Coastal Research and Planning Institute

Summary of Environmental Impact Assessment Programme for the Installation and Operation of the Offshore Wind Farm of up to 700 MW Installed Capacity in Lithuania's Marine Territory

Year of the document:	2021
Organiser (Developer) of the proposed economic activity	**Ministry of Energy of the Republic of Lithuania**
Developer of the Environmental Impact Assessment Programme:	**Public Institution Coastal Research and Planning Institute**

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ABBREVIATIONS

EPA	Environmental Protection Agency
RES	Renewable energy sources
MoE	Ministry of the Environment
IHPA	Important Habitat Protection Area
CPTRL	Comprehensive Plan of the Territory of the Republic of Lithuania
EC	European Commission
MSFD	Marine strategy framework directives
LR	Republic of Lithuania
LRS	Seimas of the Republic of Lithuania
LRV	Government of the Republic of Lithuania
MW	Megawatts
IBPA	Important Bird Protection Area
EIA	Environmental Impact Assessment
PHIA	Public Health Impact Assessment
PEA	Proposed economic activity
SEA	Strategic Environmental Assessment
TS	Transformer substation
WT	Wind turbine

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2. INFORMATION ON THE NATURE OF PROPOSED ECONOMIC ACTIVITY

2.1. Title of the proposed economic activity

Proposed economic activity – installation and operation of the offshore wind turbine (hereinafter – WT) farm of up to 700 MW installed capacity in the Lithuanian marine territory of the Baltic Sea approved by the Resolution of Government of Republic of Lithuania (hereinafter – LRV).

The specification for the procurement of document preparation services for the environmental impact assessment procedures for the wind turbines to be deployed in Lithuania's marine territory defines the PEA as the totality of offshore wind turbines, their foundations, and electricity transmission system up to the offshore substation, including the offshore transformer substation.

Electricity will be generated in the WT farm by means of the offshore WTs and by transmitting the energy produced to the electricity network.

2.2. Type of activity and indication whether the proposed activity is listed in Appendix I to the UN Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention)

Convention of the United Nations Economic Commission for Europe on Environmental Impact Assessment in a Transboundary Context (hereinafter – the ESPOO Convention) prescribes that a transboundary EIA is to be carried out when the PEA is listed in Appendix I to the ESPOO Convention.

Pursuant to Decision III/7 "Second Amendment to the ESPOO Convention" of 04/06/2004, major installations for the harnessing of wind power for energy production (wind farms) are included in Appendix I to the Convention.

On the basis of the powers granted under the Paragraph 1 of the Resolution of the Government of the Republic of Lithuania no. 900 of 28 July 2000 "On Granting of Powers to the Ministry of Environment and Its Subordinate Institutions," the transboundary EIA process is coordinated by the Ministry of Environment.

The distance from the PEA to the Latvian EEZ is about 2.8 km, to the Swedish EEZ – about 77 km, and to the Russian EEZ – about 40 km.

2.3. Description of the proposed activity

It is planned to install the offshore WT farm up to 700 MW total installed capacity in the marine territory of the Baltic Sea approved by the LRV Resolution.

Taking into account the development trends of WT high technologies, technical solutions of existing wind farms in the Baltic and North seas, and the economic efficiency aspect related to the implementation of these high technologies, the initial assessment phase will involve negotiations on 8 MW to 16 MW offshore wind turbine models, currently available on the market, for the installation of the proposed WT farm of up to 700 MW installed capacity. During the implementation of this offshore wind farm project, wind farms with a capacity of up to 20 MW or more can be expected. The height of such offshore WT may vary, but not limited to, from 140 m to 300 m; the number of such turbines in the proposed territory may be approximately 87 to 43 pcs (but not limited to), subject to the model capacity. The WT model, layout in the territory, and the number thereof, to be used for the environmental impact assessment, will be specified after the detailed wind strength measurements which are scheduled for 2022.

In that regard, the EIA report will include the assessment of several various alternatives for the offshore wind farm deployment in the proposed territory, the construction, operation, and dismantling of the offshore WTs of different heights and installed capacities to best (most efficiently) meet natural conditions in the selected area.

Based on the selected capacity of the WT, a potential significant effect of the number, physical and technical characteristics, and location of the offshore WTs on various components of the environment and public health in the approved territory will be examined. As part of the analysis of the alternatives, a scale of effect of the installed offshore wind farm on various components of the environment and public health has been assessed; essential measures to reduce the effect of installation, operation, and dismantling have been envisaged.

Taking into account solutions under the Engineering Infrastructure Development Plan for Marine Areas of Lithuania's Territorial Sea and/or the Exclusive Economic Zone of the Republic of Lithuania in the Baltic sea, Designed for the Development of Renewable Energy and with a view of using the entire territory most efficiently, peripheral wind turbines are planned to be constructed at the cable protection zone (100 m) from the boundaries of the territory, by planning the entire power plant layout grid, accordingly.[1]

Wind turbines

A wind power turbine consists of three main components: a gondola, with an embedded turbine, a rotor, with spinning blades, and a tower, with its foundation.

A *gondola* is fitted with the WT's main components (generator, gearbox, and control cabinet) which run the generator and transform the rotor's rotation energy into the three-phase variable electric power.

WT blades spin the rotor which transforms the kinetic energy of wind into the rotary energy and transmits it to a gearbox which actuates a generator.

[1] https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.416425

A *tower* is bearing tubular steel structure, the housing of which is equipped with a shaft, designed for gondola service and energy transmission, and a power transformer, which equalises a variable electrical energy and transmits it to the substation.

Wind Turbine Foundation Structures

A specific type of a WT foundation to be chosen depends on a manufacturer's requirements, as well as on geological and hydrodynamic conditions of the proposed location.

Monopile structures are used at depths up to 50 m. Piles are driven up into the seabed until the required insertion depth is reached, which depends on geological and hydrodynamic conditions. Such foundation affects the minimal area of the bottom; however, pile-driving works cause noise. The effect is short-time, however, due to its high intensity and wide-spread occurrence during the installation of the foundation, is quite significant for living organisms that have and use their hearing organs for communication. Because of the type of structure, local bottom depression may occur, while the seabed may become an artificial reef for marine organisms.

Tripods are used in intermediate-depth waters (20–80 m) and consist of three 'legs' connected to the service core which is bearing the WT foundation. Each leg of the tripod is attached to the bottom using a separate pile. Due to a relatively wider structure, pile penetration into the seabed is smaller. The effect on the seabed is combined, i.e., similar to the effect of the mono-pile and gravity-based structures.

Jacked foundations vary – they may have three or four corner piles. The structure itself is permeable, therefore, it fits well for 20 to 50 m depths. It is exposed to lower wave-impact loads. This is a highly reliable structure (though, expensive) which is rather widely used for construction of offshore platforms or offshore transformers substations.

Gravity-based foundation is used in shallow waters (0–30 m) and consists of a big and heavy steel or concrete base which is lowered right onto the seabed. A base of such type of foundation is large-sized and, as a result, affects the largest possible area of the bottom, facilitates the formation of artificial reefs, and may cause much more serious destructions of local benthic communities.

The choice of foundation determines what area of natural substrate will be affected during the construction of the foundation and how hydrodynamic conditions of the proposed location will change.

The choice of the type of offshore WT foundation will depend on the depth, geological and hydrodynamic conditions of the seabed to be installed. The type of foundation will be chosen by the developer after detailed research of the seabed during the preparation of the technical design of the WT farm. Only then the developer will choose the most appropriate and effective solution for the specific park and bottom conditions.

Electricity Transmission Solutions

A chain of medium and high voltage electrical power lines, step-up transformers, and substations is necessary so that to transform and transmit the generated electricity to the grids managed by the electricity transmission system operator LITGRID AB. Connection of the offshore transformer substation to the onshore one is not proposed or considered under the this EIA.

In seas and oceans, energy is transported and communication is maintained via subsea cables. As the capacity of wind farms and distances between power plants increase, 33 kV submarine cables, which had been used so far, no longer provide adequate throughput power.

The 66 kV voltage is planned and offered by the market to use for submarine cables, transformers, and switchgears[2], the use of 132 kV cables may be considered in the future. An exact number of WTs and cable lines in each and the voltage used is to be specified during the technical design.

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[2]https://www.tennet.eu/fileadmin/user_upload/Our_Grid/Offshore_Netherlands/Consultatie_proces_net_op_zee/Technical_Topics/4_T1._Enclosure_nr_1b_-_66_kV_systems_for_Offshore_Wind_Farms_by_DNV_GL.pdf

https://search.abb.com/library/Download.aspx?DocumentID=9AKK107046A1094&LanguageCode=en&DocumentPartId=&Action=Launch

Cable Line Laying Technology

Cable lines interconnecting the WTs and a WT with a transformer substation are recessed 1-2 m into the seabed. The technical design provides a solution of whether and/or which sections will need additional protection against physical flushing/exposure.

Installation Solutions for the Offshore Transformer Substation

The TS is designed to accumulate the power generated by the entire wind farm, to transform it, and to transmit electricity to grids. A TS is usually built in the centre of the generated power or in another location suitable for bringing medium and high voltage cable lines. Step-up transformer substations do not occupy much space in the PEA territory:[3] Dimensions of the TS foundation is similar to the one of the WT.

The choice of substation location is influenced by:

- Sea depth: construction is more cost efficient in shallower waters;
- Lengths of medium-voltage cables and energy losses in them: most cost-efficient location for the substation is a centre of generating sources;
- Proposed high-voltage connections with onshore and other wind farms;
- Additional wind turbulence caused by a substation as a structure.

The technical design will specify the need for step-up (intermediate) transformer substations and the electrical network connection scheme.

The Main Proposed Wind Farm Installation Works

During the construction phase, WT components are delivered to the construction site and assembled. The main offshore WT installation works:

- Foundation installation;
- Tower erection;
- Nacelle installation;
- Blade mounting;
- Power cable line laying within the wind farm;
- Connection of WTs to the electricity transmission system.

After the foundation has been installed at the bottom of the sea, power transmission cables are connected to it; foundation is reinforced.

The tower is erected on the installed foundation using foundation bolts. Before erecting the wind tower, horizontality of the foundation surface must be ensured.

WTs are connected and electricity is transmitted using special submarine cables. Cable laying trenches are dug in the seabed. A cable is laid in the dug-out trench using a special vessel. The cable is pulled ashore using boats and an excavator.

Power transformers, control/surveillance system are usually arranged in the power substation.

Power transmission cables are laid from WTs to the offshore power substation. WTs are connected to the power substation using submarine cables. The installed WT foundations are connected via the power transmission cables. The foundation structure is fitted with wind tower components, a rotor is suspended, and a transformer is installed. WTs are furnished with lightning-conductors, a remote surveillance & control system.

Ready-to-install WT components (upper and lower parts of the tower, blades) are loaded onto the ship using a crane and transported to the construction site.

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[3] https://www.nordseeone.com/engineering-construction/offshore-substation.html

Operation Phase

The operation phase must include the maintenance, repairs, and inspections of WTs. The safety of inspection and repair staff, arriving at the WTs, is crucial at this phase. With this aim in view, a secure outfit and procedure for access to the WTs must be selected.

Maintenance of wind farms may engage small ships which might easily approach and moor next to the WT and the service staff of which might have safe access to the WT service platform.

Dismantling Phase

The sequence of WT dismantling operations is opposite to the construction one: dismantling of power supply infrastructure; rotor disassembly; gondola and tower disassembly, and (partial) WT foundation demolition.

The main dismantling works:

- Removal of turbine lubricants and other potentially hazardous substances;
- WT cut-off from internal power cables;
- Dismantling, extraction, and removal of power cables onshore using barges and special equipment;
- Dismantling and removal of WT components: blades, gondolas, tower;
- Demolition of foundation: dismantling of foundation components, extraction from water, and removal of them onshore. In case of mono-pile foundation, it is cut off below the bottom level after a sand layer is removed.

All parts of the WTs are shipped onshore and delivered for reuse, recycling, or recovery. All parts of the WTs, except for fibreglass (blades), are subject to recovery.

2.4. Scale of the proposed activity

It will be built up with an offshore wind farm of 700 MW installed capacity. The total area of the PEA territory is 137.5 km^2.

Construction of the WTs in the marine territory will involve certified products that meet the EU requirements. Only the installation of separate equipment will be performed on site; this will require preparatory works and, later, WT operation works.

The PEA does not provide for any use or storage of hazardous substances or mixtures, radioactive agents, hazardous or non-hazardous waste.

Scope of Use of Natural Resource

Wind energy will be used to produce electricity. Pursuant to the Law of the Republic of Lithuania on Energy from Renewable Sources, *wind power means air movement energy used for generation of energy*.

2.5. Time-frame for proposed activity

EIA for wind energy far installation was started in the beginning of the Augusto of 2021. The estimated duration of the environmental impact assessment is two years, up to the August of 2023. After the finishing of EIA procedures, including transboundary consultations, and obtaining the decision of EIA in accordance with the draft Law on Renewable Resources Energy, a tender for a permit for development and operation is scheduled for 2023-09 and will end in 2024-02/03 months. A WT farm developer will be selected in the tender to develop the project.

After the tender, a maximum of 3 years is granted for obtaining a building permit (theoretically until 2027) and a maximum of 3 years for obtaining a permit to generate electricity (theoretically until 2030), i.e. since winning the tender in 2024 – maximum construction period can take a six years.

3. INFORMATION ON THE TERRITORY OF THE PROPOSED ECONOMIC ACTIVITY

The WTs are proposed to be installed in the marine territory of the Baltic Sea approved by the LRV Resolution where a tender (tenders) for the development and operation of power plants using renewable energy sources is (are) expedient by 2030.

The main characteristics of the territory:

- Area: 137.5 km^2;
- Average depth: 35 m;
- Distance from Klaipeda Seaport: from 38 km;
- Average wind speed: approx. 9 m/s (obtained by mathematical modeling (100 m above sea level)).

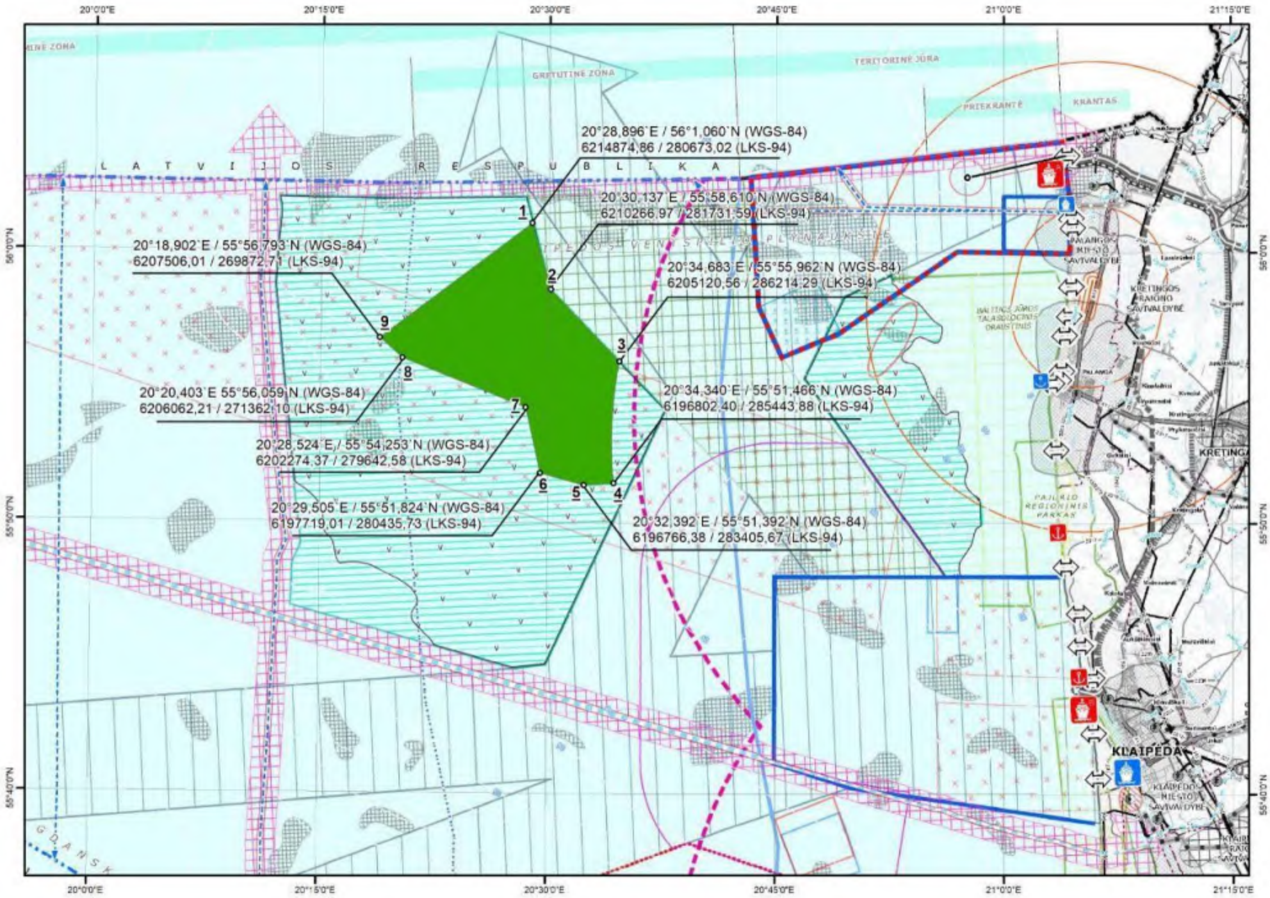

Fig. 3.1. The PEA territory in the Baltic Sea approved by the LRV Resolution.

Table 3.1. Coordinates of the territory approved by the LRV Resolution

Territory point no. (see Fig. 2.1.)	Coordinates	
	according to the World Geodetic System 1984 (WGS–84)	according to the Lithuanian Coordinate System 1994 (LKS–94)
1	20°28,896`E 56°1,060`N	X-6214874,86; Y-280673,02
2	20°30,137`E 55°58,610`N	X-6210266,97; Y-281731,59
3	20°34,683`E 55°55,962`N	X-6205120,56; Y-286214,29
3 to 4 point section	20°34,683`E 55°55,962`N, then, based on the 29,500 m arch, 21°02,476`E	X-6205120,56; Y-286214,29, then, based on the 29,500 m arch, X-6198268,02;

Territory point no. (see Fig. 2.1.)	Coordinates	
	according to the World Geodetic System 1984 (WGS–84)	according to the Lithuanian Coordinate System 1994 (LKS–94)
	55°52,987`N to 20°34,340`E 55°51,466`N	Y-314907,19 to X-6196802,40; Y-285443,88
4	20°34,340`E 55°51,466`N	X-6196802,40; Y-285443,88
5	20°32,392`E 55°51,392`N	X-6196766,38; Y-283405,67
6	20°29,505`E 55°51,824`N	X-6197719,01; Y-280435,73
7	20°28,524`E 55°54,253`N	X-6202274,37; Y-279642,58
8	20°20,403`E 55°56,059`N	X-6206062,21; Y-271362,10
9	20°18,902`E 55°56,793`N	X-6207506,01; Y-269872,71

The selected PEA area falls into the potential territories for the development of renewable energy resources approved by the solutions of Comprehensive Plan of the Territory of the Republic of Lithuania.

3.1. Location and description of the location

The PEA is situated in the Lithuania's Exclusive Economic Zone in the Baltic Sea, at depth of 25 to 45 m isobaths.

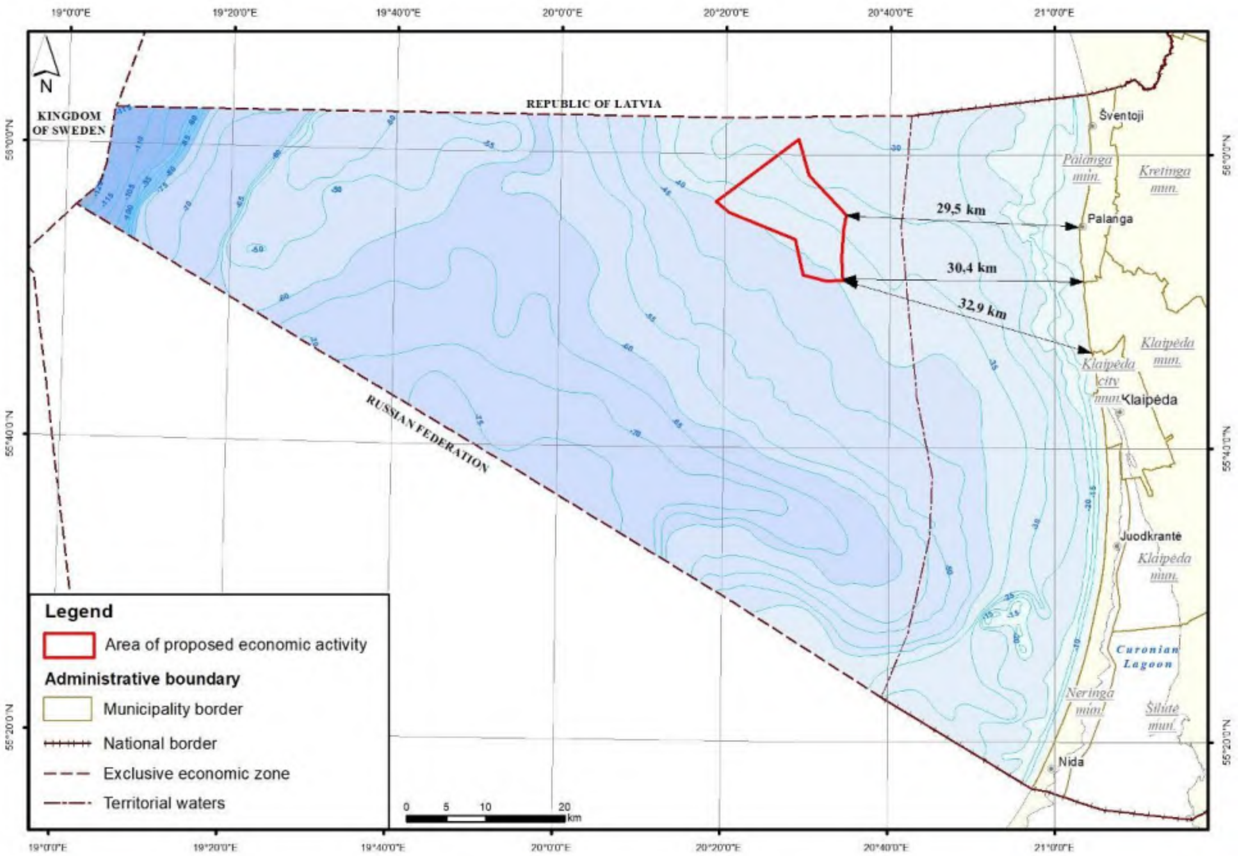

Fig. 3.1.1. Situation of PEA area.

3.1.1. Geographical and Administrative Situation of the Territory of the Proposed Economic Activity

The PEA territory is distant from the shoreline and adjacent municipalities of Klaipeda city, Klaipeda district, and Palanga. The shortest distance from the proposed territory to the town of Palanga is about 29.5 km (fig. 3.1.1).

3.1.2. Socio-economic characteristics of the Territory of the Proposed Economic Activity

The PEA territory is outside the established international shipping routes, roadsteads, or anchorage sites; neither is it bordering them. A cartographic comparison of the PEA territory with the defined water areas of Klaipeda State Seaport, Sventoji Port, and Butinge Terminal, anchorage sites, and shipping corridors is presented in Figure 3.1.2 below.

In Lithuania's marine territory of the Baltic Sea, there have been two types of engineering infrastructure identified: a pipeline complex, including the Single Point Mooring (SPM) buoy at the Butinge Terminal, and submarine cables.

The 7.3 km long pipeline at the Butinge Oil Terminal connects an underground onshore pipeline with a tanker mooring buoy and is used for oil product handing operations at AB Orlen Lietuva. The terminal has a water area allocated thereto, within a radius of 1,000 m around the SPM buoy, and a safety area of 300 m on each side of the oil pipeline. [4]

The Exclusive Economic Zone is intersected by the four submarine cable lines: 2 telecommunications cable routes, with the starting point in Sventoji, Lithuania, owned/operated by AB TeliaSonera (according to: International Cable Protection Committee). An origin of the other four cable routes crossing the Lithuanian EEZ South to North and South-west to North-east, marked on navigation maps, is unknown.

In the central part of the water area, from Klaipeda, via the Curonian Spit, and further towards the Swedish EEZ, there has been a NORDBALT link constructed, that is, a 450 km long, 700 MW high-voltage DC submarine and underground cable.

The LRV, by Resolution no. 720 of 1 September 2021, approved the engineering infrastructure development plan for the special state importance energy system synchronisation project "Construction of Harmony Link Connection and 330 kV Darbenai Switchyard." It presents a route for the proposed offshore connection HARMONY Link.

The PEA territory does not fall within the areas of the existing and proposed engineering infrastructure.

Part of the PEA territory is within the danger zone at sea, i.e., former minefields (Fig. 3.1.2).

In Lithuania's territorial sea and the Exclusive Economic Zone, there are several restricted-use, military exercise grounds, a water area with wrecks of World War II munitions, and former minefields of quite a large area. It is possible to carry out economic activities in the said territories, however, a prerequisite is to conduct seabed surveys in search of hazardous objects and, if necessary, to carry out decontamination of hazardous objects before the implementation of technical design solutions.

[4] The Shipping Rules have been approved by Order of the Minister of Transport and Communications of the Republic of Lithuania no. 3-248 of 18 September 2000 "On Approval of the Butinge Oil Terminal Shipping Rules."

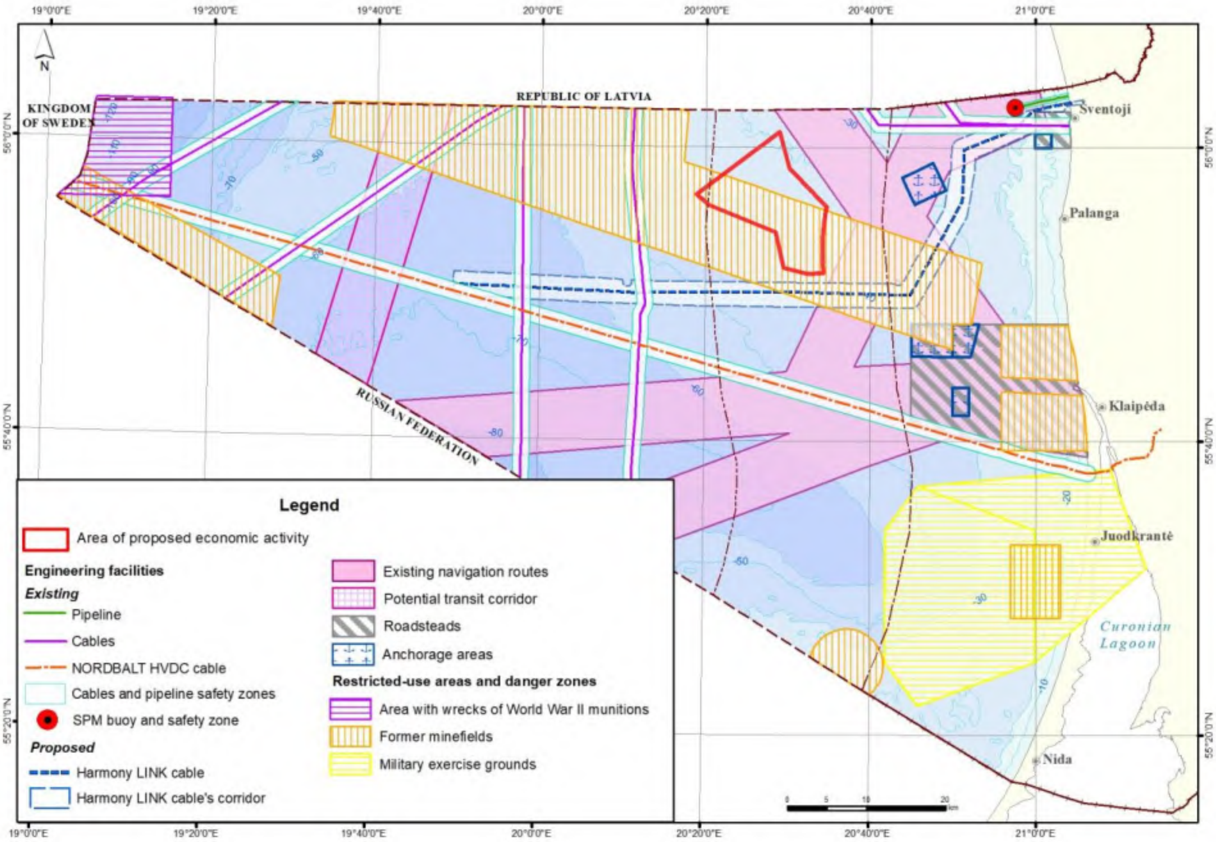

Fig. 3.1.2. Layout of the proposed territory in respect of shipping routes, engineering infrastructure and endangered zones.

Based on the classification by the International Council for the Exploration of the Sea, Lithuania's marine territory falls within statistical quarters 0H10, 40G9 and 39H10 of subdivision 26 of the fishing area where fish is caught with trawls and trap nets.

The PEA territory falls within statistical quarters 504 and 534 which accommodate trawling areas (Fig. 3.1.3).

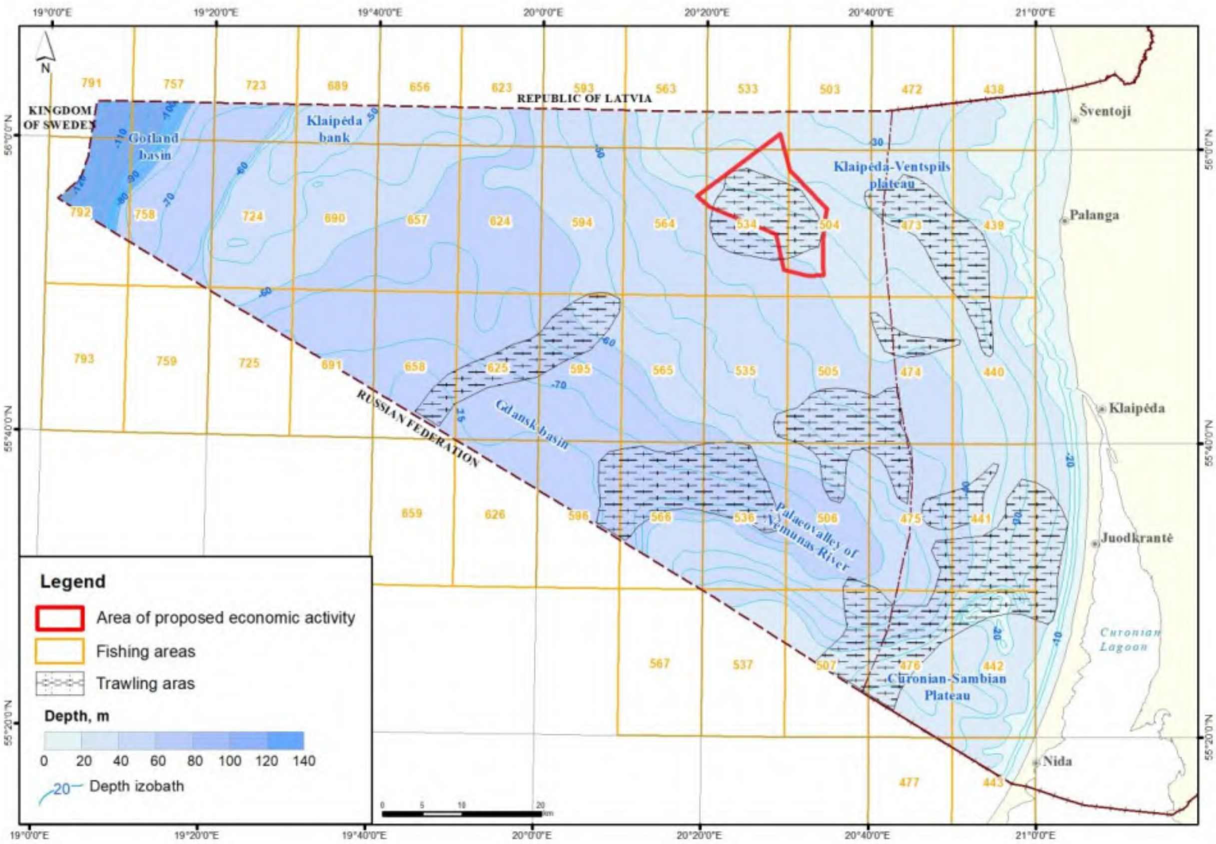

Fig. 3.1.3. Fishing areas.

A distance from the PEA territory to the nearest recreational areas and beaches of Palanga Municipality is approx. 29.5 km (Fig. 3.1.4).

According to the Cultural Heritage Register of Lithuania, there are 9 valuables registered in the maritime territory of Lithuania. The PEA territory contains no registered cultural valuables. The distance to the closest registered marine cultural valuable, i.e., the vessel 38471 “L-14” sunken in the Baltic Sea, is approx. 24 km.

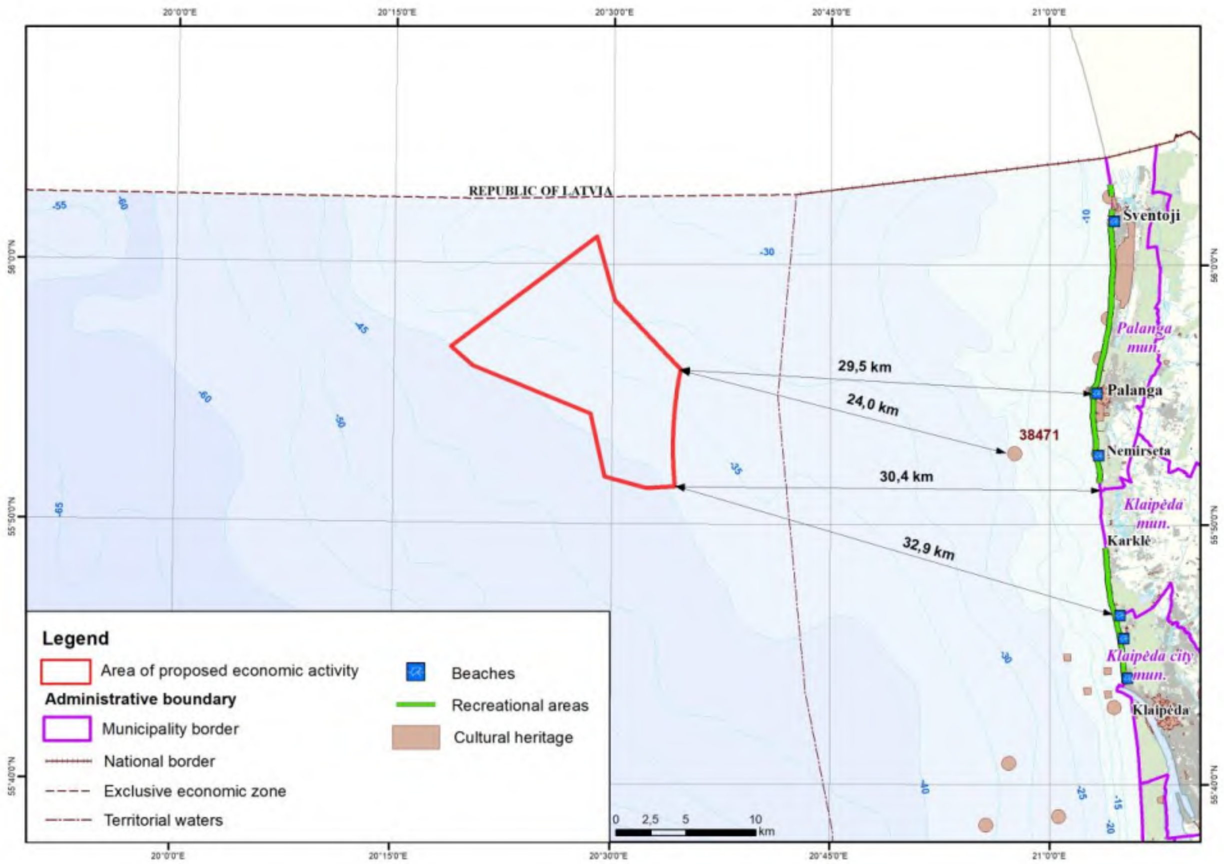

Fig. 3.1.4. Marine cultural heritage sites, residential and recreational areas in the coastal municipalities.

[5] [6]Based on the Methodology for mapping of territories of the Republic of Lithuania where design and construction of wind power plants may be subject to restrictions in relation to national security, a map of the territories of the Republic of Lithuania, where wind power plant (high-rise buildings) design and construction works may be subject to restrictions, has been developed and approved.

The PEA territory is a part of the areas where construction sites for wind power plants are subject to coordination provided that a manufacturer of energy from renewable resources signs a contract with the Lithuanian Armed Forces on part of the investment and other costs (Fig. 3.1.5).

[5] Approved by Order of the Minister of National Defence of the Republic of Lithuania no. V-921 of 22 August 2012 "On Approval of Methodology for Mapping of Territories of the Republic of Lithuania Where Design and Construction of Wind Power Plants May Be Subject to Restrictions in Relation to National Security."
[6] Approved by Order of the Commander of the Lithuanian Armed Forces no. V-217 of 15 February 2016 "On Approval of Methodology for Mapping Territories of the Republic of Lithuania Where Wind Power Plant (High-Rise Buildings) Design and Construction Works May Be Subject to Restrictions."

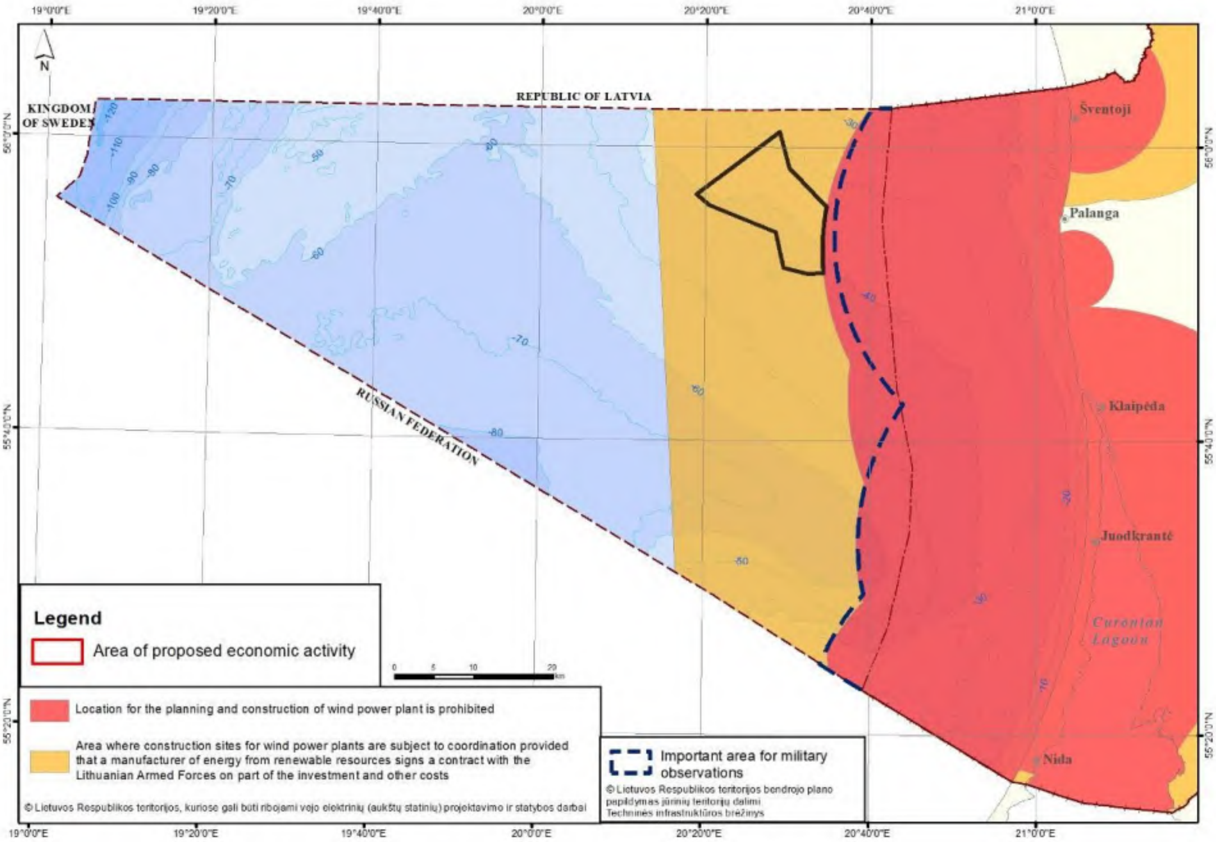

Fig. 3.1.5. Location of the PEA territory in relation to the areas subject to national security requirements (basis: the Map of the territories of the Republic of Lithuania, where wind power plant (high-rise buildings) design and construction works may be subject to restrictions, approved by Order of the Commander of the Lithuanian Armed Forces no. V-217 of 15 February 2016).

3.1.3. Distance to the Affected Party to the Espoo Convention and its sensitive areas, e. g. "Natura 2000" and other protected sites, objects and sites of cultural heritage, residential areas, etc.)

The distance from the proposed territory to the Latvian EEZ is about 2.8 km, to the Swedish EEZ – about 77 km, and to the Russian EEZ – about 40 km.

The Maritime Spatial Plan of the Republic of Latvia has been approved on 14 May 2019. According to this plan in the Latvian marine area nearby the Lithuanian-Latvian EEZ border, there are plans to install wind farms E1 and E2, also there plans for biodiversity research areas and exploration of potential offshore oil fields.

Distance from the PEA area to the planned and existing activities in the territory of Latvia are (Fig. 3.1.6.):

- Proposed offshore WT farm zone E1 – 4,6 km;
- Proposed offshore WT farm zone E2 – 10,8 km;
- Proposed biodiversity research area B1 – 3,3 km;
- Zone of exploration of potential offshore oil fields – 14,7 km
- Existing marine protected area Nida–Perkone – 24,5 km;
- Nearest Latvian coastline – 33,9 km

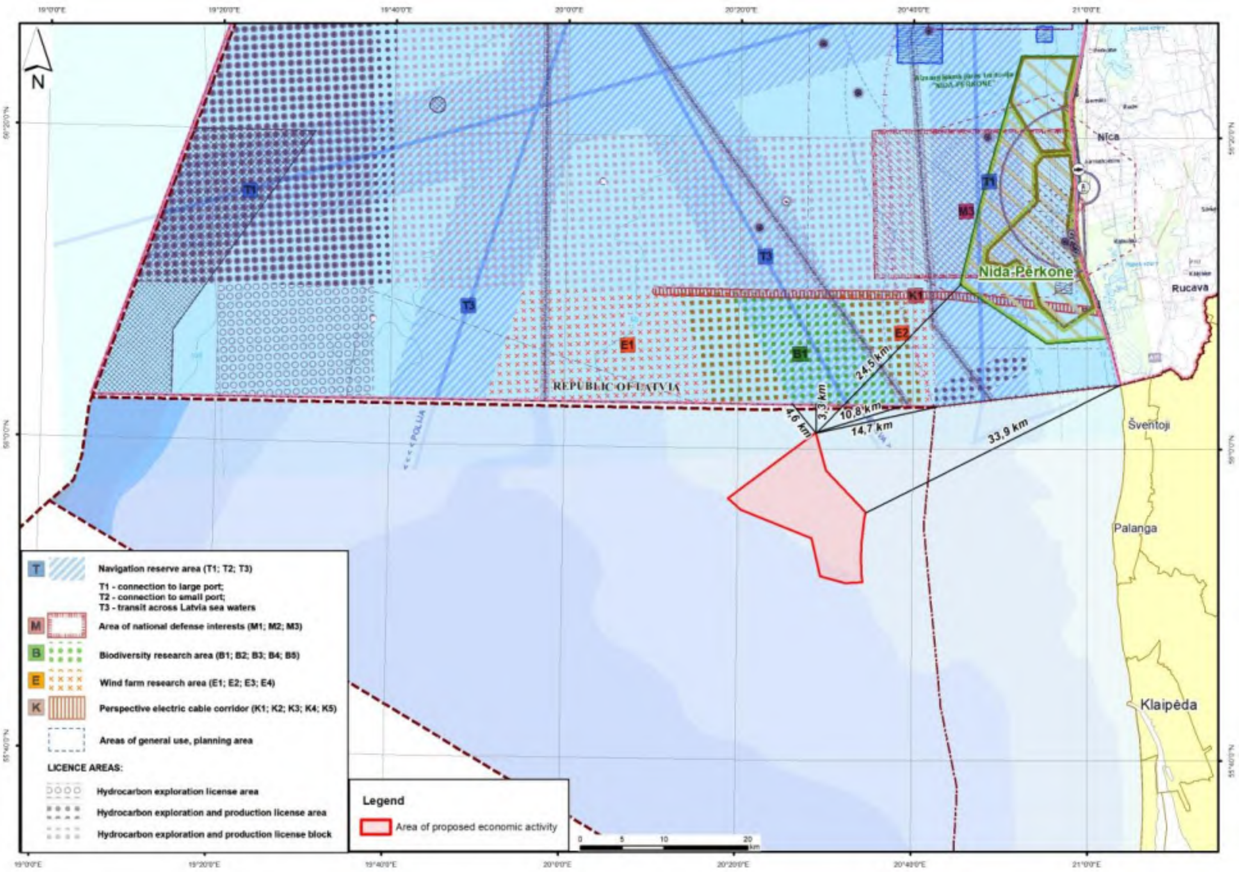

Fig. 3.1.6 pav. Distance from proposed area to EEZ of Republic of Latvia and its economic activities.

3.2. Rationale for location of the proposed activity

The offshore wind park in the Baltic Sea is one of the most important projects envisaged in the National Energy Independence Strategy, which will increase the production of local electricity from renewable energy sources and reduce dependence on electricity imports.[7]

The PEA development area fits into the potential areas most suitable for the development of offshore renewable energy projects, including wind energy alternative energy production territories defined in the technical infrastructure drawing of the Comprehensive Plan of the Territory of the Republic of Lithuania (2015), supplemented with the part "Marine Territories" (Fig. 3.2.1).

The PEA development area is within the dedicated OWE development zone approved by the Resolution of the Government of the Republic of Lithuania no. 697 of 22 June 2020 "On the Identification of the Priority Parts of Lithuania's Territorial Sea and/or the Lithuanian Exclusive Economic Zone in the Baltic Sea Where a Tender (Tenders) for the Development and Operation of Power Plants Using Renewable Energy Sources is (are) Expedient and on the Measurement of the Installed Capacities of Such Power Plants."

[7] The PEA, approved by Resolution of the Seimas of the Republic of Lithuania no. No. XI-2133 of 26 June 2012 "On Approval of the National Energy Independence Strategy."

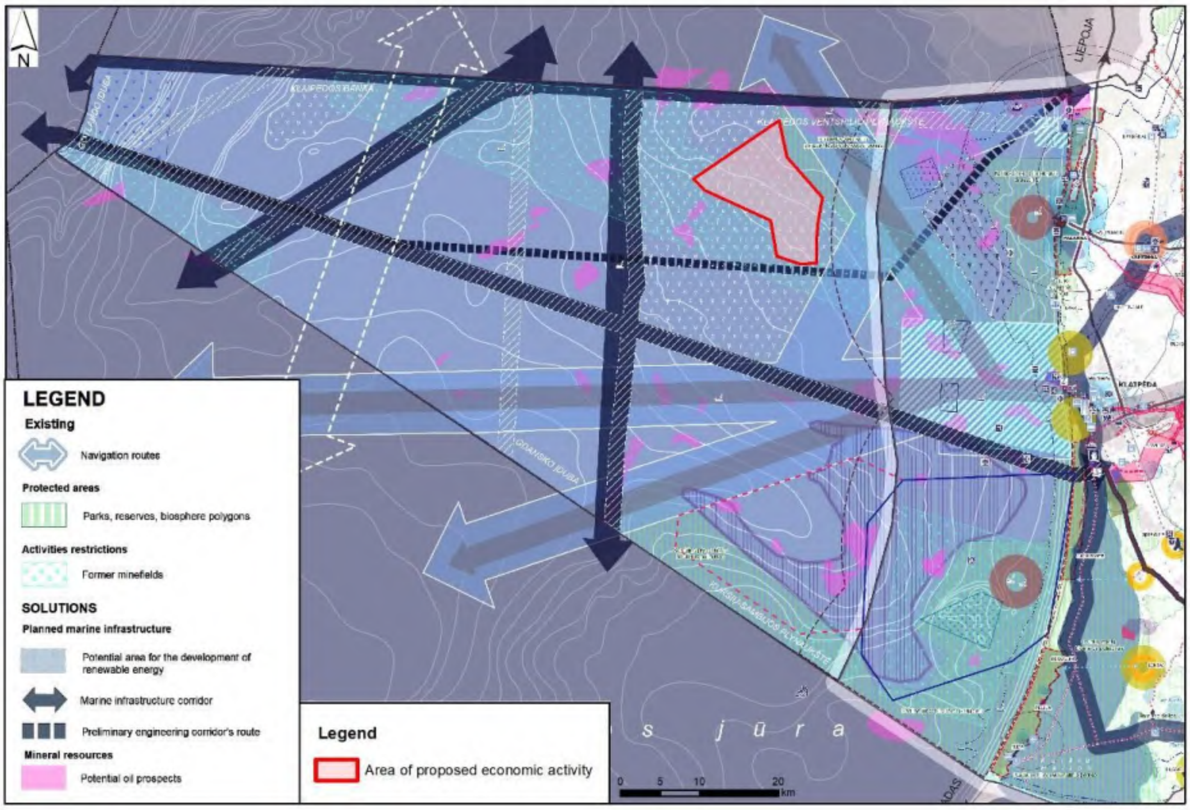

Fig. 3.2.1. Location of the PEA territory in relation to the solutions of the technical infrastructure scheme in the Comprehensive Plan of the Territory of the Republic of Lithuania supplemented with the part "Marine Territories."

4. INFORMATION ON EXPECTED ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

4.1. Information on possible local and transboundary environmental impacts of the activity on the following environmental aspects

4.1.1. Human health and safety

The key factors determined by onshore wind energy that may affect public health are: noise, flickering, electromagnetic field, and infrasound.

An impact of the WTs is usually studied and may occur for the living environment up to 2 km from the proposed WTs. The effect of flickering can be perceived at up to 1-1.5 km from WT towers. Electromagnetic fields are only generated in the immediate vicinity of a WT rotor or overhead power lines and usually grow weak to the limit values of about 20-30 m from the cables. Infrasound is also typical for the natural environment, in particular, for the marine environment due to wind and wash of waves. Since competent experts have found that modern WTs emit merely slight infrasound, neither WT-induced infrasound nor low-frequency sound are controversial in European countries. Due to the long distance to the nearest living environment (29,5 km to Palanga coastline and 33,9 km to nearest Latvian coastline), the said factors are not so relevant for offshore wind energy which is normally developed at quite a long distance from the coast.

The Public Health part of the EIA Report will be drafted and the potential impact on public health will be assessed in accordance with the guidelines provide for in Annex 1 of the Procedure “Recommendations on the Structure and Scope of Environmental Impact Assessment Documents,” Chapter II, Section 8 “Public Health.”

When preparing the EIA Report, an impact of the PEA on public health shall be assessed by analysing the likely direct and indirect effect of physical factors caused by the PEA on public health. Public health impacts are addressed to the population living in the impact zone of economic activities and to other people, especially, the most vulnerable groups of the population (e.g., children, the elderly and the sick, who are most sensitive to increased pollution).

Measures to reduce an impact of the proposed economic activity on public health and residential, recreational or other areas envisaged in the approved territorial planning documents will be discussed int EIA report.

4.1.2. Flora and fauna

In the Lithuanian waters of the Baltic Sea, there are protected areas and sites of the European ecological network “Natura 2000” demarcated. The PEA territory borders the biosphere reserve of the Klaipeda-Ventspils Plateau and important habitat and bird protection areas (Fig. 4.1.1). Information on the closest protected areas is provided in Table 4.1.1.

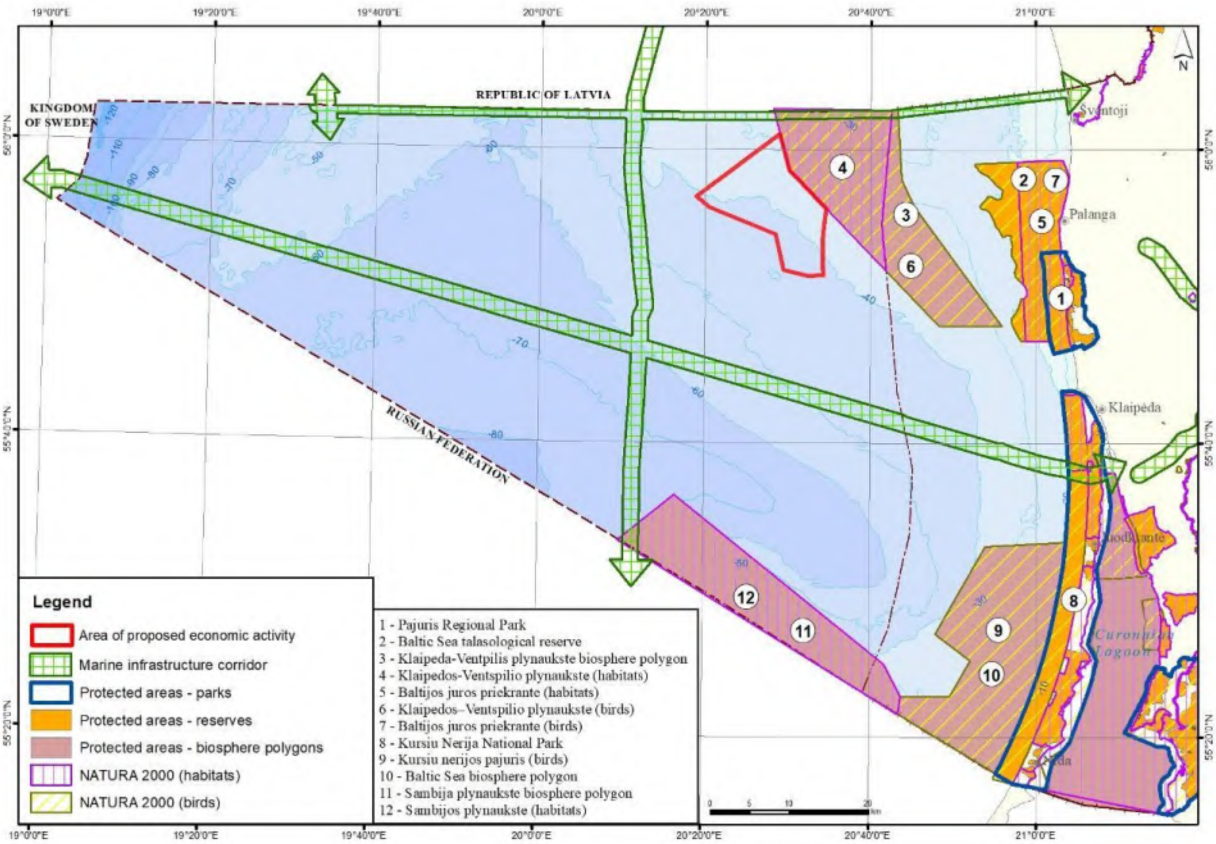

Fig. 4.1.1. Protected areas and NATURA 2000 sites closest to the PEA territory.

Table 4.1.1. Information on the protected areas and NATURA 2000 sites bordering the PEA territory, purposes of establishment thereof, protected natural habitats and species of EU importance (according to the State Cadastre of Protected Areas of the Republic of Lithuania).

Protected area	Area, ha	Purpose of establishment, protected valuables	Distance from the boundary of the proposed territory
Biosphere reserve of the Klaipeda-Ventspils Plateau	31949.309903	To protect a valuable part of ecosystem of the Baltic Sea in the Klaipeda-Ventspils Plateau, in particular, with a view to conserve: Areas of the natural marine habitat of EU importance, i.e., 1,170 reefs, to ensure a favourable conservation status thereof; a place of regular gatherings of wintering water birds of EU importance: velvet scooter (*Melanitta fusca*), to ensure a favourable conservation status thereof; wintering and migrating populations of razorbill (*Alca torda*), long-tailed duck (*Clangula hyemalis*), to ensure a favourable conservation status thereof; to conduct observation (monitoring) of the natural habitat and the protected species referred to in paragraph 3.1 of the Regulation, studies in relation to the protected valuables; to collect information on status thereof; to analyse the impact of human activities on the marine ecosystem; to ensure the sustainable use of natural resources; to promote ideas and ways of biodiversity conservation.	borders

Protected area	Area, ha	Purpose of establishment, protected valuables	Distance from the boundary of the proposed territory
NATURA 2000 IBPA Klaipeda-Ventspils Plateau	31949.309903	to protect gatherings of the wintering velvet scooter (*Melanitta fusca*)	borders
NATURA 2000 IHPA Klaipeda-Ventspils Plateau	17948.498809	1,170 reefs	borders

Potential Impact of the Proposed Economic Activity on Biodiversity

The installation of the offshore wind farm may have severe implications for biodiversity, both positively and negatively.

The main positive aspects are related to the establishment of invertebrate communities on WT piles and the restriction of fishing. This can make a WT farm a safe place for fish communities, thus, recovering fish populations in the Baltic Sea.

The main negative aspects for birds are:

- Site avoidance and loss of feeding grounds for seabirds;
- Barrier effect for migrating birds;
- Direct collision and death caused by the WT.

Several negative aspects for other marine animals should be mentioned as well:

- Noise during the construction of a wind farm, which may cause adverse physiological effects (including damage to organ tissues), disrupt animal communication, influence behaviour (including eviction from their natural habitats or hunting areas);
- Potential barrier and death effect on migrating bats.

Projected studies and exploratory work to be carry out during EIA	
Type of study	***Projected studies***
Seabed habitats	Bottom sampling and benthic habitat surveying using a remotely operated underwater vehicle (ROV). Distribution of benthic habitats, species composition and abundance of benthic fauna.
Birds, bats	Recording of birds, feeding on water, with the vessel for a period of two years, every month, during the spring-autumn seasons (May-October). Recording of birds, feeding on water, with the plane for a period of two years, every month, during the autumn-spring seasons (November-April). Observation of bird migration using visual and radar method during spring and autumn migration seasons. During the monitoring, data on species composition, abundance of migrating and resting birds will be collected. Recording of bat migration and flight intensity using an ultrasonic detector.
Marine Mammals	Recording of marine mammals on the plane or vessel every month for a period of two years.

4.1.3. Ambient Air and Climate

The key meteorological factor of favourable conditions for the development of offshore wind energy projects is wind strength. Based on the aggregate data (Fig. 4.1.2), the wind strength at sea increases as moving further away from the shore and varies from 7 to 10 m/s. Preliminary data (based on mathematical modelling) suggest that the average wind speed in the PEA territory may reach approx. 9 m/s. Detailed wind speed measurements are planned to be carried out in the PEA area before the start of the tender.

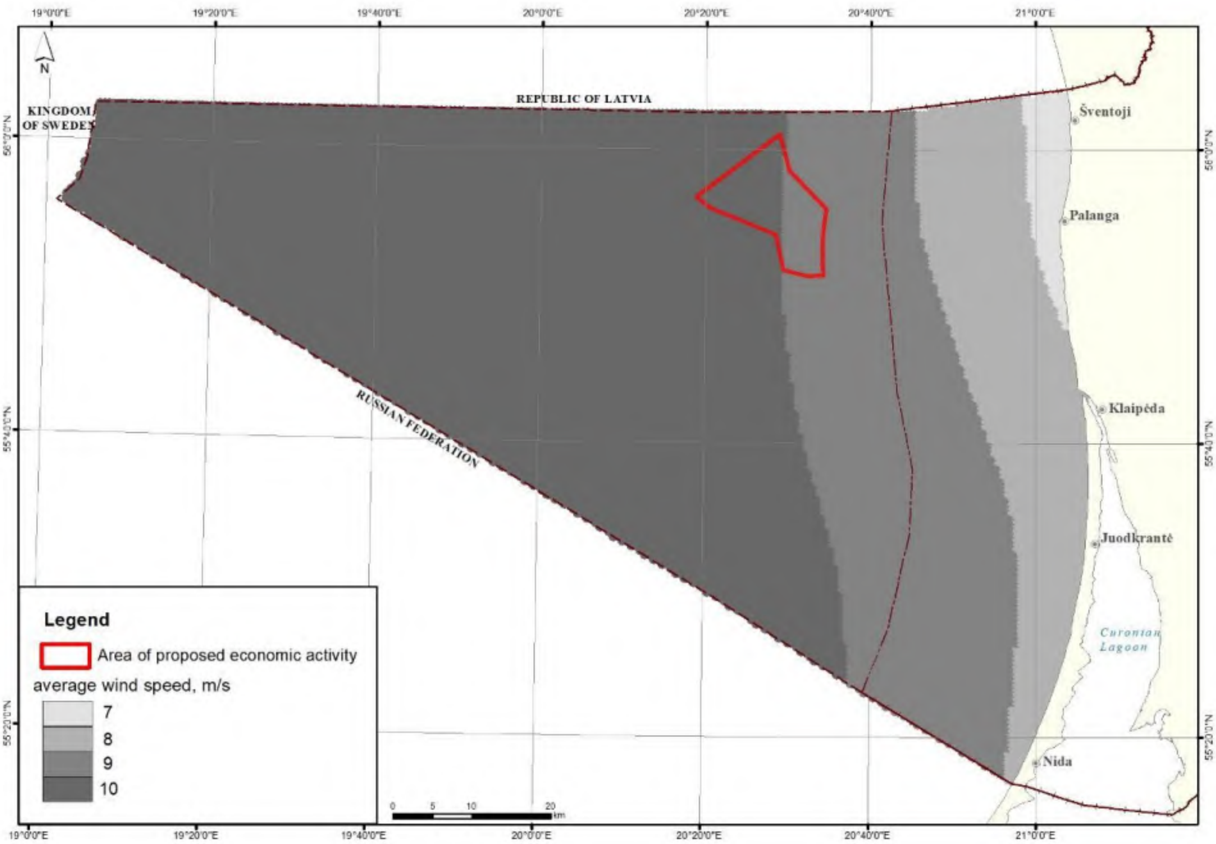

Fig. 4.1.2 Average wind speed at sea.

Air pollution is associated with mechanisms of construction and maintenance of wind farms rather than with the main proposed activity, i.e., electricity production by wind turbines. Main sources of ambient air pollution during the offshore wind farm installation, operation, and dismantling phases are means of transport and operated construction machinery.

Renewable energy sources, as a climate change mitigation measure, are particularly welcome in terms of climate impact. Wind energy is one of the renewable forms of energy, which reduces the use of fossil fuels and, together, emissions of CO2 and other substances into the ambient air. The use of wind energy plays a great role in controlling climate change by reducing greenhouse gas emissions from the energy sector. The PEA implementation is expected to have an indirect positive effect on the climate.

4.1.4. Water

<u>Hydrological and Hydrodynamic Conditions of Lithuania's Baltic Sea</u>

<u>Wave height</u>. The highest waves are observed in autumn and winter; the lowest ones – in summer. An annual mean wave height is about 0.7 m.

In the south-eastern part of the Baltic Sea direction of wave motion almost coincides with direction of prevailing winds, i.e - SW-W-NW:

0-2 m high waves, caused by 4-9 m/s speed winds in ~70 % of cases;

2-4 m high waves, caused by 10-19 m/s speed winds in ~24 % of cases;

4-7 m high waves, caused by storm winds in ~4 % of cases;

Calm sea is normally observed in summer and spring (~5 %).

Currents. Lithuania's territorial waters have a basic cyclonic direction of currents in the Baltic Sea (counter-clockwise) (Žaromskis, 1996), which forms prevailing flows of water masses along the coast from south to north.

The lowest current rates are observed in the spring-summer season, the highest – in autumn-winter. Due to unevenness of the wind field and intense variation of wind speeds, wind-induced currents have a complex spatial structure and high variation over time. The speed of wind-induced currents is decreasing in greater depths.

At the sea surface (0-10 m layer) there are weak and medium currents prevailing, with a speed normally not exceeding 0.20 m/s (Žaromskis, Pupienis, 2003). The marine area between the coast and 35 m isobath has northward currents. Currents are directed toward the south far less often, toward the south-west – least often. The northward direction of the current is determined by the freshwater flowing from Curonian Lagoon. The 35-45 m deep area away from the shore is predominated by south-west, south, and west currents. Even further, i.e., beyond the 45 m isobath, currents are directed toward the east and north-east. In the intermediate water layer (10-30 m), there are various current regimes formed. The water area of up to 25 m depth, like in the surface layer, mostly has northward currents. Less frequently, currents are directed south- and westward. Beyond the 45 m isobath, there are north and north-east currents prevailing. In the intermediate water layer, current speed is 0.11 to 0.14 m/s. Weak, 0.07-0.09 m/s rate currents normally prevail in the bottom layer. The water area to 35 m isobath mostly has north-west and south-east currents, in 35 to 45 m isobath – north-west, west, and south-west currents, and beyond 45 m – north currents (Žaromskis, Pupienis, 2003).

Simulation of average current rates (m/s) and directions (degrees) for different seasons (spring, summer, autumn, winter) (SMHI BALTICSEA_REANALYSIS_PHY_003_011 2012-2016) shows that weak surface and bottom currents prevail in the open sea, with the speed averaging 3-5 cm/s in the surface layer and 1-3 cm/s in the bottom one.

Temperature, Salinity, and Water Clarity Lithuania's marine area in the Baltic Sea is relatively shallow, as a result, thermal regime of the water responds to seasonal fluctuations of climate conditions very quickly (Dailidienė et al., 2011). Minimum water temperatures are reached in February (to -0.5°C), and maximum – in July-August (to 28.2°C).

Variations of salinity in the southeastern Baltic Sea, in Lithuania's marine area, depend on the inflow of fresh waters from rivers , as well as on the variations of salinity in the central Baltic Sea. In Lithuania's water area, average water salinity is about 7 ‰.

The Baltic Sea monitoring reports by the Department of Marine Studies of the EPA show that the highest water clarity is in the open sea where the *Secchi* depth reaches 4.5 m.

Ice Cover No permanent ice cover is formed in the Lithuanian area of the Baltic Sea. In normal and severe winters, a shore ice belt, from a few metres to a few kilometres wide, is formed in coastal areas. It usually consists of piled ice rocks, brought to the shore by wind and water currents which stays stable only in calm and cold weather.

Water Quality

Ecological and Chemical status of the water bodies is being constantly monitored in the designated monitoring sites (Fig. 4.1.3).

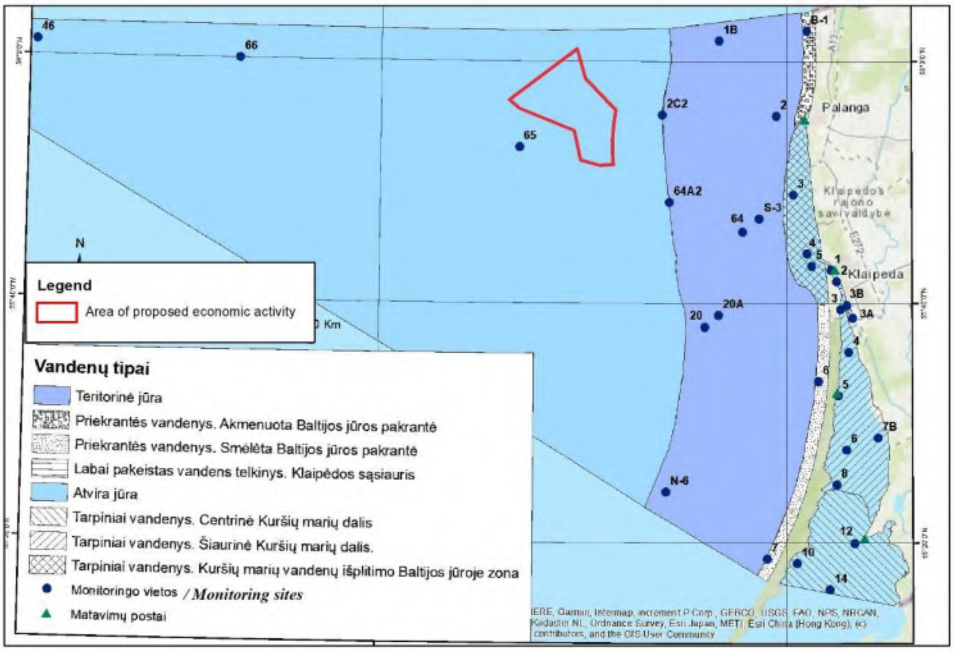

Fig. 4.1.3. Monitoring sites in the Baltic Sea and the Curonian Lagoon.

Potential Impact of the Proposed Economic Activity on Water

Under normal operating conditions, the offshore wind farm will not have any significant impact on seawater quality. However, temporary changes in water quality are possible during construction, i.e., when installing foundations and laying cables due to a temporary increase in suspended particles (turbidity) in the bottom layers of water column.

Where the proposed economic activity relates to the sea, information on the marine environment and its characteristics shall be provided: geochemical properties of the water of the Baltic Sea, currents, waves, including medium, storm values, their recurrence, seasonal and perennial fluctuations.

Characteristics of good environmental status of the sea have been established by Order of the Minister of Environment of the Republic of Lithuania no. D1-194 of 4 March 2015 “On Approval of the Characteristics of the Good Environmental Status of the Lithuanian Marine Area.” The qualitative descriptors for determining good environmental status (according to Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy) have been established in Order of the Minister of Environment of the Republic of Lithuania no. D1-500 of 14 June 2010 “On Approval of the Procedure for Assessment of the Marine Environmental Status, Setting of Characteristics of Good Environmental Status of the Baltic Sea, Objectives of Protecting the Marine Environment, the Monitoring Programme and Measures,” Annex 2.

Operation of the proposed offshore wind farm is not expected to have any significant impact of water; the EIA will rather be aimed to assess peculiarities of hydrological and hydro-chemical conditions of the territory in question. Available data will be measured and new studies on hydrological and hydro-chemical parameters of water will be conducted.

Projected studies and exploratory work to be carry out during EIA	
Type of study	***Projected studies***
Hydrological parameters	Speed and direction of water currents, temperature, salinity
Hydro-chemical parameters	pH, dissolved oxygen, suspended solids, petroleum hydrocarbons, polyaromatic hydrocarbons, heavy metals

4.1.5. Soil: Seabed and Deep Sea

The seabed of the Lithuanian marine area in the Baltic Sea was caused by glacial activity, by water level changes in different eras of Baltic Sea evolution, and by modern sedimentation processes. There are two favourable topographic forms, i.e., plateaus, and adverse forms, i.e., basins, identified at the bottom of the sea.

The Klaipeda-Ventspils Plateau is the main area for potential wind energy development.

Based on foundation technologies, the best conditions for the installation of wind farms are seabed areas with a depth of 20 to 40 m. The water depth in the PEA territory is ~ 30–40 m.

<u>*Distribution of Bottom Sediments*</u>

The seabed of the Lithuanian water area is covered with recent and relict bottom sediments (Gulbinskas, 1995). Relict sediments are sediments deposited during the Ice Age and Baltic Sea evolution stages. They occur in hydrodynamically active areas of the sea where sedimentation no longer takes place today or, even, where bottom destruction occurs. In many such spots, glacial deposits (moraine) are heavily eroded; their surface is covered with boulders, pebble, shingle, or uneven-grained sand.

Relict deposits and sediments also cover the Klaipeda-Ventspils Plateau, within which the PEA territory is located. Relict sediments consist of moraine of varied composition (sand, loam, boulder clay) and the eroded elements (boulders, pebble, shingle). This boulder rock separates the coastline of Lithuania's mainland from the open sea.

Recent sediments are found in accumulation areas. The main types of sediment are sand, silt and mud) (Emelyanov et al. 2002). Sand mostly consists of fine-grained sand. There are three areas of dispersal of such sand: one of them is also found at the foot of Klaipeda-Ventspils Plateau; herein the sand deposits at a depth of 26-40 m. Bottom in deeper marine areas (45–65 m) is covered by silty sediments. Mud sediments consist of fine and pelitic silt. The said types of bottom sediments are widespread at a depth of 50-60 m and cover the bottoms of Gdansk and Gotland basins.

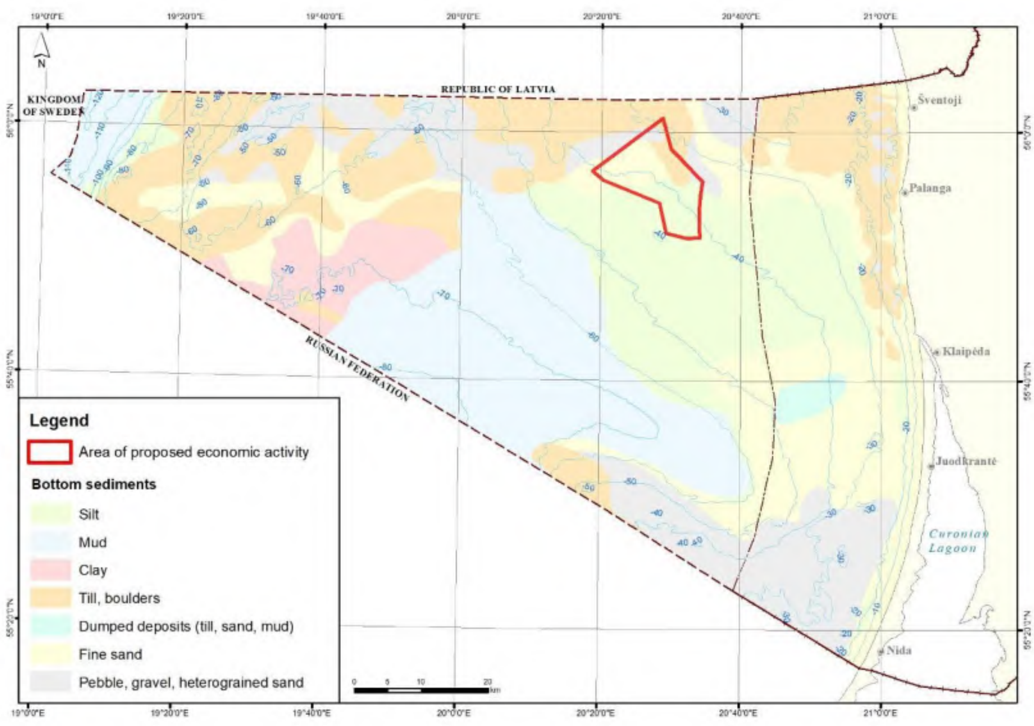

Fig. 4.1.4. Lithological composition of bottom sediments.

The upper part of the geological section consists of quaternary sediments of 5-10 m thick in plateaus to more than 100 m in paleosections. Under the quaternary sediments, there occur formations of the Middle and Upper Devonian periods (sandstone, siltstone, dolomite), Permian (dolomite limestone), Lower Triassic (clay, clayey siltstone, and marl), Middle and Upper Jurassic (argillite), and Lower and Upper Cretaceous epochs (Terigenic clay, siltstone, glauconitic-quartz sand).

The quaternary sediments consists of three key lithostratigraphic complexes: Pleistocene glacial deposits (prevailing moraine loams and sandy loams), sediments (clays, sands) formed during various phases of Baltic Sea evolution (mud of Late Glacial and Holocene periods), as well as recent marine sediments (sand, silt, mud).

In the PEA territory, quaternary sediments are about 20–30 m thick. Beneath them, there are normally deposits of the Triassic, less often of the Permian period found.

Mineral Resources

Oil According to the Lithuanian Geological Survey on potential oil structures in the Lithuanian marine area, the Lithuanian EEZ is supposed to store about 40–80 million tons of oil. The PEA territory does not fall within the known potential oil locations, though, it is possibly adjacent thereto. Therefore, once the additional results of potential oil structure surveys are received, this information will be further assessed.

Sand and Gravel The sand and gravel resources in the Lithuanian EEZ have not been yet explored or included in the state register of mineral resources as a mineral deposit. Nonetheless, there have been found accumulations of these resources during the geological mapping. In the marine area, there are two locations defined as potential sources of sand for shore management:

- The south-eastern slope of Klaipeda-Ventspils Plateau, 25-30 m deep, coastal formations of the transgressive and regressive phases of the Baltic Sea. Sand dispersal over relatively large areas on the slopes of the plateau. A sand layer thickness reaches 1 metre and more.
- On the surface of the Curonian-Sambian Plateau, there are found relict formations of the Ice Age or the Baltic Sea evolution stages. Sea depth is 20-30 metres. Sand dispersal range is the largest here; a layer thickness is over 3 metres.
- In Preila-Juodkrante district, the most promising elevation area is between 20-27 m isobaths. When implementing the Coastal Strip Management Programmes, the sand from the district of Preila - Juodkrante was used for restoration of beaches of Palanga.

There are no approved sand deposits in the PEA territory.

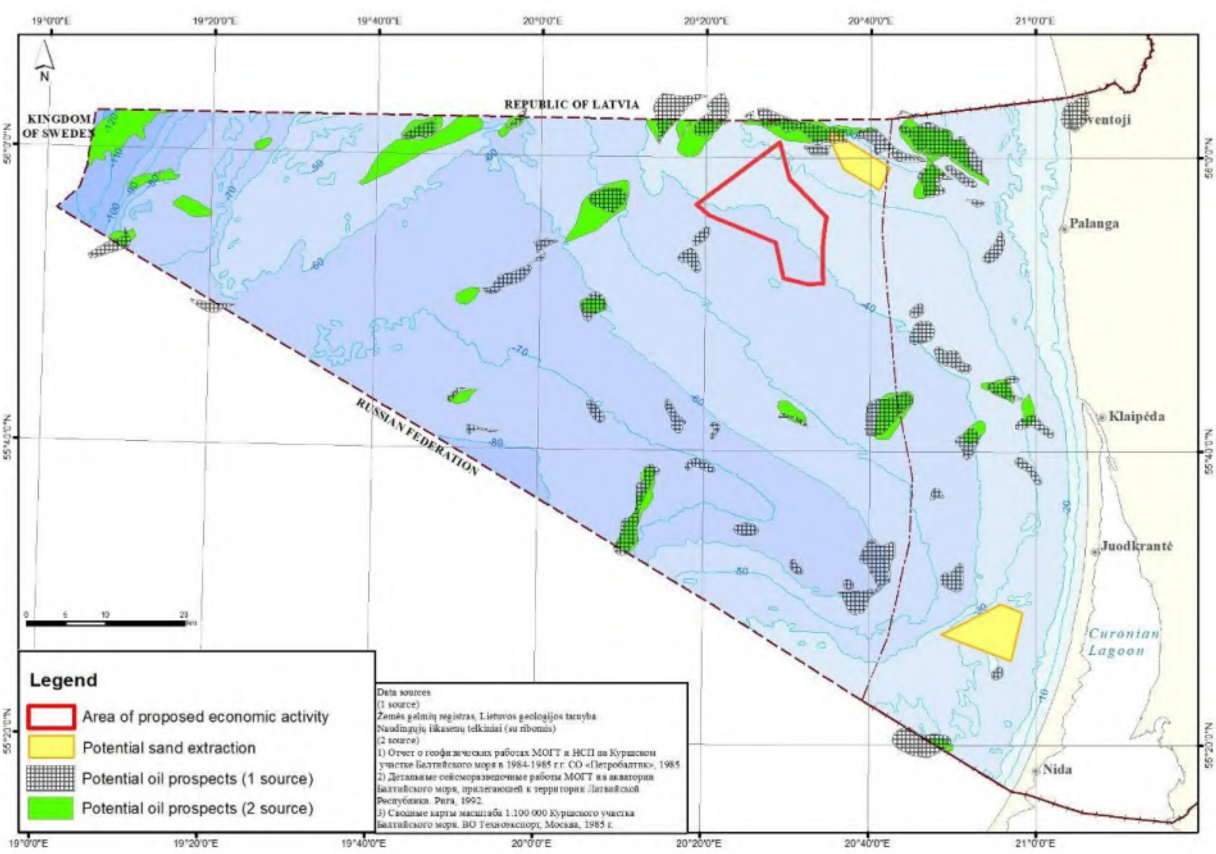

Fig. 4.1.5. Layout of the PEA in respect of mineral deposits.

Potential Impact of the Proposed Economic Activity on Seabed

The geological structure of the area has a greater impact on the processes of installation of the WTs, cabling, and the selection of foundation structures. The EIA will especially focus on assessment of geological conditions of the PEA territory so that to measure a potential impact of the WT installation on the integrity of the seabed.

Projected studies and exploratory work to be carry out during EIA	
Type of study	***Projected studies***
Submarine morphology	Seabed surveys.
Geological structure of the bottom surface	Distribution and composition of bottom sediments.
Geochemical surveys	Contamination of bottom sediments.

4.1.6. Landscape

Landscape/Seascape

Based on the morphological zoning of the landscape, there have been defined the Eastern shallow marine section of the Baltic Sea South-East Baltic Sea submarine plateau area Curonian-Western Samogitia coastal submarine plateaus and depressions of the Baltic Sea. There is a prevailing seascape of submarine plateaus and depressions.

The PEA territory is located in the open sea, more than 29 km away from the shore, and is beyond the boundaries of the general landscape defined in the National Landscape Management Plan. [8]

The EIA will include the assessment of the potential visibility of the offshore wind farm from onshore observation sites.

Projected studies and exploratory work to be carry out during EIA	
Type of study	***Projected studies***
Visibility of WT farm	Assessment of visual pollution of the object and visualisation by modelling

4.1.7. Cultural Heritage

According to the Cultural Heritage Register of Lithuania, there are 9 valuables registered in the maritime territory of Lithuania. The PEA territory contains no registered cultural valuables. The distance to the closest registered marine cultural valuable, i.e., the vessel 38471 “L-14” sunken in the Baltic Sea, is approx. 24 km.

According to the charts of the Lithuanian Transport Safety Administration, there are several dozen sunken objects marked in the Lithuanian EEZ that are not included in the Cultural Heritage Register.

Most of the sunken objects are industrial ships; though, remains of wooden vessels great scientific value were discovered, too. There were also several valuable habitats of cultural underwater seascape with natural relics and tree remains found.

One discovery site is marked nearby the PEA territory but does not fall within it.

Information to be provided in the EIA report:

Projected studies and exploratory work to be carry out during EIA	
Type of study	***Projected studies***
Search for sunken objects	Seabed surveys.

4.1.8. Material Valuables

The feasibilities of developing offshore wind energy are directly related to other activities currently carried out in the marine area, i.e., shipping, navigation routes; fishing; mining sites for excavated soil, potential locations for sand excavation to nourish beaches; offshore engineering installations (power and communication lines, pipelines, etc.) and their safety zones; restricted-use areas (military exercise grounds, sunken ships, dangerous objects, cultural heritage values); marine areas for conservation purposes; other potential activities (prospect sites of useful resources).

In order to rationally use marine areas and sea resources, it is important to coordinate basic and projected activities with interests of sea users.

It should be noted that the installation of the offshore wind farms will significantly contribute to the implementation of objectives of the Lithuanian Energy Independence Strategy.

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[8] approved by Order of the Minister of Environment of the Republic of Lithuania no. D1-703 of 2 October 2015 “On Approval of the National Landscape Management Plan.”

5. INFORMATION OF THE POTENTIAL SIGNIFICANT TRANSBOUNDARY IMPACT

The expected transboundary impact will be assessed as part of the EIA. Due to its peculiarities, the PEA may have a transboundary impact in the following aspects:

Aspect / Environmental component	**Description of potential impact**
Impact on birds and bats	The WT farm may be a barrier to birds and bats migrating over the Baltic Sea It is known that there are intense migrations of geese, gruiformes, diver, passerine, and other bird families observed over Lithuania's territorial waters. Research data shows that there is a probability that bats, under favourable natural conditions, may migrate to wintering grounds over the Lithuanian marine area of the Baltic Sea, near the coastline.
Shipping	As mentioned above, the PEA territory is outside the established international shipping routes, roadsteads, or anchorage sites; neither is it bordering them. Therefore, no significant impact on shipping or international shipping routes is expected.
Visual effect	The PEA territory is located about 30 km from the Latvian coastline. At such a distance, offshore wind farms will be barely visible from onshore observation sites, therefore, significant visual effect is unlikely.
Mineral Resources	The northern part of the PEA territory overlaps with the boundaries of potential oil production structures. The potential oil production locations are also known in the marine area of the Republic of Latvia. A distance from the PEA border to the sea border with Latvia is about 2.8 km, therefore, an impact on oil resources in the Republic of Latvia and prospective mining is unlikely.

The PEA territory does not fall into the corridors of international shipping lines crossing and planned in the maritime territories of Lithuania and Latvia (Fig. 5.1.1), therefore no negative impact on international shipping is foreseen.

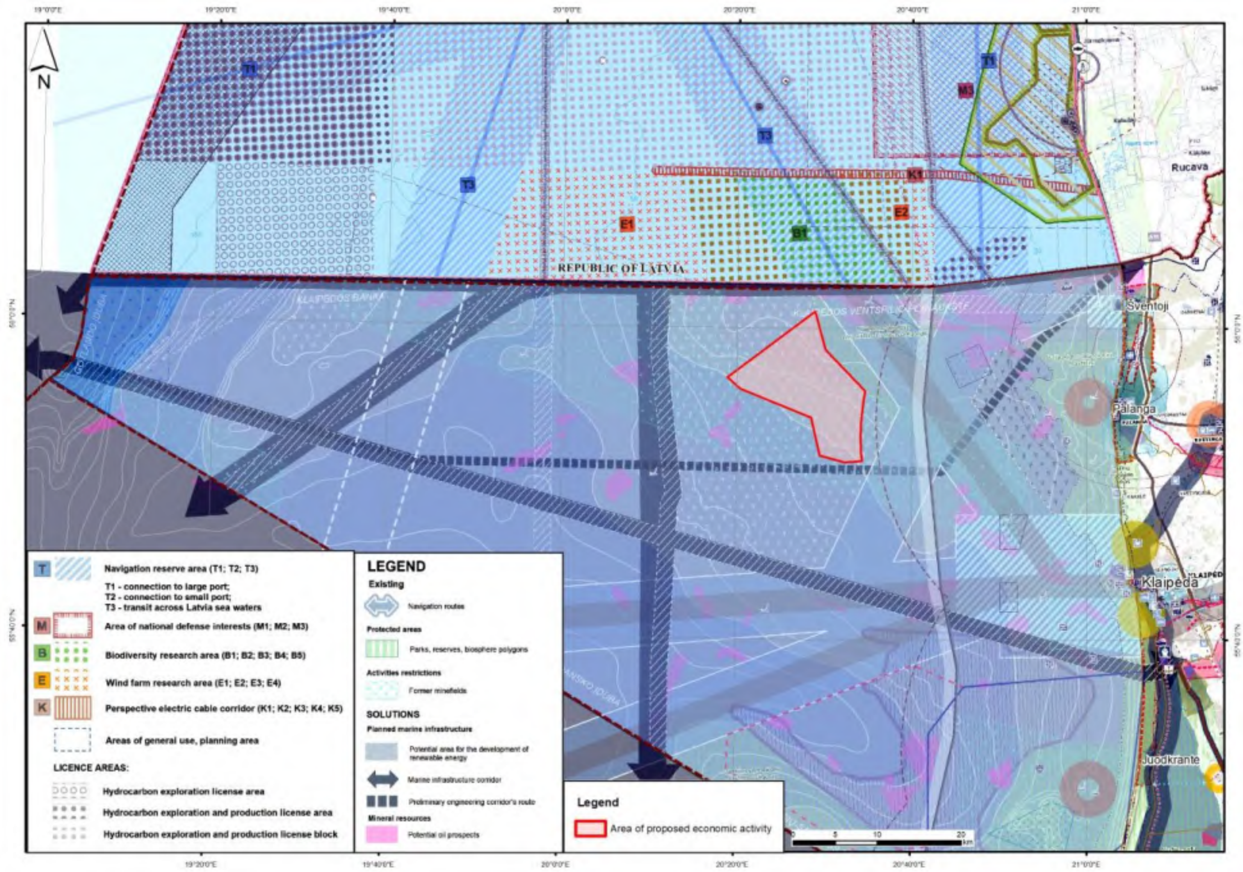

Fig. 5.1.1. Layout of the proposed territory in respect of the solutions of the technical infrastructure scheme in the Comprehensive Plan of the Territory of the Republic of Lithuania supplemented with the part "Marine Territories" and Maritime Spatial Plan of Republic of Latvia.

The PEA development area fits into the potential areas most suitable for the development of offshore renewable energy projects, including wind energy alternative energy production territories defined in the technical infrastructure drawing of the Comprehensive Plan of the Territory of the Republic of Lithuania (2015), supplemented with the part "Marine Territories" (Fig. 5.5.1). The solutions of this plan has been transferred to the new Comprehensive Plan of the Territory of the Republic of Lithuania "Lietuva 2030". It should be noted that during the planning processes, a strategic environmental impact assessment and transboundary consultations were carried out for these areas and the solutions planned in them.

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