containment equipment is regularly inspected and maintained, operationally checked and tested, and used during activities or available as required for the response.

6.3.8.4 Assessment of residual impact

By implementing the measures established in point 6.2.9.1.3, the residual impact is presented in the table below.

Table 6.150 Residual impact assessment

Effect	Magnitude	Sensitivity	Meaning of Impact	Meaning of Residual Impact
Accidental pollution	Medium	Medium	Moderate	Minor
GENERAL ASSESSMENT	**Insignificant impact**			

Based on the current conditions of the assessed component, the characteristics and works of the project, as well as the appropriate implementation of the measures proposed above, a minor / insignificant negative impact on sensitive receptors of marine ecosystem, in a transboundary context is expected in the event of accidental pollution.

6.3.9 Marine Strategy

The Marine Environment Strategy Framework Directive (2008/56/EC) (DCSMM) was transposed into national legislation by the Government's Emergency Ordinance 71/2010 on establishing the strategy for the marine environment and adopted by Law 6/2011 for the approval of the Emergency Ordinance of Government no. 71/2010 regarding the establishment of the strategy for the marine environment and by Law 205/2013 for the amendment of GEO 71/2010 regarding the establishment of the strategy for the marine environment.

In the context of the obligations provided by the Marine Environment Strategy Framework Directive that must be fulfilled by Romania, as an EU member state, efforts are aimed at improving and maintaining the good condition of the Black Sea marine ecosystem.

Progress towards the achievement of GHG (Good Environmental Status) and environmental objectives is assessed through programs aimed at collecting data and information and subsequently reported. The last national report on the ecological state of the Black Sea marine ecosystem in order to fulfill the reporting obligations provided for in art. 17 of the Marine Environment Strategy Framework Directive (2007/56/EC) was carried out in 2018.

Table 6.151 The impact of the Neptun DEEP project in a cross-border context

Descriptor		Criteria[51]	The impact of the Neptun DEEP project in a cross-border context
D1	**Biodiversity** *Marine Mammals*	D1C1 – Primary: The mortality rate per species from bycatch is below levels that threaten the species so that long-term viability is ensured.	The activity carried out will not affect the size of the population because the project does not involve activities that can cause bycatch. The impact on the environmental objectives for descriptor 1, biodiversity, will not prevent or delay the achievement of good environmental status for this descriptor as defined by its objectives.
		D1C2 – Primary: The population abundance of the species is not adversely affected by anthropogenic pressures so that long-term viability is ensured.	Potential effects caused by disruption of species activity may occur but without affecting population size.
		D1C3 - Secondary The population demographic characteristics of the species indicate a healthy population which is not adversely affected by anthropogenic pressures.	The activity carried out will not affect the demographic characteristics of the population.

[51]DECISION (EU) 2017/848

Descriptor		Criteria[51]	The impact of the Neptun DEEP project in a cross-border context
		D1C4 The distribution area of the species and, as the case may be, the structure is consistent with the prevailing physiographic, geographical and climatic conditions.	The activity carried out will not affect the distribution area of the species.
		D1C5 Species habitat has the extent and condition necessary to support the various stages of the species' life cycle.	The activity carried out will not affect the habitat for the species.
	Biodiversity *Fish*	D1C1 – Primary: The mortality rate per species from bycatch is below levels that threaten the species so that long-term viability is ensured.	The activity carried out will not affect the size of the population because the project does not involve activities that can cause bycatch.
		D1C2 – Primary: The population abundance of the by-caught species is not adversely affected by anthropogenic pressures so that long-term viability is ensured	Potential effects caused by disruption of species activity may occur but without affecting population size.
		D1C3 - Primary The population demographic characteristics of the species indicate a healthy population which is not adversely affected by anthropogenic pressures.	The activity carried out will not affect the demographic characteristics of the population.
		D1C4 The distribution area of the species and, as the case may be, the structure is consistent with the prevailing physiographic, geographical and climatic conditions.	The activity carried out will not affect the distribution area of the species.
		D1C5 Species habitat has the extent and condition necessary to support the various stages of the species' life cycle.	The activity carried out will not affect the habitat for the species.
	Biodiversity *Pelagic habitats*	D1C6 – Primary: The condition of the habitat type, including its biotic and abiotic structure and functions, is not adversely affected by anthropogenic pressures.	The activity carried out will not affect the pelagic habitats on the territory of Bulgaria.

Descriptor		Criteria[51]	The impact of the Neptun DEEP project in a cross-border context
D2	**Non-indigenous species**	D2C1 – Primary: The number of non-indigenous species newly introduced by human activities into nature, over assessment periods (6 years), measured from the reference year, as reported for the initial assessment under Article 8(1) of Directive 2008/56/ CE, is kept to a minimum and, if possible, reduced to zero.	The activity carried out will not introduce non-native species.
	Non-indigenous species	D2C2 – Secondary: The abundance and spatial distribution of established non-native species, especially invasive species, that contribute significantly to adverse effects on specific groups of species or general habitat types.	There is no cause-and-effect relationship The activity will not affect the abundance or spatial distribution of non-native species
		D2C3 – Secondary: The proportion to which each species group and the extent to which each large habitat type assessed is being adversely altered by non-native species, particularly invasive non-native species	There is no cause-and-effect relationship
D3	**Populations of all commercially exploited fish and crustaceans**	D3C1 – Primary: The fishing mortality rate of commercially exploited species is at or below levels that can produce maximum sustainable yield (MSY)	There is no cause-and-effect relationship.
		D3C2– Primary: Reproductive stock biomass of commercially exploited species populations is above biomass levels that can generate maximum sustainable yield	Potential effects caused by disruption of species activity may occur but without affecting population size.
		D3C3 – Primary: The age and size distribution of specimens from the populations of commercially exploited species indicates the good health of the population.	Potential effects caused by disruption of the species' activity may occur but without affecting the population size.
D4	**Marine Food Web**	D4C1 – Primary: The diversity (species composition and their relative abundance) of trophic associations is not adversely affected as a result of anthropogenic pressures.	There is no cause-and-effect relationship.

Descriptor		Criteria[51]	The impact of the Neptun DEEP project in a cross-border context
		D4C2- Primary The balance of total abundance among trophic associations is not adversely affected by anthropogenic pressures.	There is no cause-and-effect relationship.
		D4C3 – Secondary: The size distribution of specimens within trophic associations is not adversely affected by anthropogenic pressures.	There is no cause-and-effect relationship.
		D4C4 – Secondary (to be used to support criterion D4C2 if necessary): Productivity of the trophic association is not adversely affected by anthropogenic pressures.	There is no cause-and-effect relationship.
D5	**Eutrophication** *Nutrients in the water column: Dissolved inorganic nitrogen (DAN), total nitrogen (AT), dissolved inorganic phosphorus (FAD), total phosphorus (FT)*	D5C1 – Primary: Nutrient concentrations are not at levels indicating adverse effects of eutrophication.	There is no cause-and-effect relationship.
	Eutrophication *Chlorophyll a in the water column*	D5C2 – Primary: Chlorophyll concentrations are not at levels indicating negative effects of nutrient enrichment.	There is no cause-and-effect relationship.
	Eutrophication *Harmful algal blooms (eg, cyanobacteria) in the water column*	D5C3 – Secondary: The number, spatial extent, and Duration of harmful algal bloom events are not at levels indicative of adverse effects of nutrient enrichment	There is no cause-and-effect relationship.
	Eutrophication *The photic limit (transparency) of the water column*	D5C4 – Secondary: The photic limit (transparency) of the water column is not reduced, due to the increase in the number of suspended algae, to a level that indicates	There is no cause-and-effect relationship.
D5	**Eutrophication** *Dissolved oxygen at the bottom of the water column*	D5C5 – Primary (may be replaced by D5C8): Dissolved oxygen concentration is not reduced, due to nutrient enrichment, to levels indicating negative effects on benthic habitats (including biocenoses and related mobile species) or other eutrophication effects.	There is no cause-and-effect relationship.

Descriptor		Criteria[51]	The impact of the Neptun DEEP project in a cross-border context
	Eutrophication *Opportunistic macroalgae from benthic habitats*	D5C6 – Secondary: Abundance of opportunistic macroalgae is not at levels indicating negative effects of nutrient enrichment.	There is no cause and effect relationship.
	Eutrophication *Macrophyte communities (algae and perennial sea grasses such as Fucaceae, zoster and sea grass) in benthic habitats*	D5C7 – Secondary: The species composition and relative abundance or depth distribution of macrophyte communities reach values indicating that there is no negative effect as a result of nutrient enrichment, including by reducing water transparency.	There is no cause-and-effect relationship.
	Eutrophication *Macrofauna communities in benthic habitats*	D5C8 – Secondary (unless used instead of criterion D5C5): The species composition and relative abundance of macrofaunal communities reach values indicating that there is no adverse effect due to nutrient and organic enrichment.	There is no cause-and-effect relationship.
D6	**The integrity of the seabed** *Physical loss of the seabed (including tidally bounded areas).*	D6C1 – Primary: Spatial extent and distribution of physical loss (permanent change) of the natural seabed.	No. The project will not affect the integrity of the seabed on the territory of the Republic of Bulgaria
		D6C2 – Primary: Spatial extent and distribution of pressures associated with physical disturbances exerted on the seabed	No. The project will not affect the integrity of the seabed on the territory of the Republic of Bulgaria
	The integrity of the seabed *Large benthic habitat types or other habitat types as used in descriptors 1 and 6.*	D6C3 – Primary: The extent in space of each type of habitat negatively affected by physical disturbances through the changes produced at the level of the biotic and abiotic structure and its functions.	No. The project will not affect the integrity of the seabed on the territory of the Republic of Bulgaria
D7	**Hydrographic changes** *Hydrographic changes of the seabed and water column (including tidally bounded areas)*	D7C1 – Secondary: Spatial extent and distribution of permanent change in hydrographic conditions (eg, changes related to wave action, currents, salinity, temperature) of the seabed and water column, particularly associated with physical loss (1) of the seabed natural.	No. The project will not produce hydrological changes on the territory of the Republic of Bulgaria.

Descriptor		Criteria[51]	The impact of the Neptun DEEP project in a cross-border context
	Hydrographic changes *Hydrographic changes of the seabed and water column (including tidally bounded areas)*	D7C2 – Secondary: Spatial extent of each benthic habitat type adversely affected (physical and hydrographic features and associated biological communities) due to permanent alteration of hydrographic conditions.	No. The project will not produce hydrological changes on the territory of the Republic of Bulgaria.
D8	**The concentrates contaminate**	D8C1 – Primary: Inside coastal and territorial waters, contaminant concentrations do not exceed established limit values contaminate[52] 1. Heavy metals in water, sediments, biota 2. Synthetic pollutants in water, sediments, biota 3. Polynuclear aromatic hydrocarbons in water, sediments, biota 4. Radionuclides in water.	Potential effects caused by an unplanned event such as accidental pollution may occur The risk of water contamination with natural radionuclides is not estimated.
D9	**Contaminant concentrations in fish** *Pb, Cd, Hg, PAH Polycyclic aromatic hydrocarbons (PAHs), sum of dioxins (WHOPCDD/F-TEQ) and sum of dioxins and dioxin-like PCBs (WHOPCDD/F-PCBTEQ), PCBs 28, 52, 101, 138,153, 180, Benzo-apyrene, Radionuclides*	D9C1 – Primary: Level of contaminants in edible tissues (muscle, liver, roe, meat or other soft parts, as appropriate) of seafood (including fish, crustaceans, mollusks, echinoderms, algae and other marine plants) caught or harvested in the environment natural (exclusively finned fish) do not exceed the limits: heavy metals, polychlorinated biphenyls, organochlorine pesticides, polycyclic aromatic hydrocarbons.	Potential effects caused by an unplanned event such as accidental pollution may occur. The risk of water contamination with natural radionuclides is not estimated.

52 ANEMONE Deliverable 1.3, 2021. "Black Sea monitoring and assessment guideline", Todorova V. [Ed], Ed. CD PRESS, 190 pp., http://www.blacksea-commission.org/Downloads/ANEMONE/Deliverable%201.3.pdf

Descriptor		Criteria[51]	The impact of the Neptun DEEP project in a cross-border context
D10	**Waste** *Waste (except micro-waste), classified into the following categories (1): artificial polymer materials, rubber, cloth/textiles, paper/cardboard, processed/processed wood, metal, glass/ceramics, chemicals, unspecified and food waste.*	D10C1 – Primary: The composition, quantity and spatial distribution of litter on coastlines, in the surface layer of the water column and on the seabed are at levels that do not affect the coastal and marine environment	No impact. The generated waste is transported on the territory of Romania, to authorized economic operators.
	Waste *Micro-waste (particles < 5 mm), classified as "artificial polymer materials" and "other*	D10C2 – Primary: The composition, amount and spatial distribution of micro-debris on coastlines, in the surface layer of the water column and in the seabed, sediment are at levels that do not affect the coastal environment and are large.	No impact.
D10	**Waste** *Waste and micro-waste in the categories "artificial polymer materials" and "other", assessed on any species in the following groups: birds, mammals, reptiles, fish or invertebrates*	D10C3 – Secondary: The amount of waste and micro-waste ingested by marine animals is at a level that does not adversely affect the health of the species concerned.	No impact.
	Species of birds, mammals, reptiles, fish or invertebrates that are at risk from the waste	D10C4 – Secondary: The number of specimens of each species that are adversely affected by the waste, for example by entrapment, other types of injury or mortality or health effects	No impact.

Descriptor		Criteria[51]	The impact of the Neptun DEEP project in a cross-border context
D11	**Energy and noise** *Impulsive anthropogenic noise in water.*	D11C1 – Primary: The spatial distribution, temporal dimension and sources of anthropogenic impulsive noise do not exceed levels that adversely affect marine animal populations	During the installation of the Neptun Alpha Platform Jacket, the generated noise is of an impulsive type and according to the modelling, the noise will also propagate on the territory of Bulgaria. Potential effects caused by exposure to underwater noise of marine mammals and fish may occur, namely, disruption of species activity
	Energy and noise *Continuous low-frequency anthropogenic sound in water.*	D11C2 – Primary: Spatial distribution, temporal dimension and continuous low-frequency anthropogenic sound do not exceed values that adversely affect marine animal populations.	During the works carried out in the marine area, the noise generated is of a continuous type and according to the modelling, the noise will also propagate on the territory of Bulgaria. Potential effects caused by underwater noise exposure of marine mammals and fish may occur, namely, disruption of species activity.

Status descriptors

The descriptors associated with biodiversity (D1), marine food webs (D4) and seabed integrity (D6) are closely related. The objectives of the three descriptors are to maintain biodiversity at species, population and habitat levels and to ensure that ecosystem structures and functions are supported.

Potential impacts on species and habitats in a transboundary context include underwater noise impacts and accidental oil spills.

It is estimated that the potential risk of affecting the integrity of the seabed on the territory of the Republic of Bulgaria is negligible.

The potential impacts on the environmental targets for descriptors 1,4 and 6 are assessed as not affecting the achievement of good environmental status for this descriptor as defined by its objectives.

Descriptor 2 – Introduction of non-indigenous species

The Neptun Deep project has the potential to introduce non-native species through the traffic of vessels used in construction, operation and decommissioning, as well as through colonization along the gas production pipeline and underground infrastructure. Introduction of non-native species has the potential to threaten native species through competition for food and space. The impact will be local and there will be no impact in a cross-border context.

Therefore, it can be concluded that the Neptun Deep project will not affect the achievement of the targets or long-term objective of good ecological status for Descriptor D2.

Descriptor 3 – Populations of all fish and crustaceans exploited for commercial purposes

The implementation of the project may lead to potential effects caused by the disruption of the activity of the species but without affecting the size of the population through the underwater noise generated as well as, in the event of an unplanned event of accidental hydrocarbon pollution.

Impacts in a transboundary context during construction and operation (individually or cumulatively) will not result in significant impacts on fishing levels, fertility and/or stocks, age and size distribution.

Thus, it can be concluded that the Neptun Deep project will not affect the achievement of the targets for commercial fish and shellfish in the Republic of Bulgaria, nor will it affect the achievement of the long-term objective of good ecological status for the D3 descriptor.

Descriptor 5 – Eutrophication

There will be no impact on descriptor 5, eutrophication, and it is stated that the project will not affect the achievement of good environmental status for this descriptor as defined by its objectives**.**

Descriptor 7 – Hydrographic changes

Both during the construction stage and during the operational period of the Neptun Deep Project, there will be no hydrographic changes in a transboundary context.

Therefore, it can be concluded that the Neptun Deep project will not affect the achievement of the targets or long-term objective of good ecological status for Descriptor D7.

Descriptor 8 – Contaminant concentrations

Unplanned events such as accidental fuel spills can lead to increased concentrations of contaminants in a transboundary context. The probability of such an event occurring is low. The risk of accidental fuel spillage can be prevented by applying accident prevention measures. Also, by applying the intervention plans in case of accidental pollution, the spread of the layer is limited and thus the cross-border impact is prevented.

Thus, it can be concluded that the Neptun Deep project will not affect the achievement of the contaminant concentration targets, nor will it affect the achievement of the long-term objective of good ecological status for the D8 descriptor.

Descriptor 9- Contaminant concentrations in fish

Potential accumulations in the tissues of marine organisms of certain concentrations of contaminants may occur in those marine organisms that would be in the area of incidence, as a result of a major

pollution accident at Neptun Deep. The concentration of contaminants in fish and other seafood will only occur as a result of a major fuel spill.
It is assessed that the potential risk of increasing the level of contaminants in fish and other seafood for human consumption is negligible, given the low probability of a fuel spill accident occurring.
Potential impacts on the environmental targets for descriptor D9, contaminants in fish and other seafood for human consumption, are assessed not to affect the achievement of good environmental status for this descriptor as defined by its targets.

Descriptor 10 Waste

There will be no impact on descriptor D10, waste, and it is stated that the project will not affect the achievement of good environmental status for this descriptor as defined by its objectives.

Descriptor 11 Energy and noise

The construction works associated with the Neptun Deep project will generate both impulsive and continuous noise. According to the modelling, the noise might also propagate on the territory of Bulgaria, but the estimated underwater noise level will not have a significant impact on marine mammals and fish, due to the mitigation's measures implemented, such as soft start techniques.

Therefore, it can be concluded that the Neptun Deep project will not affect the achievement of the targets or long-term objective of good ecological status for Descriptor D11.

6.4 EVALUATION OF THE CUMULATIVE EFFECT

The currently active oil companies that have carried out exploration and exploitation activities in the Black Sea are OMV Petrom, Black Sea Oil & Gas, Lukoil Overseas.

Based on publicly available information, 21 drilled wells have been identified, of which 5 are in operation, 16 wells are abandoned/preserved following exploration, as shown in Table 6.173

Table 6.152 List of drilled wells and planned wells

Company	Block name	Name of probe	Date of exploration	Distance to drilling centers in ND(km) project		
				PSDC1	DODC1	DODC2
ExxonMobil Exploration and Production Romania Limited Nassau (Bahamas), Bucharest Branch and	XIX Neptun	Califar 1	2015	36.1	30	34.62
	XIX Neptun	Delfin 1	2015	32.2	35.38	38.75
	XIX Neptun	Domino 1	2011	24.43	1.76	3.68
	XIX Neptun	Flamingo 1	2015	71.14	46.46	48.85
	XIX Neptun	Pelican Sud 1	2014	3.05	22.4	20.22
	XIX Neptun	Domino 2	2014	24.05	9.75	4.66

OMV Petrom S.A	XIX Neptun	Pelican Sud1	2015	3.7	21.82	20.82
	XIX Neptun	Domino1	2015	25.31	4.47	2.54
Black Sea Oil & Gas	EX-25 Luceafarul	Ovidiana-1		67.8	88.87	84.74
	EX-25 Luceafarul	Madalina-1	2015	74.6	92.23	87.78
	XV Midia	Iulia	2015	46.84	69.63	66.51
	XV Midia	Paula		34.46	57.98	56.5
	XV Midia	Ana 100	2018	50.51	68.52	63.76
	XV Midia	Ana 101	2018	50.51	68.52	63.76
	XV Midia	Ana 102	2018	50.51	68.52	63.76
	XV Midia	Ana 103	2018	50.51	68.52	63.76
	XV Midia	Doina 100	2018	39.7	61.75	57.56
Lukoil Overseas	EX-29 Rapsodia	Elena	November 2014	44.01	54.67	57.55
	EX -30 Trident	Daria	2015	42.11	48.86	51.9
	EX -30 Trident	Lira	2015	42.96	38.41	43.15
	EX -30 Trident	Trinity	2018	55.98	47.07	52.06

Their location relative to the NP project is shown in the figure below.

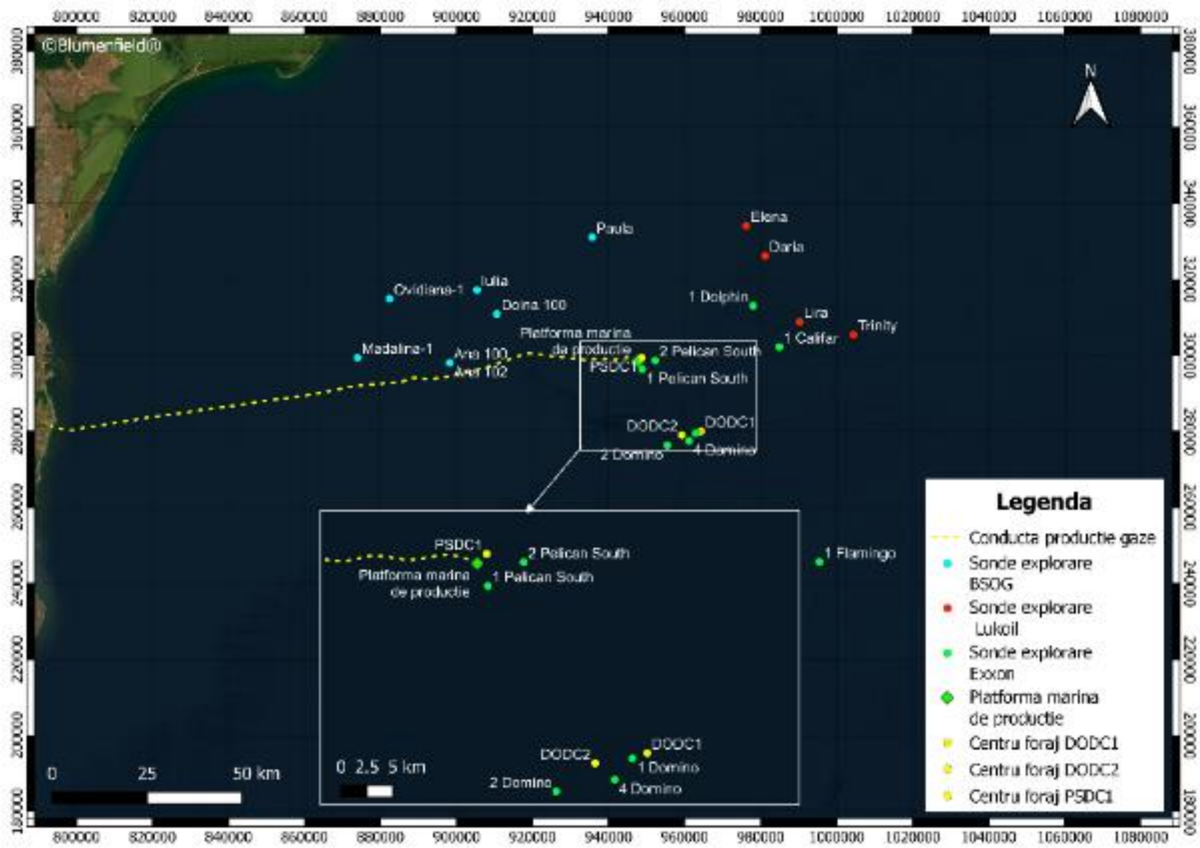


Figure 6.139 Drilled wells and planned drilling wells identified from available information.

The cumulative impact between the Neptun Deep project and the abandoned wells from the exploration campaigns of active companies is negligible.

The cumulative impact of the activity carried out by Black Sea Oil & Gas company is assessed in the section below.

It is estimated that no impact will occur in the transboundary context due to the potential cumulative impact between the existing abandoned wells and the assessed project, during both construction and operation phases.

6.4.2 Planned projects that can generate cumulative impact with the Neptune Deep project.

The identification of planned and existing projects that can have a potential cumulative impact with the Neptun Deep is presented in Section 2.2.10. The figures 6.140 and 6.141 indicate the location of the existing and planned projects, which can generate a cumulative impact with the Neptun Deep.

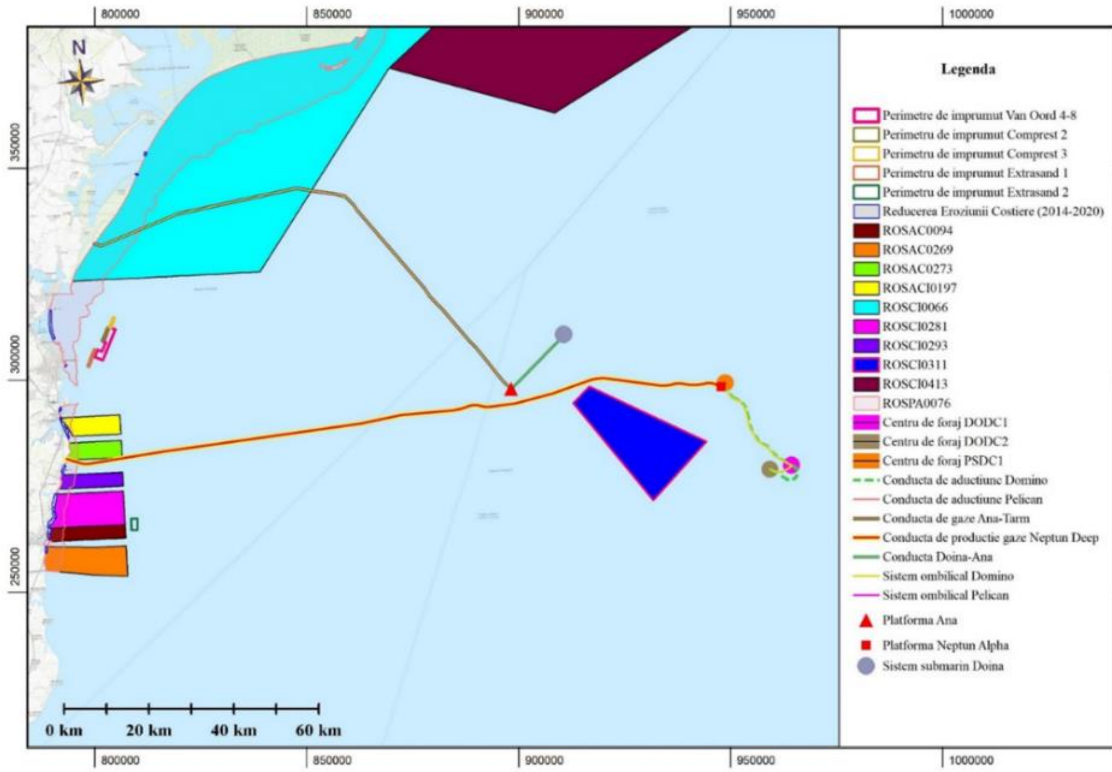


Figure 6.140 Projects or elements thereof that may generate cumulative impact together with the project studied in the marine area.

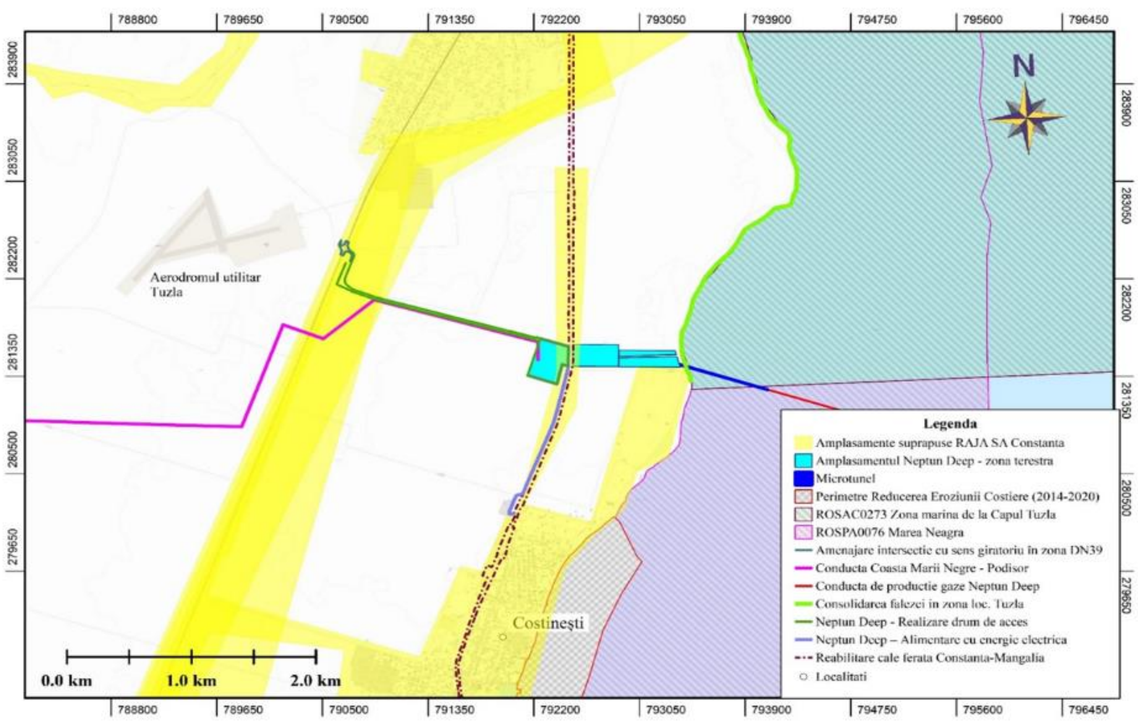


Figure 6.141Projects or elements thereof that can generate cumulative impact together with the project studied in the terrestrial area

Table 6.153 Assessment of cumulative impacts with existing and planned projects

No.	Name of existing/planned project	Activity carried out	Distance from the Neptune Deep project	Potential effects Generated	Potential impact assessment
1	Coastal erosion reduction Phase II (2014-2020) Holder: Romanian Waters National Administration – Dobrogea-Seaside Water Basin Administration Constanta (ABADL)	Building and expanding beaches to adapt to climate change, prevent and manage risks through protection against coastal erosion. The project is ongoing.	The nearest sanding perimeter is the Costinesti area at approx. 1.2 km from the land area of the project and approx. 1.5 km from project marine area. The sanding perimeter in the Costinesti area intersects ROSPA0076 the Black Sea In the vicinity (5-28 m) ROSCI0293 Costinesti-23 August	Turbidity Noise Presence of vessels Biodiversity	Temporary indirect disturbance of habitats 1110 and 1170 in the site ROSCI0293 Costinesti – 23 August. According to the project assessment, the site ROSAC0273 the Cape Tuzla Marine Area will not be affected/impacted. Temporary disturbance of fish and marine mammal species due to noise generated by excavation work. Temporary damage to feeding areas for fish, marine mammals and waterfowl. Thus, the cumulative impact generated by underwater noise is assessed to be negative, direct, local, short-term and of low intensity resulting in a small magnitude. If the work on the two projects will be carried out simultaneously, a medium sensitivity with a small negative magnitude is estimated, resulting in a minor cumulative impact. In the operation and decommissioning phase of the

No.	Name of existing/planned project	Activity carried out	Distance from the Neptune Deep project	Potential effects Generated	Potential impact assessment
					studied project, the impact is negligible. It is estimated that no impact will occur in a transboundary context due to the potential cumulative impacts resulting from the construction of and beach extension and the project studied during both the construction and operational periods
2.	Waterfront consolidation works in the area of Tuzla, Constanta County. Holder: Romanian Waters National Administration – Dobrogea-Seaside Water Basin Administration Constanta (ABADL)	Preventing the expansion of landslides and increasing tourist attractiveness in the coastal sector of Tuzla commune. Currently, works are suspended due to a dispute between ABADL and Tuzla City Hall.	The waterfront consolidation works will be carried out on the cliff located along the eastern part of the onshore site of the project, at a distance of approx. 20 m The microtunnel related to the Neptun Deep project will undercross the cliff area, being drilled into the rock layer under the cliff, > 2 m deep, thus not affecting the cliff or its consolidation works. It intersects with ROSAC0273 Cape Tuzla	Changes in sedimentary substrate Noise Turbidity Pollutant emissions in air Biodiversity	Disturbance of waterfowl in the resting area (Tuzla beach) The simultaneous deployment of the two projects will lead to increased emissions of pollutants into the air, increased underwater noise and environmental noise, and suspension of sediment in the water column. Thus, the cumulative effect generated by underwater noise, turbidity is assessed to be negative, direct, local, short-term and of low intensity leading to a small magnitude A medium sensitivity and low negative magnitude resulting in a minor cumulative impact shall be estimated. In the operation and decommissioning phase of the

No.	Name of existing/planned project	Activity carried out	Distance from the Neptune Deep project	Potential effects Generated	Potential impact assessment
			Marine Area ROSPA0076 the Black Sea In the vicinity (3.5 km) ROSCI0293 Costinesti-23 August		studied project, the impact is negligible. It is estimated that no impact will occur in a transboundary context due to the potential cumulative impacts resulting from the construction of and beach extension and the project studied during both the construction and operational periods
3.	Regional project for the development of water and wastewater infrastructure in the operating area of SC RAJA SA Constanta Holder: RAJA SA Constanta	Rehabilitation and extension of distribution and sewerage networks, rehabilitation of wastewater pumping station and wastewater discharge pipes in Tuzla, Constanta County.	The analyzed project intersects with the RAJA site in the railway area. The project also includes the rehabilitation of a 500 mm discharge pipeline crossing from south to north the S3 area owned by OMV Petrom at the project site, by removing the old water pipe and installing a new pipeline along the local road De 277. The onshore section of the production pipeline and fiber optic cable related to the Neptun Deep project will	Emissions of pollutants to air	The simultaneous deployment of the two projects will lead to increased emissions of pollutants into the air. They will not affect protected natural areas: ROSAC0273 the marine area at Cape Tuzla, ROSCI0293 Costinesti – August 23, ROSPA0076 the Black Sea Disturbance of waterfowl in the resting area (Tuzla beach) Therefore, the cumulative effect generated by the project construction works is assessed to be negative, direct, local, short-term and of low intensity and the magnitude will be small A medium sensitivity and low negative magnitude resulting in a minor cumulative impact shall be estimated.

No.	Name of existing/planned project	Activity carried out	Distance from the Neptune Deep project	Potential effects Generated	Potential impact assessment
			undercross the location area of the new RAJA unloading pipeline In the vicinity of ROSAC0273 the Marine Zone at Cape Tuzla, ROSCI0293 Costinesti-23 August, ROSPA0076 the Black Sea		In the operation and decommissioning phase of the studied project, the impact is negligible. It is estimated that no impact will occur in a transboundary context as a result of the potential cumulative impact resulting from the construction, rehabilitation and extension of distribution and sewerage networks and the project studied both during construction and operation;
4.	Midia Natural Gas Development Project Holders: Black Sea Oil & Gas SA in partnership with Petro Ventures Resources SRL and Gas Plus Dacia SRL	The project carries out activity and consists of exploitation of natural gas from the Black Sea and its processing on shore. The existing installations in the marine area consist of an underwater well at Doina and four production wells at Ana, an underwater production complex on the Doina field connected by an 18 km pipeline to the Ana production platform. A 121 km underwater pipeline will	The Ana production platform of the Midia Natural Gas Development Project is located approx. 49.5 km west distance from the production platform of the Neptun Deep project and approx. 3.5 km north of the production pipeline of Neptun Deep. It intersects with ROSPA0076 Black Sea About. 12.7 km from ROSCI0311 Brave Canyon.	Water Biodiversity Natural resources	No impact during the construction period. The depletion of natural resources represents a significant cumulative impact. Under the assumption of unplanned events (e.g. natural disasters – earthquakes, explosions, pipeline damage) that have a very low probability of occurrence given the design conditions of pipelines and underwater infrastructure and event protection barriers, the impact is estimated to be significant on water, marine biodiversity.

No.	Name of existing/planned project	Activity carried out	Distance from the Neptune Deep project	Potential effects Generated	Potential impact assessment
		ensure the transport of gas from the Ana platform to shore, where it follows 4.1 km of underground pipeline to the gas treatment plant.	About. 46 km from ROSAC0273 Cape Tuzla Marine Area About. 53 km to ROSCI0293 Costinesti-23 August.		
5.	Electrification and rehabilitation of Constanta Mangalia railway line Holder: National Railway Company CFR SA through SC Baicons Impex SRL	Rehabilitation and electrification of railway infrastructure on the railway section between Constanta and Mangalia The project has an estimated implementation time of 24 months, but no date is specified The project is under regulatory procedure	The railway to be rehabilitated intersects with the project area. In the Neptun Deep project, works are foreseen to undercross the gas production pipeline, and during the construction period a temporary level crossing with the railway will be arranged.	Emissions to air Ambient noise	The simultaneous deployment of the two projects will lead to increased emissions of pollutants into the air and increased noise levels. Therefore, the cumulative effect generated by the project construction works is assessed to be negative, direct, local, short-term and of low intensity and the magnitude will be negligible A small sensitivity of negligible magnitude is estimated, resulting in an insignificant impact In the operation and decommissioning phase of the studied project, the impact is negligible.

No.	Name of existing/planned project	Activity carried out	Distance from the Neptune Deep project	Potential effects Generated	Potential impact assessment
6.	Black Sea sand mining projects Holders: SC EXTRASAND PCM SRL, SC STRICT AQUASERV SRL, SC COMPREST UTIL SRL, SRL, SC METAL TRADE RNG SRL, SC VAN OORD DREDGING AND MARINE CONTRACTORS, ENVISAN NV BELGIUM - PITESTI BRANCH, SAGA LOGISTICS MANAGEMENT SRL, BOSKALIS INTERNATIONAL BV	Blocks of exploitation of the Black Sea nispi At different stages of regulation/deployment	They are located on the continental shelf in the exclusive economic zone of Romania at distances of more than 10 km from the marine area of the analyzed project. Over 2 km from ROSPA0076 Black Sea Over 7 km compared to ROSAC0273 Marine area at Cape Tuzla and ROSCI0293 Costinesti – August 23	Noise Biodiversity	Temporary disturbance of fish and marine mammal species due to noise generated by dredging works. Temporary damage to feeding areas for fish, marine mammals and waterfowl. Therefore, the cumulative effect generated by the construction works of the project, if the works are carried out simultaneously, is assessed to be negative, direct, local, short-term and of low intensity and the magnitude will be low. A medium sensitivity and low negative magnitude resulting in a minor cumulative impact shall be estimated. In the operation and decommissioning phase of the studied project, the impact is negligible. It is estimated that no impact will occur in a transboundary context due to the potential cumulative impact resulting from the exploitation of sand in the Black Sea both during the construction and operational periods

No.	Name of existing/planned project	Activity carried out	Distance from the Neptune Deep project	Potential effects Generated	Potential impact assessment
7.	Neptun Deep - Construction of access road, site organization, insurance and connection to utilities, access ways to them, related to SRM and CCR.	Construction of access road	The new permanent access road will support the construction and operation of the facilities of the Neptun Deep project. It will intersect with the site in the terrestrial area of the project analyzed on the surface S1	Noise Biodiversity	Temporary disturbance of waterfowl in ROSPA0076 resting on arable land. The cumulative effect generated by the construction works of the project is assessed to be negative, direct, local, short-term and of low intensity and the magnitude will be negligible. A small sensitivity of negligible magnitude is estimated, resulting in an insignificant impact. In the operation and decommissioning phase of the studied project, the impact is negligible. Road traffic will not cause mortalities in the case of conservation objectives of protected natural areas located in the vicinity.
8.	Arrangement of roundabout junction in the area of national road DN39 (E87) - km 23 + 190	Roundabout construction	The proposed roundabout will connect the proposed new access road for the Neptun Deep project with DN39. It is located approx. 1.6 km from the western limit of the S1 surface	No effects	No impact
9.	Neptun Deep – Power supply, site	Power supply	The proposed substation will provide electricity for	No effects	No impact

No.	Name of existing/planned project	Activity carried out	Distance from the Neptune Deep project	Potential effects Generated	Potential impact assessment
	organization, natural gas metering station and control center		the construction and operation of the onshore components of the Neptune Deep project (SRM, CCR, etc.).		
10.	Black Sea Coast - Podișor (RO) pipeline for Black Sea gas collection	construction of a pipeline to transport natural gas to the NTS The Black Sea Coast - Podișor (RO) pipeline will transport the gas produced during the operational phase of the Neptun Deep project, to the NTS in Romania.	A Transgaz facility connected to SRM within the Neptun Deep project will be built. The Transgaz connection point. (*installation that is not part of the Neptun Deep project, will be subject to a separate authorization procedure*) will be installed on the private land owned by OMV Petrom (area S1, cadastral number 109216).	Morphological changes in terrain Noise Pollutant emissions to air	The simultaneous deployment of the two projects will lead to increased emissions of pollutants into the air and increased noise levels. Therefore, the cumulative effect generated by the project construction works is assessed to be negative, direct, local, short-term and of low intensity and the magnitude will be negligible. A small sensitivity of negligible magnitude is estimated, resulting in an insignificant impact. In the operation and decommissioning phase of the studied project, the impact is negligible.

6.5 RESIDUAL IMPACT

The impact significance of the environmental factors has led to either recommending maintaining the insignificant impact level or to implement measures to prevent or reduce the impact. These recommendations and measures are detailed in the corresponding section of each environmental factor and are also summarized in the tables listed in Chapter 8, specifically tables 8.1 – 8.3.

The projected residual impact, taking into account the effects of implementing the proposed mitigation measures, is presented below:

Phase	Effects	Magnitude	Sensitivity	Impact	Mitigations measures	Residual impact
	Land use					
Construction	Change of land use	Negligible	Low	No impact	Recommendations for maintaining the insignificant impact	Insignificant
	Land and surface occupation of the marine substrate	Negligible	Low	No impact	Recommendations for maintaining the insignificant impact	Insignificant
Operation	Occupation of land and the surface of the marine substrate	Negligible	Low	No impact	Recommendations for maintaining the insignificant impact	Insignificant
Decommissioning	Release of the land as a result of the decommissioning of the project components	Positive	Low	Positive	-	Positive
	Soil and subsoil					
Construction	Excavation of topsoil	Medium	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	Physical changes in soil and subsoil stratification	Medium	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	Soil compaction and degradation	Medium	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	Introduction of non-native plant species with invasive	Negligible	Low	No impact	Recommendations for maintaining the insignificant impact	Insignificant
Operation	Occupation of the surface soil and the subsoil with constructions and underground installations	Low	Low	Minor	Recommendations for maintaining the insignificant impact	Minor

Phase	Effects	Magnitude	Sensitivity	Impact	Mitigations measures	Residual impact
Decommissioning	Excavation of topsoil	Medium	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	Physical changes in soil and subsoil stratification	Medium	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	Soil compaction and degradation of its structure	Medium	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	Introduction of non-native plant species with invasive potential	Negligible	Low	No impact	Recommendations for maintaining the insignificant impact	Insignificant
	Sedimentary substrate					
Construction	Physical disturbance at the level of the sedimentary layer	Negligible	Medium	Insignificant	Recommendations for maintaining the insignificant impact	Insignificant
	Changing the quality of the sediments as a result of the suspension and resedimentation process	Negligible	Medium	Insignificant	Recommendations for maintaining the insignificant impact	Insignificant
	Change in sediment quality as a result of the discharge of water-based drilling fluid at the level of the sedimentary substrate	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
Operation	Physical presence of underwater facilities	Negligible	Medium	Insignificant	Recommendations for maintaining the insignificant impact	Insignificant
	Local emissions of metal ions from sacrificial anodes that provide cathodic protection of the pipeline	Negligible	Medium	Insignificant	Recommendations for maintaining the insignificant impact	Insignificant
	Increasing the concentration of sediment quality parameters by sedimentation of chemical compounds from the planned discharged effluent	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor

Phase	Effects	Magnitude	Sensitivity	Impact	Mitigations measures	Residual impact
Decommissioning	Physical disturbance at the level of the sedimentary layer	Negligible	Medium	Insignificant	Recommendations for maintaining the insignificant impact	Insignificant
	Changing the quality of the sediments as a result of the suspension and resedimentation process	Negligible	Medium	Insignificant	Recommendations for maintaining the insignificant impact	Insignificant
	Water body					
Construction	Increasing turbidity in the water column	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
	Temporary increase of nutrients and possibly some pollutants present in sediments due to sediment suspension	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
	Impact of water quality through controlled discharge of effluents during the construction phase	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
	Effects on hydrographic conditions	Negligible	Medium	No impact	Recommendations for maintaining the insignificant impact	Insignificant
	Effects on hydrogeology	Negligible	Medium	No impact	Recommendations for maintaining the insignificant impact	Insignificant
	Routine discharges from vessels used in decommissioning	Negligible	Medium	No impact	Recommendations for maintaining the insignificant impact	Insignificant
Operation	Affecting water quality through the controlled discharge of effluents during the operating period	Medium	Medium	Moderate	Recommendations for maintaining the insignificant impact	Minor
	The presence of the natural gas transport pipeline	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
Decommissioning	Temporary increase in turbidity	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor

Phase	Effects	Magnitude	Sensitivity	Impact	Mitigations measures	Residual impact
	Routine discharges from vessels used in decommissioning	Negligible	Medium	No impact	Recommendations for maintaining the insignificant impact	Insignificat
	Air					
Construction	Emissions of pollutants in the onshore	Low	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	Emissions of pollutants in the offshore	Low	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	GHG emissions	Low	High	Moderate	Mitigation measures applied	Moderate
Operation	Emissions of pollutants in the onshore	Low	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	Emissions of pollutants in the offshore	Low	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	GHG emissions	Low	High	Moderate	Mitigation measures applied	Moderate
Decommissioning	Emissions of pollutants in the onshore	Low	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	Emissions of pollutants in the offshore	Low	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	GHG emissions	Low	High	Moderate	Mitigation measures applied	Moderate
	Noise					
Construction	Increasing the noise level in the onshore	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
	Increasing noise levels in the offshore	Medium	Medium	Moderate	Mitigation measures applied	Moderate
Operation	Increasing the noise level in the onshore	Negligible	Medium	No impact	Recommendations for maintaining the insignificant impact	Insignificant
	Increasing noise levels in the offshore	Negligible	Medium	No impact	Recommendations for maintaining the insignificant impact	Insignificant
Decommissioning	Increasing the noise level in the onshore	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor

Phase	Effects	Magnitude	Sensitivity	Impact	Mitigations measures	Residual impact
	Increasing noise levels in the offshore	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
	Radiation					
Construction	Light radiation emissions	Negligible	Low	No impact		Insignificant
Operation	Light radiation emissions	Negligible	Low	No impact		Insignificant
	Thermal radiation emissions	Negligible	Low	No impact		Insignificant
	Natural radionuclide emissions	Low	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	Material Goods and Natural Resources					
Construction	Damage to material goods	Low	Low	Minor	Mitigation measures applied	Nesemnificativ
	Use of the natural resources	Low	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
Operation	Use of the natural resources	Medium	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	Producing major accidents accompanied by explosions and/or fires that would spread and affect the material assets of the local community	Medium	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
Decommissioning	Damage to material goods	Low	Low	Minor	Mitigation measures applied	Insignificant
	Cultural heritage					
Construction	Affecting the cultural heritage	Negligible	Medium	No impact	Permit conditions for maintaining the insignificant impact	Insignificant
Decommissioning	Affecting the cultural heritage	Negligible	Medium	No impact	Permit conditions for maintaining the insignificant impact	Insignificant
	Landscape					
Construction	Change of land use	Negligible	Low	No impact	Recommendations for maintaining the insignificant impact	Insignificant

Phase	Effects	Magnitude	Sensitivity	Impact	Mitigations measures	Residual impact
	The drilling platform	Negligible	Low	No impact	Recommendations for maintaining the insignificant impact	Insignificant
Operating	Presence of NGMS and CCR	Negligible	Low	No impact	Recommendations for maintaining the insignificant impact	Insignificant
	The presence of the production platform	Negligible	Low	No impact	Recommendations for maintaining the insignificant impact	Insignificant
Decommissioning	Change of land use	Negligible	Low	No impact	Recommendations for maintaining the insignificant impact	Insignificant
	Human settlements					
Construction	Change of land use	Neglijable	Medium	No impact	Recommendations for maintaining the insignificant impact	Insignificant
Operation	Presence of NGMS and CCR	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
Decommissioning	Change of land use	Positive	Low	Positive		pozitiv
	Demography, the economic and social environment					
Construction	Demographic changes due to project works	Positive	Low	Positive		Positive
	Changes at the economy level	Positive	Medium	Positive		Positive
	The presence of vessels used in construction	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
Operation	Changes at the economy level	Positive	High	Positive		Positive
	The presence of the production platform	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
Decommissioning	Demographic changes due to project works	Positive	Medium	Positive		Positive
	The presence of vessels used for decommissioning	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
	Population health					
Construction	Increase in air pollutant emissions	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor

Phase	Effects	Magnitude	Sensitivity	Impact	Mitigations measures	Residual impact
	Increasing noise level	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
Operation	Increasing noise level	Negligible	Medium	No impact	Recommendations for maintaining the insignificant impact	Insignificant
Decommissioning	Increase in air pollutant emissions	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
	Increasing noise level	Low	Medium	Minor	Recommendations for maintaining the insignificant impact	Minor
	Biodiversity					
Construction	Onshore noise	Low	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	Top soil layer	Negligible	Low	Insignificant	Mitigation measures for maintaining the insignificant impact	Insignificant
	Roadkill	Low	Low	Minor	Mitigation measures for maintaining the insignificant impact	Minor
	Increased turbidity	Low	Medium	Minor	Mitigation measures for maintaining the insignificant impact	Minor
	Relocation of substrate with living organisms	Low	Medium	Minor	Mitigation measures for maintaining the insignificant impact	Minor
	Temporary and local increase in nutrients and possibly pollutants present in sediments due to sediment resuspension	Low	Medium	Minor	Mitigation measures for maintaining the insignificant impact	Minor
	Increased underwater noise	High	High	Major	Mitigation measures applied	Moderate
	Crushing and/or denudation of hard substrate populated with marine organisms as a result of the placement of ship anchors used for installation of the production pipeline	Low	High	Moderate	Mitigation measures for maintaining the insignificant impact	Moderate

Phase	Effects	Magnitude	Sensitivity	Impact	Mitigations measures	Residual impact
	Artificial lighting	Low	Low	Minor	Mitigation measures for maintaining the insignificant impact	Minor
Operation	Emissions to offshore marine waters of chemical compounds that have the potential to affect the aquatic environment	Medium	High	Moderate	Mitigation measures for maintaining the insignificant impact	Moderate
	Increased noise level during depressurization	Low	Low	Minor	Recommendations for maintaining the insignificant impact	Minor
	Artificial lighting	Low	Low	Minor	Mitigation measures for maintaining the insignificant impact	Minor
Decommissioning	Increased noise levels onshore	Low	Low	Minor	Mitigation measures for maintaining the insignificant impact	Minor
	Temporary and local increase in nutrients and possibly pollutants present in sediments due to sediment resuspension	Low	Medium	Minor	Mitigation measures for maintaining the insignificant impact	Minor
	Increased underwater noise	Medium	Medium	Moderate	Mitigation measures for maintaining the insignificant impact	Moderate
	Artificial lighting	Low	Low	Minor	Mitigation measures for maintaining the insignificant impact	Minor

6.6 CONCLUSION RELATED TO NEPTUN DEEP ENVIRONMENTAL IMPACT

Based on the data, information, and documents provided by the project's titleholders to Blumenfield®, combined with the data collected on the field investigations stage, taking into account the current state of the environmental, as well as the impact of project activities and their effects on environmental and socio-economic factors, while adhering to the project and technical execution standards, along with mitigation measures on environmental factors set through this document, the impact is assessed to be within acceptable limits.